A low carbon transport policy for the UK

Keith Buchan

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Low carbon transport policy for the UK
Phase 2

Final technical report November 2008

Preface

The MTRU project proposal which led to this report was developed during 2005 and match funding for half the cost of the project was sought at the same time. Campaign for Better Transport have co-sponsored both Phase 1 and 2, and provided much additional and welcome support through their transport networks. Their website is www.bettertransport.org.uk .

Thanks are due to the wide range of individuals have commented on draft material, both directly and through the website: www.transportclimate.org . Material has been posted there on a regular basis since the project began. The Transport Planning Society arranged for three public presentation/discussion groups in London, Leeds and Bristol in 2008 which have also greatly assisted in finalising the report. Draft material has also been sent to the Department for Transport, HM Treasury and the Committee for Climate Change and a number of very useful presentations and discussions have been held with all of them over the last two years.

The contents of the report are, of course, entirely the responsibility of the author, Keith Buchan.

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Executive Summary

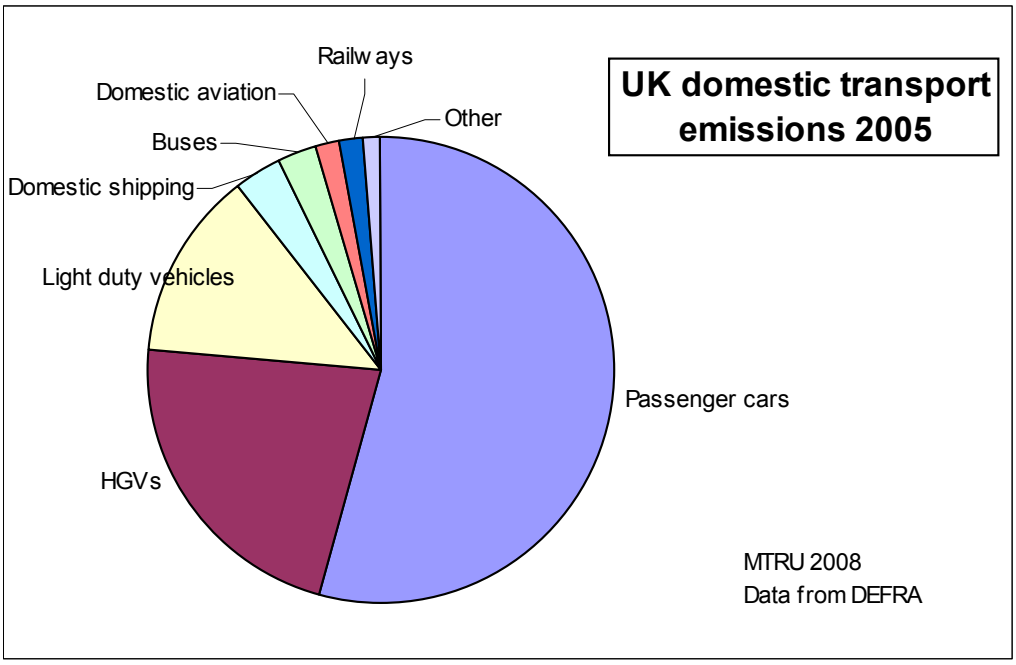
Transport and climate change

In recent years levels of gases which create the "greenhouse effect" and thus lead to climate change have been increasing in the Earth's atmosphere. Predicting the nature of this change in a specific region of the world is fraught with difficulty, but the overall risk of significant warming has led most countries to agree that the problem must be tackled, and work together to do so. In the UK this has led to legislation (the Climate Change Bill: **CCB**) which is designed to achieve a significant cut in greenhouse gas (**GHG**) emissions. This should happen year by year, achieving at least a 27% cut by 2020 and 80% by 2050, compared to the levels in 1990.

Transport is a major source, responsible for about 28% of all GHGs produced in the UK. Other significant emitters, such as power stations, are attempting to achieve reductions through an EU-wide system based on permits to emit a certain amount of GHGs. These are at a level agreed by the EU. The system allows for trading, so that if one power station produces a lot of low emission energy, it can sell its surplus permits to pollute to one which is emitting more GHG than it should. The pluses and minuses of this approach are discussed in more detail in the main report. Aviation is likely to be included in a revised EU trading scheme. The rest of transport, however, is a non-traded sector and must reduce its emissions through specific policies and actions.

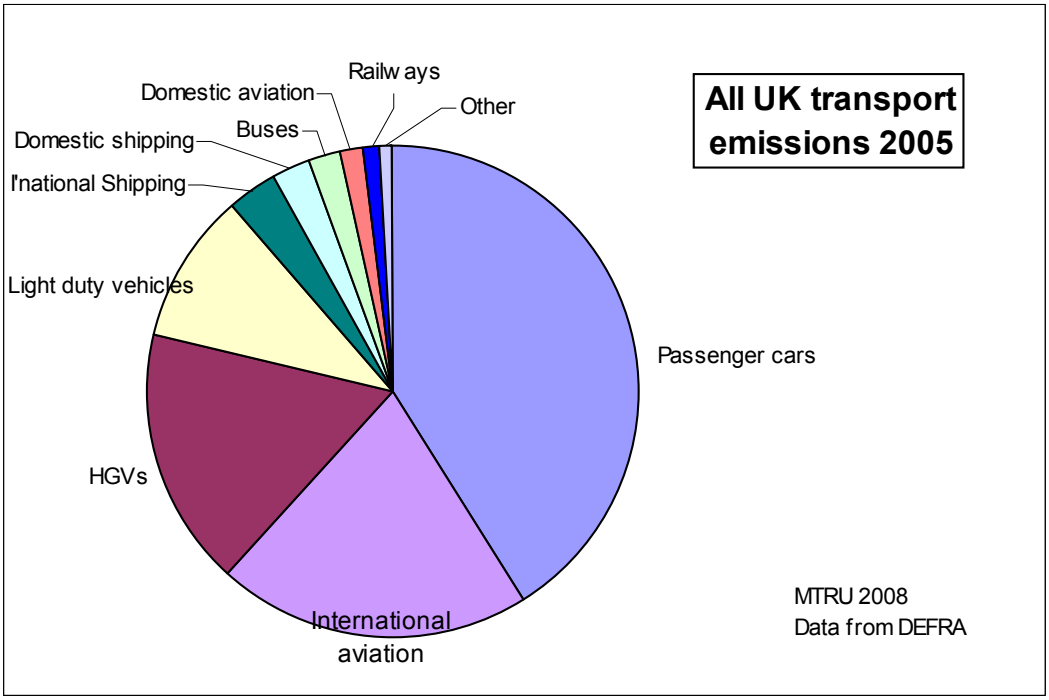
For transport within the UK, passenger cars are the main source, followed by heavy goods vehicles and light goods vehicles, the latter including car sized vans. This is shown in Figure 1 below.

Figure 1



If international shipping and aviation are included, aviation becomes the second largest source of transport emissions. This is shown in Figure 2 below.

Figure 2



Thus any attempt to tackle emissions from transport will have to consider road traffic as a priority, and take into account international aviation, where there are many unanswered questions over the practicality or effectiveness of including them in the traded sector. Policies are included in the report which would tackle this in a way which would ensure some stabilisation of demand.

Engaging the public

Before setting out policy principles and summarising the hundred or so policies in the report, how they interact, and what they could achieve, there is one important issue to be addressed. This is the way in which people perceive any transport policy and how they need to be engaged.

In transport, public perceptions must be recognised and understood. For example, drivers may complain that some policymakers are "car bashing" or that taxing motorists is just an easy way of supporting local and central Government spending in general. Another common complaint is that it is unfair to ask people to change their travel behaviour if there is no alternative. An example of this is a policy which changes the price of travel in a way that means people do not make new and less polluting choices and simply end up doing the same thing but having to pay more.

While complaining about change may be an inevitable part of human life, there is some justice in the view that it is hard to see the link between some transport policies and social or environmental objectives. There has been a failure to target objectives clearly, to understand the importance of facilitating and allowing time for

new choices to be identified and developed, and to design transport in a way that responds to what people themselves know will make change attractive to them.

New policy framework

Over the last decade a range of transport policies have been developed which seek to meet personal travel needs by engaging with transport users directly. Since it is about working with people to change patterns of travel in the most acceptable and practical way, this often called a policy for "Smarter Choices". This approach is integral to the policies in the report and has its own chapter. It should be applied together with a number of other policies which support some modes and discourage others. However, the detailed application of these policies, particularly at local level, will be guided by the Smarter Choices process. This grass roots approach to improving transport is very different from the traditional top down methods which focus on building major schemes for one mode at a time.

In addition to this new way of working, a set of principles was published earlier as part of this project to create a clear framework for the wide ranging transport policy package in the report. In summary, these are:

- ***Transport policies*** to combat climate change should be based on three principles:
    - The main objectives must be individually identified and clearly stated. *(Rational).*
    - It must be clear to those who are affected how the policy mechanism relates to the objective. *(Transparent).*
    - Where travel choice is influenced by policy, particularly change in cost, people are supported in finding an alternative and as much time as possible is given to adapt. *(Equitable).*

- ***Fiscal policies*** to encourage change in transport use for the purpose of reducing greenhouse gases should not be used for raising general revenue. Income should be returned as directly as possible to either individuals or businesses so that their total taxes are not increased.

- ***The policy package*** must be comprehensive and integrated across all modes and take land use planning into account. Issues such as the availability of alternative choices and rebound effects (where more efficient vehicles encouraging more car use) must be included.

Consistency and timing

There is one further related issue which is extremely important in terms of public policy. Current policies tend to focus on either short term changes (such as adjusting tax rates), or very long term ideas with no specific timescale (such as electronic road user charging). This makes it difficult to implement policies which require phasing in over a period of years, or need immediate implementation but will not have an impact unless pursued for in the long term. These can be summarised as policies which:

- are implemented now but do not become fully operational for several years, for example to allow time to prepare for change,
- need to be introduced slowly, for example over the course of a decade, to allow time to explore different ways of adapting,
- need to be introduced immediately with a modest impact, but maintained and enhanced over a long period, for example changes to land use planning.

Several of the most effective policies in this report fall into these categories.

Dealing with the recent economic changes

While this project was being undertaken, major economic events have occurred which change the context significantly. However, it is important to distinguish two separate factors which have a major impact on transport. The first is the oil price rise to $147 a barrel, followed by significant falls and volatility around the $100, and then the $70 mark. This is related to the way in which demand has risen in line with global economic growth to come close to the level of production. In this situation small changes in demand can cause a strong change in price. Oil price in itself is a major factor in economic growth and thus will act at least in part as a moderating influence.

For transport the significance is that most forecasts are based on a combination of low oil price and high economic growth. This combination has now been shown to be completely unrealistic. This is particularly relevant to forecasts for the main transport GHG emitters: road and air. In the case where economic growth is low, oil prices will be lower, and vice versa. Current transport forecasts for these modes will have to be substantially revised for this reason alone and are likely to fall significantly. The report calls these the modes of uncertainty.

In addition, the UK economy (like many others) is now in recession. In many cases, forecasters would assume that in the long term growth would recommence and even “catch up” with the long term trend.

Given the fundamental restructuring that is taking place in the economy such a forecasting assumption would be high risk. Growth throughout the developed world has been debt driven in recent years and assets (often financial instruments) have been created, sold and resold and this has kept financial markets liquid. However, asset values are sensitive to a downturn and any recall requires the sale of disproportionately large amounts of assets such as property – causing a further fall in value.

Governments are struggling to keep up with the results of this high financial “leverage” and the subsequent “deleveraging” in the markets. This has already led to nationalisation of financial institutions in the US and throughout Europe which would have been unthinkable a year ago. Many observers call this a “Minsky moment” after the economist who predicted the current behaviour of financial markets if they were left relatively unregulated.

Assuming that recapitalisation of the banking system (a huge and uncertain task) is achieved in an orderly manner, what are the longer term implications for transport?

The first is that, because travel is income related, a slow down in household expenditure, or a rise in the proportion required for non-discretionary items such as housing, home energy and travel to work, will result in a series of actions which will reduce travel. In this sense, policies which seek to minimise the need to travel and make local communities more attractive will offer positive help. In the longer term, even work catchment areas may change, with commuting distances being stabilised rather than increasing. Options will, however, be maintained by reducing journey costs through car sharing.

The reason that the policy package set out in this report offers positive benefits in the new economic situation is that the key objective is not to increase public transport use, it is to reduce emissions by reducing fuel used and thus the real economic costs. In the case of the main emitters these are very closely related to distance travelled, at least in the short and medium term. One route to lower cost, replacing existing vehicles with more efficient (or smaller) models, will be made difficult by the economic situation – new car sales in September and October 2008 were down over 20% on the year before. This clearly has major drawbacks for the current reliance on technology to deliver carbon savings. On the other hand, people will simply be less able to afford to drive or fly, especially longer distances which are not work related.

The emphasis on Smarter Choices – helping people to find new and less polluting (and less costly) ways of travelling and influencing the provision of the services they need – is precisely what is required when household budgets are under financial pressure and national budgets suffer from high fuel imports.

New ways of delivering economic growth will be the focus of thinking once the crisis has been worked through. The low importance given previously to transport costs and emissions has led to systems which are sensitive to oil prices and rely on cheap sources of supply. These are less resilient to the changes which are inevitable and have already started. Placing a higher level of importance on reducing fuel consumed is the lower risk way forward.

Balance between technology and behavioural change

Before describing the key elements in the policy package there is one further piece of analysis which has guided their design. This is the issue of whether improving vehicle technology on its own can reduce emissions to meet the climate change targets. The report uses the MTRU spreadsheet model to examine this, and is in broad agreement with the latest DfT research that technology can make a significant contribution, but that it would struggle to deliver even half of the reductions required, particularly in the medium term.

Even by 2050, there is no clear pathway for vehicle technology to deliver on its own, although the DfT seems more optimistic, placing great emphasis on electric power. The report examines this in detail and concludes that unless vehicle charging is rationed, a major increase in power station capacity is required of at

least 150%. Higher speed vehicle charging on demand would require major rewiring at least of domestic supplies and increased power generating capacity, in line with the speed increase, to cover the peaks. There is no robust estimate of the costs or practicality of meeting all private transport needs through electric power or related new technologies including hydrogen. In addition, high efficiency vehicles such as hybrids offer most improvement at very slow speeds and are not strongly affected by congestion. This has not been properly accounted for in most forecasts of the impact of vehicle technology.

The conclusion is that policies which produce more efficient patterns of travel will be needed alongside those for improving fuel consumption both in the medium and the long term, and that they need to be implemented as a matter of urgency.

Overview of the policy proposals

The report contains a range of policies from walking to aviation and deep sea shipping. They vary in impact but are mutually supportive and need to be implemented as a package. In this sense the policies are genuinely integrated.

This brief section indicates the extent and some of the interrelationships between elements of the package. It relates back to the need to engage public understanding and follow the principles of rationality, transparency and equity.

Passenger
Starting with the issue of providing alternatives, a new public transport accessibility standard is proposed for land use planning to make sure that most people do have an alternative available, particularly for those journeys or occasions where walking or cycling is not suitable. Together with minimum standards for cycle parking and routeing, this balances the proposal for a ceiling on parking spaces. It is integrated with the introduction of a new travel planning (Smarter Choice) initiative for individuals and businesses.

There are more specific proposals for improvements to public transport to provide more services, more capacity and a more comprehensive package including a national travelcard compatible with all public transport networks in the UK. This would start with a step change in quality and quantity in the six largest cities outside London. The benchmark will be to avoid the strongly perceived need for second cars or more in many households. This will be supported by the wider availability of car clubs and their inclusion within the travelcard scheme.

Smarter Choice schemes at work will have tax concessions instead of the current penalties. At present, cash support to employees for car sharing, walking, cycling or public transport is subject to tax and national insurance, but car parking is not. Tax rules should be amended to reverse this situation. Other journeys including shopping and leisure can be supported by this travel planning process. A programme of free advice will be offered through a major new scheme, delivered locally but funded nationally. Such planning will be a useful part of supporting individuals and businesses in the current economic downturn.

Again in terms of engaging people who are affected, a new approach to motoring regulations is proposed, removing the disproportionate treatment of offences which are technical in nature and hard to relate to any objectives other than financial. Traffic management will improve reliability but reduce speeds down to meet the existing limits. Parking initiatives will seek to reduce hassle and cost through new pre-booking schemes.

Reducing the need to travel is supported by the emphasis on higher densities and support for local facilities. As this is developed, walking and cycling will become more attractive, walking is already the mode of choice for the shortest journeys.

Alongside this, increases in support for walking and cycling are proposed and are affordable because so little is spent at the current time. For walking, a key issue is not high levels of expenditure but the designing of both residential areas and public space to be connected and safe. Conditions can often be improved by removing obstacles and changing priorities on existing streets – the issue here is often one of professional capacity and commitment rather than cost.

Railway electrification and capacity improvements are proposed, plus a major bus service improvement programme in cities outside London with the easy to use travelcard. Simplified fares will be attractive but structured to avoid competing with cycling and walking.

Fair taxation of air travel will lead to a stabilisation of longer distance flying and reductions in domestic aviation, where rail alternatives will become increasingly attractive as they are further improved. This is already happening to some extent and could be accelerated, even without high speed lines. However, new line capacity will be needed and should be assessed, including high speed options. For many travellers, however, the key factors are likely to be capacity, comfort, reliability and affordability.

The enthusiasm of the 1990s for major tram schemes has not led to widespread implementation and what is needed is a more consistent planning approach to all transit schemes, whether bus or rail based. New, lighter and cheaper alternatives have been developed for rail based schemes and need to be brought forward into full scale projects. These will contribute to carbon reduction particularly in the longer term.

Some policies involve charges on vehicle use, for example fuel duty, but this is not applied as a stand alone measure. Its rationale in this case is to avoid the benefits from improving vehicle efficiency being used up by people travelling further. Thus the proposed annual increase in fuel duty is determined by the level of efficiency improvements predicted in the overall vehicle fleet. This reduces what forecasters have called the “rebound” effect from efficiency improvement and would significantly reduce the high cost which is often wrongly attached (even in the Stern report) to reducing emissions from transport. Efficiency is encouraged by a first year charge, similar to that already proposed. However, this would be higher and structured more fairly to reflect emissions. At the same time, annual duty (the tax disc) would still be emissions related, but reduce, especially for vehicles which were purchased before such a policy was envisaged.

The reasons for this structure are clear: the charge is related to the cost of the improvements which manufacturers can bring forward but do not, so that it becomes attractive to do so. It is clear to people why the charge is applied and they can avoid it by taking efficiency more into account in their purchasing. They still have the choice of not doing so, but in these circumstances they will have an incentive to use the vehicle as efficiently as possible, for example by combining journeys. The whole process is phased in to allow for users and manufacturers to adjust and the new vehicles to replace the less efficient ones.

Freight
Heavy goods vehicles will be charged for the environmental damage they cause and this alone will encourage other modes and better planning of where depots are located and where goods are landed relative to their final destination. Once this is in place and fully operational, consideration can be given to increasing the maximum permitted length of HGVs on motorways and suitable dual carriageways. Safety will be improved by a new package of support for small hauliers including better facilities.

Both rail and road need the planning system to allocate and protect suitable sites, particularly where their networks can be connected.

Specific rail capacity restrictions have been identified by the freight industry and need to be addressed, as well as ensuring that port development is conditional upon a properly functioning sustainable alternative to road use. This is not the case at present.

All the freight modes (road, rail and water) can be made more efficient but this will be at a slower rate than private cars in the medium term. Maritime fuel is particularly polluting and if biofuel is to have any role it should be in this sector and not others. New high efficiency ship designs are already being developed elsewhere and funding for a new prototype to be built in the UK is also proposed.

Summary
The above is meant give an indication of the breadth and depth of the package and its sense of purpose.

While it contains some familiar elements, it is the combination which allows the package to meet its aims, and which allows it to meet the principles of rationality, transparency and equity set out earlier.

Effectiveness of individual elements and the total travel offer

There is one final important issue to be considered – whether people's overall travel needs can be met by the new package.

The total sustainable travel offer
Any analysis of the reasons for the rise in car use recognises that once the entry cost of owning a car (purchase, maintenance, insurance, VED) has been met, the marginal cost is low and perceived as being even lower. It is also the case that

growth in ownership has been in households buying second, third or fourth cars. This tends to turn car passengers into car drivers and create more solo journeys. In fact, much of the predicted growth in traffic comes from lower car occupancy.

Thus policies which seek to address use will also have to address the issue of growth in car ownership, particularly multiple household car ownership.

This in turn reinforces an important understanding of the way that people perceive the availability of sustainable alternatives. A total package which can cater for all journeys without using a car can be more powerful than taking individual journeys and offering a specific alternative. A combination of a variety of destinations within walking and cycling distance, availability of attractive public transport, and access to car use when most needed (for example through car clubs), will reduce car ownership and produce a greater variety of mode choice. Inner London provides a well documented example of this pattern, where households of a particular structure and income have lower levels of car ownership than comparable households elsewhere. This reflected in their patterns of travel.

This can be illustrated by the following example. A journey to a town centre which was undertaken by public transport may have required a late evening bus or train service for the trip home. This may have been much less well used than a service earlier in the day. However, removing it would mean that public transport could no longer deliver the total journey and thus both parts of the journey would have to be undertaken by car. If the person involved does not have a car, and the journey they wish to make is important, they will motivated to get one. The more journeys that require a car, the stronger that motivation. Once a car is bought, it is far less likely that the person will use other public transport services and quite likely they will not use them at all. It will also make walking and cycling less likely. Thus removing what looks like an underused bus service is part of a process that leads directly to the transfer of a large number of journeys to car from public transport, reducing its efficiency and even the viability of previously well used services. Walking and cycling are also reduced and people make longer journeys overall. It is also the case that in the current regulatory framework for buses, with the split between commercial and non-commercial services, there is low opportunity for cross-subsidy to provide a complete network and avoid this effect.

This is one of the reasons that public transport planning is more complicated than selling an individual service. It is the reason that this report includes policies which will improve local bus and rail planning and lead to the creation of minimum public transport access standards, starting with those applied to new development. Part of this process will be to support car clubs which give the opportunity to use a car when it is most needed, without undermining the choice of using other modes for a wide range of other journeys.

How much reduction is needed and when?

There are three key elements to understanding the overall quantity of reductions and even more importantly when they are needed between now and the target date of 2050. They are fully explored in the report but can be summarised as:

- In relation to climate change, total emissions between now and 2050 are what matter - not distant targets.
- Emissions early in the period are more damaging – a tonne of CO2 emitted now will have a warming effect every year to 2050 (and beyond).
- Transport is a continuous process and the cheapest opportunities to change behaviour are lost if they are not taken early – catching up later becomes increasingly expensive.

The above assumptions may not at first sight seem controversial, but they have major implications for policy.

The first is that effective action must be taken as early as possible to minimise cost and to reduce the risk of climate change. Different policies have very different timescales, for example vehicle efficiency needs early action, but will not have a major impact for over a decade. Behavioural change is much faster.

Thus the interactions which result in people choosing where to travel, which mode to use, and how they use their cars, must lead policymaking, rather than isolated proposals limited to improving one mode, or trying to influence choice without considering changes to land use or transport availability. This is not confined to passenger transport – businesses make decisions about which supplier to use, how to organise stockholding and distribution, and where to focus their market, by balancing location and transport cost. It should be noted that the transport of goods produces about a third of domestic transport emissions, and this is growing, while car emissions are higher in total, but stable.

Climate Change Bill

In terms of policymaking there is one Government initiative above all which will have a major impact on transport emissions – the Climate Change Bill. This has been through its stages in the House of Lords and has passed Committee Stage in the Commons (October 2008). It is expected to be law later in 2008. This creates legally binding targets for reductions, including “at least” 26% on 1990 levels by 2020 and 80% by 2050. The latter was recently raised from 60%.

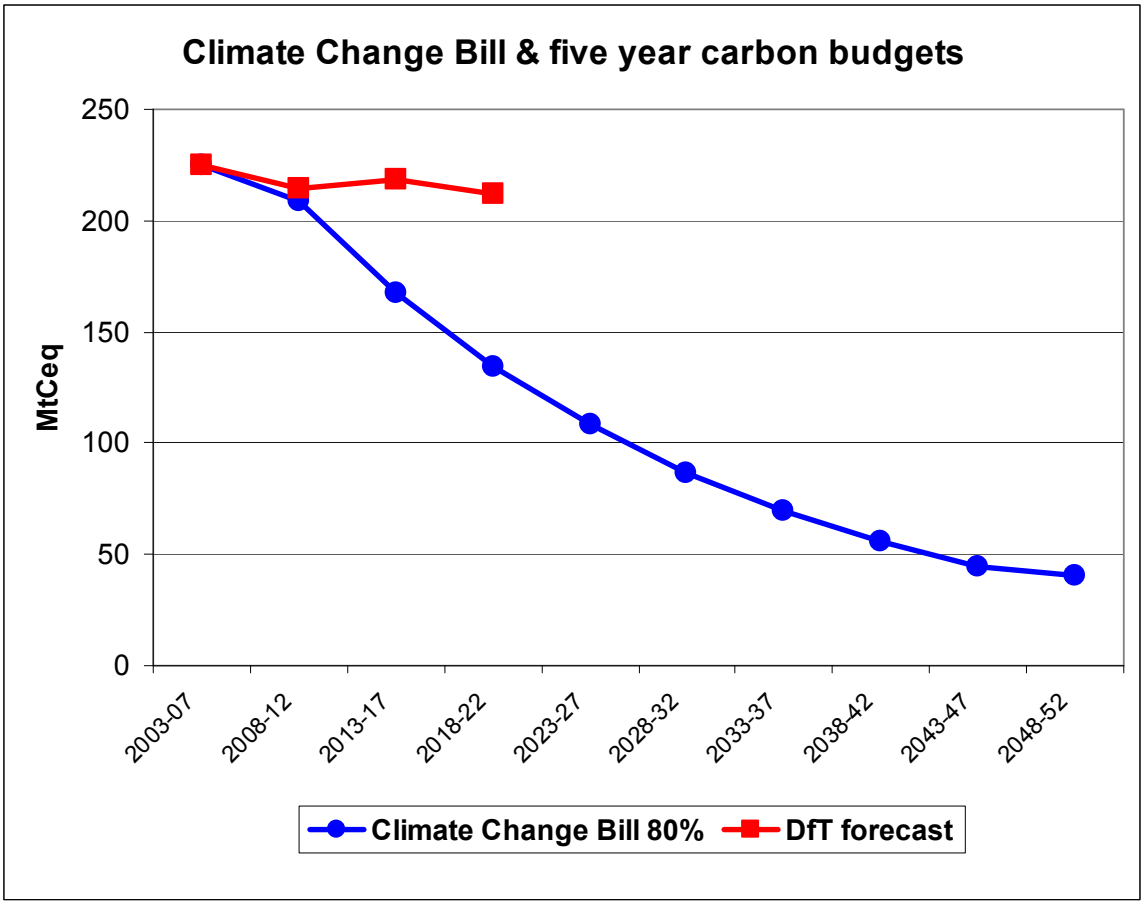
A new independent Committee on Climate Change (CCC) will advise Government on a more detailed set of budgets which will cover 5 year periods up to 2050. The first to have its budget set is 2008-12. These targets and budgets are of course derived from the estimates of what is required to avoid severe climate change. This budget period approach reflects at least in part the need to consider total emissions rather than end date targets.

Using the principle that total emissions between now and 2050 are the key, the 5 year emissions budgets required have been estimated for this report in advance of the CCC advice, and used to guide policy development. They can also illustrate the level of change required. This is shown in Figure 3 below.

It also shows the most recent Department for Transport estimate of the impacts of existing policy, most of which are derived from improvements in vehicle efficiency

and the use of biofuels. The efficiency improvements are the most that could be achieved and make optimistic assumptions about the speed of car replacement.

Figure 3



Source: DfT carbon pathways, CCB, MTRU analysis

The chart shows the extent of the challenge facing transport policy. It leads to three key conclusions of the report:

- Extending current policies, including aggressive efficiency improvement, will achieve less than 5% reduction on 1990 levels by 2020.
- Zero traffic growth plus efficiency improvements will still not meet the Climate Change Bill targets.
- Reductions of 15% on today's traffic levels are required to catch up with the targets.

This in turn means that policies to change behaviour will need to deliver at least an equivalent level of reduction to that from the radical improvements which are assumed for vehicle efficiency. The package has been developed on this basis.

Risk analysis and other objectives

In current circumstances the low carbon policy package is in fact lower risk than a business as usual approach. It could offer help in dealing with the continuing change in economic circumstances both for private individuals and businesses.

However, there are three other important reasons for pursuing a new policy approach.

Security of supply

The first of these relates to energy supply, where the UK is no longer an oil or gas exporter. While Governments may support low carbon power generation through nuclear or non-fossil fuel, the current system will take time to change, over a decade to see any significant improvement. For at least the next two decades, the UK will depend on a variety of sources for its energy supply, most of which are outside the EU. This applies to gas, oil or the feedstock for many biofuels. This issue has only recently become a source of attention for policymakers. It is now clearly a political matter and needs to be reflected in transport policy objectives.

Health and travel safety

Government policy is already moving towards including health, as well as safety and security, in transport objectives. While there are no benefits from using any form of motorised transport (including public modes), there are disbenefits if this reduces overall levels of physical activity. On the other hand, if physical exercise can be incorporated into a normal daily activity, there are clear benefits. Walking is beneficial, but cycling is strongly beneficial in terms of keeping fit as well as maintaining a healthy weight. Despite its apparent low cost, many successful cycle commuter schemes appeal to high income, health conscious employees. Support for both these modes is contained within the package, as part of Smarter Choices, but also in their own right.

Safe travel is no longer limited to reducing accidents, although there are policies supporting this, particularly in matching driving behaviour to different road types and locations. Transport safety needs to be accompanied by actions to make travel more secure and to feel so. This involves better street design as well as more secure public transport, walking and cycling networks.

Congestion

While an economic downturn or high oil prices may reduce traffic without further intervention, policies which could do so in conditions of growth are clearly of benefit. In this report, the main aim is to reduce greenhouse gas (GHG) emissions. Governments have tended, however, to focus more on reducing congestion. While the proposals in this report, such as a fuel duty/efficiency package, land use changes, and Smarter Choices, are targeted to GHG reductions, they will have important congestion benefits. Reductions in congestion may be less than road user charging, because there will be less targeting of the most congested places and times. However, there will be strong association between reducing congestion and the policy package because a major impact will be on commuting, which generally takes place at the most congested time of day.

In many ways, however, the long running emphasis on road user charging as the preferred option for demand management has deflected attention from other measures. These may be less “pure” in terms of economic theory, for example

local workplace parking charges, but have a predictable effect and may work better with practical policies such as Smarter Choices. This report does not propose either of these forms of charging, but does include a charge on parking spaces above the nationally set ceiling for new development. This would also be applied nationally, to avoid local authority fears of destructive competition from neighbouring authorities. Such competition, and the threat of it, are key reasons which have limited the effectiveness of parking controls.

Conclusions

This report is Phase Two of a two year project on transport and climate change and sets out a wide ranging package of specific policies to bring transport emissions in line with the levels required to reduce the risk of extreme climate change. Phase One considered an equally wide range of background issues, including the effectiveness of promoting biofuels or offsetting emissions, whether Government created markets in permits to pollute can make a significant contribution, and if they do what the social and moral implications will be. The Executive Summary from Phase One is attached as an Annex to the report.

Since the drafting of this report began there have been major changes in oil prices and in the global financial system. There are particular problems in regard to the way economic growth has been achieved through increasing levels of personal and corporate debt. This was secured on the basis of asset values which have proved to be in many cases overestimated or completely lacking. Coupled with weakening of the regulatory system, the evolution of novel financial instruments to avoid it altogether has enabled the current collapse in liquidity, further undermining both personal and corporate asset values. While Governments are now struggling to avoid a global depression, recession in most developed economies has already begun.

In this sense the emphasis in this report on transport policies which change behaviour is fortuitous. Many of them will help to reduce resource costs and provide alternatives to the high levels of car and lorry use. The approach to recycling any income from environmental charges fits well with policies to support the real economy and relieve poverty. In addition, any slow down in vehicle purchase (as is currently very much the case) will weaken the impact of technology on total emissions, making behavioural change even more important.

In fact, the original set of principles which have guided the whole project are still relevant, in particular that policies should be well targeted, transparent (especially to those who are affected) and equitable.

In the light of the Climate Change Bill, which will make reductions in some sectors (including transport) legally binding, the reductions needed in relation to avoiding climate change have been identified together with their timing.

These make a package of behavioural change policies essential, contributing at least as much as technological change to reducing transport emissions. The package set out in the report is designed to reduce motorised traffic by around 15% by 2020 instead of catering for growth.

The policy package reflects the need for adaptation, phasing and consistency over a longer time period.

It is also better suited to the new circumstances of oil price volatility linked to economic growth, and the current financial restructuring, than business as usual. These circumstances also mean that most current demand forecasts for road and air will have to be radically revised.

Broader objectives such as improving health and reducing congestion are also addressed by the package.

Overall the package achieves the level of reductions currently required by reallocating existing transport budgets and a series of environmental charges which are recycled to avoid any increase in general taxation revenue. In many cases the change in travel patterns, for individuals and businesses will reduce their direct costs and make the whole transport system more efficient.

A full list of policies from each chapter is set out at the end of this summary.

Timetable and assessment

In order to give a further picture of how the package could be implemented, a timetable has been prepared for a number of representative policies as set out in Table 1 on the following page.

This is followed by a summary assessment against the latest Government objectives for transport, contained in the document *Towards a Sustainable Transport System* (TaSTS). These five objectives are:

- *Maximising the overall competitiveness and productivity of the national economy, so as to achieve a sustained high level of GDP growth.*
- *Reducing transport's emissions of CO2 and other greenhouse gases, with the desired outcome of avoiding dangerous climate change.*
- *Contributing to better health and longer life-expectancy through reducing the risk of death, injury or illness arising from transport, and promoting travel modes that are beneficial to health.*
- *Improving quality of life for transport users and non-transport users, including through a healthy natural environment, with the desired outcome of improved well-being for all.*
- *Promoting greater equality of transport opportunity for all citizens, with the desired outcome of achieving a fairer society.*

The Assessment Table (Table 2) reflects these in the five columns:

Economic competition	Reduce GHGs	Safety & Health	Quality of life	Equity

Table 1 Indicative timescale: low carbon transport policy package

Policy proposal	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Limits on parking in new development												
Excess parking charge on space above limit												
Smarter choice fund (all journey types)												
Tax benefit reform to support smarter choices												
Fuel duty increases linked to car efficiency												
City bus planning reforms initiation phase												
City fares simplification in concert with above												
Bus service enhancement following above												
Rapid transit schemes across spectrum												
Aviation duty reform (beyond current proposal)												
Fuel duty + altitude effect applied to domestic aviation												
Additional rail capacity on existing routes												
Rail reopenings and local line support												
Motoring fixed penalty reform												
HGV weight distance charge												
Third sector bus operator support and training												
HGV small operator support and training												
LGVs and vans brought into car efficiency charge scheme												
1st year car & LGV charge escalator												
National travelcard including car club use												
In-vehicle information for speed and fuel use												
Speed limit enforcement included in ATM												
High efficiency ship prototype												
Maritime bio-fuel replacement												
Slow down in road and runway capacity increases												
New walkable streets fund												
Cycling infrastructure investment fund												

Green is implementation period, implementation ends where policy is reviewed/completed

Assessment Summary against TaSTS objectives

The following table takes the above sample policies and assesses their performance against the new objectives set out in TaSTS. Where there are negative and positive effects, both scores are shown rather than a neutral entry.

Clearly, the policies score very well against the climate change objective, since this is their main motivation. However, the robust nature of, and balance within, the overall package is illustrated by the small number of negatives and the positive scores in achieving other objectives, particularly health and equity.

The positive scores appear fairly self evident, but a few of the negatives may need further explanation.

Negatives
Some policies which impose costs on business have positive as well as negative scores in the competitiveness column, which reflect the fact that the revenue is recycled and that resource costs (mainly oil) are reduced. This is clearly the case for the aviation entries.

A more complex issue is the case of speed limit enforcement, where the negative score represents time lost if a lower speed limit is imposed on grounds of fuel efficiency alone. In fact, there should be no negative score from enforcing the existing speed limit, or to be more accurate there is a balancing benefit of obeying the law which must at least equal any time cost. If it did not, illegal behaviour which saved time would have to be supported in social cost benefit analysis.

There is also the important issue of how much other people value the increase in law abiding behaviour – this could be calculated in exactly the same way as the value of time currently in use. This sum may well exceed the value of any time costs but is never referred to. There are other complex issues here, for example a comparison of the cost of preventing road fatalities or serious injuries with the cost of preventing the same from violent crime.

The answer is that the idea of being law abiding is similar to the situation in relation to avoiding climate change – it is an objective which policy seeks to achieve, not an option which is costed and then traded off in a cost benefit table.

The negative scores for walking and cycling under health represent concerns over road safety, although it would be the aim to improve safety as the walking and cycling policies are implemented. It is included to provide a warning as well as being cautious in the assessment table.

Key to the Table
Score is positive: + or negative: - or neutral: N
Scale is low, medium, high

Table 2 Assessment Summary Table: Low carbon transport policy package

	Economic competition	Reduce GHGs	Safety & Health	Quality of life	Equity
Limits on parking in new development	N	+++	N	N	N
Excess parking charge on space above limit	N	+++	N	N	N
Smarter choice fund (all journey types)	N	+++	++	+	+
Tax benefit reform to support smarter choices	+	+++	N	+	+
Fuel duty increases linked to car efficiency	N	+++	+	+	-
City bus planning reforms initiation phase	+	+	+	+	++
City fares simplification in concert with above	+	+	+	+	++
Bus service enhancement following above	+	+	+	+	++
Rapid transit schemes across spectrum	+	++	+	+	+
Aviation duty reform (beyond current proposal)	- - + +	+++	+	+	+
Fuel duty + altitude effect on domestic aviation	+ + -	+++	+	+	+
Additional rail capacity on existing routes	+	++	+	+	N
Rail reopenings and local line support	+	++	+	+	+
Motoring fixed penalty reform	N	N	N	+	+
HGV weight distance charge	+	+++	+	+	N
Third sector bus operator support and training	++	+	N	+	++
HGV small operator support and training	++	N	++	N	++
LGVs and vans brought into car efficiency scheme	+	+++	N	N	N
1st year car & LGV charge escalator	N	+++	N	N	N
National travelcard including car club use	+	++	-	+	+++
In-vehicle information for speed and fuel use	N	+	+	+	+
Speed limit enforcement included in ATM	+ -	++	++	N	++
High efficiency ship prototype	++	++	N	N	N
Maritime bio-fuel replacement	N	+	+	N	N
Slow down in road and runway spending	- +	+	+	+	+
New walkable streets fund	+	++	++ -	+++	+++
Cycling infrastructure investment fund	+	++	+++ -	++	+++

Policy Package

A full list of policies, which are also included at the end of each chapter, is set out below.

Transport charge rebate scheme

Changes to taxation and transport charges are part of this policy package but the aim is to change behaviour and not to increase Government income. Thus any revenue in excess of current levels of tax will be included in an eco- rebate scheme as follows:

1 Private user surplus recycled as:

Annual tax free lump sum cashback
Reduction in employee National Insurance
Sum added to a new national travelcard scheme

2 Business user surplus recycled as:

Annual cash back on business rates
Reduction in employer National Insurance
Reduction in Corporation Tax

Land use policy proposals

PPG13 current maximum permitted number of parking spaces in new development made mandatory

PPG13 current maxima redefined as applying to gross site area, not gross floor area

Current PPG13 maxima reduced by 1% of current level each year from 2010 to 2050

In existing developments, car parking over the limit will be charged at £50 per space from 2010 onwards, rising by £10 per year to 2050

PPG6 strengthened and clarified to focus development in town centres not peripheral locations

Minimum public transport accessibility standards set for all inhabited areas according to size of settlement and density

Development size linked to the same settlement size/density bands as for PT accessibility

Minimum development intensity, defined as ratio of floor area to site area, graded according to size – in other words large developments have to achieve high density

Clear support in planning guidance for “Smart Growth” policies for new and existing settlements, especially the “eco-towns” initiative (if it proceeds)

PPS3 revised to to include minimum residential development densities above a floor number of dwellings

New residential planning guidelines for local facilities with 3rd sector endowments rather than one off capital charges

All local plans to identify key walking routes between developments and residential zones and undertake a quality audit by 2020

Location and centralisation decisions for facilities including health, education and leisure to take full account of increased transport costs and emissions and the results of such analysis to be made public.

Policies for behavioural change

A national funding scheme for smarter choices would be established deploying £200million a year for 10 years with a phased start up. It would be open to any organisation to deliver the programme, with encouragement to local authority, third sector and commercial partnerships.

Programme to be purpose based with specific initiatives for:

shopping: (including home delivery, local collection centres, local outlets, local sourcing)

schools: (including walking and cycling initiatives but with school safety zones and non-statutory school bus initiatives in rural areas)

workplaces: (including established techniques to encourage video conferencing, car share, public transport, cycle and walking, new green cashback scheme exempting up to £300 per employee per year if paid into approved scheme)

leisure: build on existing entrance/public transport ticket, as well as range of access improvements by sustainable modes (also see planning guidelines to create more local facilities)

Long distance in UK travel & communications initiative for business – looking at ease of planning and booking journeys, identifying obstacles through pilots, £50million over 3 years leading to specific scheme.

Policies for technological change

First year charges on cars related to their level of emissions to increase annually to 2020 and applied per gram above an efficiency reference level, at least 130 in 2012, 100 in 2015 and 90 by 2020.

Efficiency reference level to rise annually as technology becomes available and thus the charge on less efficient vehicles will also rise in real terms.

Air conditioning and other power consuming devices to be included in gms/km calculations.

Vans brought within car efficiency standards scheme.

Fuel duty to rise in line with predicted improvements in efficiency to avoid rebound effect.

VED increases to be slowed down as the least effective means of changing purchasing behaviour.

Biofuel

No transfer of existing land acting as a carbon sink to biofuel use in the UK.

No feedstock to be imported until certification can be made reliable - this will help take pressure off food prices and virgin rainforest.

No further increases in biofuel content for road surface transport beyond 5% (UK set aside land should just be able to provide this).

Priority for biofuel for maritime transport (domestic and international bunker), aim for 50% by 2020, 75% by 2050.

Research into 2nd and 3rd generation biofuels accelerated.

Urgent UK and international action to preserve existing rainforest stock.

Policies for walking

In addition to the walking accessibility of individual sites and the permeability of new development set out in the land use chapter:

Government Guidance to include:

- scheme appraisal required to reflect the hierarchy in the Manual for Streets
- the impact on walking conditions and levels of use to be assessed in all appraisal of local transport schemes
- use of new techniques to measure walkability.

New funding specifically to cover local street audits for walking both where people start and where they finish their journeys.

Reform of local street priorities to create safe and walkable home and shop community zones.

Reform to include defining areas of shared (negotiable) space – traffic at eye contact speed, fewer boundaries, walking priority.

New pedestrianisation challenge fund for local authorities to create best practice examples in different areas, urban, suburban, market town, village etc.

Evolution of minimum walkability standards building on best practice – both for new development but also retrofitted.

Encouragement of innovative travel bonus schemes as part of Smarter Choices to make walking more attractive for all journey purposes.

Avoid changing clock times in October and implement a trial of SDST.

Funding for research and development programme with the motor industry into a range of options for encouraging slow car use, from driver alerts to speed limiters.

Inclusion of walk catchment as part of defining accessibility – for example larger service or retail development "sinks" need associated high density "sources". These can be residential or commercial (this is linked to the Government's concept of agglomeration).

Cycling policy proposals

Cycle parking standards to be introduced for existing town centres, and at workplaces, leisure and educational facilities through the travel planning initiative – automatic 100% funding from national budget.

Second generation priority networks for every town over 15,000 population, based on safe links from homes to workplaces, schools, health centres, parks and other leisure centres – expanding Cycling England programme and extending to 10 years.

Completion and extension of current National Cycle Network

National bike hire scheme similar to VELIB based at stations and in city centres – pilot schemes in different areas including London, different towns and rural stations by 2010, national scheme by 2015, full demonstration funding.

Policies to engage the motorist and respect the role of the car

New initiative to create better understanding of why people drive, and among drivers, of why specific traffic controls and management schemes are implemented.

National action to promote schemes such as bookable parking and information including the funding of trial schemes.

In relation to parking, target deliberate and persistent offenders rather than, for example, people who make occasional minor parking errors, and investigation of the equivalent to a police "caution" for one off minor offences.

Removal of income to local authorities in excess of that needed to operate parking schemes to the eco tax rebate scheme.

Greater differentiation of traffic offences with wider spectrum of fixed penalties and greater focus on dangerous behaviour.

Investigation of national, free motoring "package" possibly including GPS, car security, information and training – developed with established motoring organisations and insurance companies.

National car club initiative with common means of payment, possibly with national free "unique need" car access scheme.

Local bus policies

Introduction of national travelcard which will also include concessionary fares scheme.

Introduction of public transport accessibility standards for rural as well as urban areas.

Fuel duty rebates (BSOG) scrapped and replaced with hours of service run grant – set at level where no operator faces a reduction (effectively increasing rural grant and encouraging fuel efficiency).

PTEs to receive increase in bus subsidy up to 50% of London level per head of population, leading to >30% increase in service kilometres, 10% general reduction in fares and simplification (costing further 10%).

Reform of local public transport planning in urban areas to include a new duty to integrate, to provide a comprehensive network and new reserve powers to ensure participation (this is partly in the new Local Transport Bill).

Transit policy proposal and programme cost

The overall target is difficult to cost without specific schemes. However, the additional expenditure would be of the order of £150-200mn a year, assuming that the schemes over and above those currently planned would focus on lower cost implementation. This does not include money already allocated for new and expanding lines (for example Nottingham Phase 2). It should also be the case that developer contributions, focussing on capital cost, should be easier to negotiate for specific rapid transit schemes.

The above must include pilot schemes covering new forms of rapid transit, including bus but more particularly ultra light rail.

Aviation policy proposals

A per aircraft charge should replace current APD, based on maximum take off weight and distance bands.

A double fuel duty charge should be placed on GB domestic flights in addition to a weight distance charge.

The EU distance zone should be split into two bands but this may be difficult to negotiate. A single zone is therefore proposed in the short term.

Outside the EU a four zone system would strike a reasonable balance between complexity and boundary problems, such as those currently experienced.

Significant increases in the level of charge are proposed, although these do not fully reflect the emissions caused. To put this in perspective, the total charges (not just the increased revenue over existing APD) would still not exceed the application of VAT to international air fares. It would, however, be much better tuned to environmental damage.

Excess revenue from any aviation charge imposed for environmental reasons should be recycled. This could be to those who currently suffer airport pollution. Alternatively, income from leisure flights could be recycled to the general population and from business flights to businesses.

Car policy proposals

ATM is a positive and early measure which would assist motorists but offers the potential to assist in the reduction of emissions directly (through improved traffic flow) and indirectly (through more realistic journey time choices).

National speed limits should be enforced to a far higher level than at present and this should be co-ordinated with the roll out of ATM.

The use of variable speed limits should be included in a new debate about further reducing national limits on motorways and trunk roads and setting target average speeds.

Road maintenance requirements need to be reassessed in the light of HGV controls but not reduced.

The need for road building generally and the particular costs and benefits are in a complete state of flux and capital expenditure needs to be slowed down significantly up to 2020.

The drivers' package suggested in the local transport section would also benefit longer distance car users.

Longer distance public transport proposals

DfT should commission a more comprehensive data set for longer distance road public transport.

Vehicle technology improvements for longer distance road vehicles should be sought in parallel with local bus design. Coaches already pay fuel duty, so new registration and VED incentives should be given to improve efficiency.

Reopening rail connections should be reconsidered in the light of uncertainty over oil and energy prices, security of supply, and DEFRA carbon prices.

Network Rail should consider both a speed priority option and a capacity priority option in its latest study on new rail capacity.

The analysis of new rail lines should be explicit about assumptions on

- load factors,
- level of electrification, and
- sources of electricity supply

and how these change the costs and benefits.

The study should look at all options including new freight only sections.

A rolling programme of further electrification of the rail network should be assessed as a matter of urgency in view of the uncertainty over self-propulsion methods and the DfT prediction of rising emissions from rail.

High speed lines should be considered but detailed issues about how many high speed limited stop paths are needed and how best to provide them (with and without new lines) should be included.

No study of future rail capacity should prevent or delay implementation of capacity or other improvements to existing lines, including further electrification.

Summary of marine policy framework

The carbon cost of sea transport should be included in any carbon tax on the sale of goods.

The easiest method of applying this would be a flat rate addition to port charges based on emissions per charter, preferably at EU level.

Any carbon harbour tax must take account of the fluctuations and current high price of oil and be phased in.

The EU should drop its support for refined biofuel in road vehicles and prioritise the replacement of bunker crude with bio crude as a short to medium term measure.

A review of port facilities to identify where new power supply infrastructure is needed should be undertaken.

Following this review a programme of port power supply improvement should be undertaken, based on local generation using renewable sources.

The Government should initiate a major research and development project on marine propulsion and hull design including wind assistance.

The marine project will need sufficient capital funding to build a full size demonstration vessel.

Freight policy proposals

A weight/ distance charge for HGVs over 25tonnes gross to be introduced, reducing their VED to a nominal amount (EU permitting) and applying the charge to foreign vehicles (similar to Swiss scheme), starting at 10p per kilometre in 2010 and rising to 20p per kilometre by 2020.

HGV charge income to fund road industry training initiatives, support for small hauliers, improved local road surface maintenance, new driver facility standards, cashbacks through the licensing system for well maintained vehicles, subsidised insurance costs and free MOT tests. All these would raise safety standards and improve compliance.

Remaining income recycled to companies through a lump sum UBR rebate and lower NI contributions or lower corporation tax.

HGVs in the distance charging scheme pay only a minimum charge of £50 (requires agreement from the EU).

Together with the weight distance charge a review of maximum size limits and restriction of the heaviest lorries to the motorway network plus similar dual carriageway roads. Routes would be defined by local authorities to serve local business.

Rail freight bottlenecks addressed in rail capacity programme.

Land for intermodal transport to be identified in local and regional plans.

Proposals to reform transport appraisal

The new objectives for sustainable transport will need to be reflected in NATA, for example health. Proposals which seek to achieve a particular objective can be compared by measuring their effectiveness per pound of cost. Complex schemes will need the decision maker to consider strengths and weaknesses against cost.

Appraisal methods mean that NATA often promotes schemes which run counter to government policy. DfT should set up a multi-modal, multi-interest monitoring and advisory group to ensure the widest possible consideration and acceptance of amendments to NATA by professionals and the public. This will help avoid unintended consequences. *(this has been partly implemented).*

In relation to climate change, the concept of achieving a necessary target requires significant change to NATA. NATA could simply apply a pass/fail criterion if schemes do not achieve the target reduction.

The NATA appraisal internet site, webtag, should be continued as a source of guidance but extended significantly to include more good practice, for example to support the next four recommendations.

The Assessment Summary Table (AST) is at the heart of the appraisal system and needs to be completed in a way that is internally consistent and consistent with other appraisals. This needs a new and more comprehensive approach involving training, better guidance, and monitoring. This should include a specifically trained practitioner having overall responsibility for producing the AST.

The development of alternatives to proposed schemes needs to be taken seriously. This needs even greater emphasis in guidance, but also improved monitoring. Schemes should be judged against the best performing alternative, not against an often unrealistic 'do minimum'. Any serious alternative should have its own AST which has a comparable level of detail to the main proposal.

The impacts of schemes should be described properly in the AST, for example it should set out how large individual time-savings are or what the noise context is relative to standards for sleep or conversation. These aspects should not just be averaged and have a monetary value put on them.

Because of conceptual and practical problems, there should not be trading off of very different costs and benefits to produce a single monetary value, these include: personal injuries and death; climate change; time savings; value of a landscape; damage to historic buildings; street conversation; a night's sleep; air pollution nuisance; air pollution damage to health; health benefits of exercise and social inclusion.

For this reason the preferred option is to describe scheme or policy impacts more accurately, without valuation, in the AST.

Forecasting and modelling resources should be prioritised, first ensuring the best possible data (on travel as well as impacts). After this there should be more broad brush testing of properly modelled alternatives. This can be done using the improved travel and other data and much simpler models. Only if absolutely necessary should highly elaborate network based models be developed.

Every appraisal relies on forecasts, at present supplied by the DfT through their TEMPRO programme. At present this does not produce a demand management forecast, without road pricing. This could use benchmark values from existing DfT studies such as Smarter Choices.

Walking and cycling need to be properly represented in the appraisal process and appropriate methods of modelling them need to be developed that allow for useful comparison of their benefits with other transport modes.

When polluting behaviour is reduced and tax is lost as a result that should not be seen as a cost and be allowed to reduce scheme benefits. In reverse, gains in tax through increases in polluting behaviour should not be viewed as a benefit and be allowed to reduce scheme costs. A separate statement on changes in tax revenue should be made. This must distinguish between charges for polluting behaviour and general taxes.

- Fuel duty should be seen as an environmental tax which needs to be minimised by encouraging people to shift to less fuel intensive forms of transport, whereas NATA currently sees it as a source of government income to be maximised
- People shifting to public transport where fares are not subject to VAT and where fuel duty income falls should not be seen as disbenefits of a scheme

Numbers of travellers changing mode should be identified in the appraisal, rather than treated as generated traffic (and thus have their value reduced). Nor should they have their working time values altered when they switch, as at present.

The problems of using different average values (including national equity rates) continue to produce counter intuitive results and undermines the basis of a cost benefit analysis of the traditional type. The issue of the compatibility of national and scheme specific forecasts, and valuations, is complex and needs its own research and consultation project. A move away from derived valuations, rather than extending their use, will be of some help.

1 Introduction

Purpose of the report

This report is Part 2 of a project on the impact of climate change on transport UK transport policy, including our involvement in international travel and trade. The final outcome is a comprehensive package of transport policies, although it is not the intention to address this issue alone. There are many other policy objectives, most recently set out by Government in its consultation report "Towards a Sustainable Transport Strategy" (TaSTS) which need to be taken into account. It nevertheless remains the case, that the new emphasis on climate change, and the challenging framework of the Climate Change Bill, will require a major reappraisal across policy areas.

The Government itself has commissioned several major reports which have contributed to this process and is setting up a Committee on Climate Change to advise on overall targets for reductions in greenhouse gas emissions across all sectors. The first over arching report, by Sir Nicholas Stern in 2006, is recognised for its breadth and depth and tried to tackle ethical issues such as responsibility to future generations, within an economic framework. Unsurprisingly this stimulated much debate among economists, but the work is widely referred to and remains a key landmark. It is disappointing therefore that the Government has not adopted the basic economic structure for the price of carbon in Stern – a price significantly higher than the current level and with future damage discounted far less than current practice.

This omission has caused serious anomalies in the appraisal of transport investment and it is of great concern that the welcoming of Stern was not accompanied by adopting one of its key recommendations.

The Government has, however, responded to the urgency of the problem by promoting the Climate Change Bill, which sets out the idea of five year "budgets" for carbon in several sectors, including transport. The independent Committee on Climate Change (CCC) will advise on what the budget levels should be.

In transport policy itself, there have been three highly focussed pieces of work produced recently which deal with specific topics:

- Rod Eddington on transport and economic competitiveness
- Julia King on low carbon vehicle technology
- Ed Gallagher on biofuels and land use

These reports have each explored a particular niche in transport policy and have provided much useful information and analysis. However, they do not provide an overall framework within which the elements of a transport policy can be developed.

For example, the need to slow down any rush to biofuels is now well documented (King then Gallagher) and UK policy has moved quickly in response. This includes adopting the Californian carbon content approach for biofuels by 2010, as described in Phase 1 of this project. However, this means that there should be an

increased emphasis on short term behavioural measures to reduce emissions which are hardly mentioned in the King report. However, Gallagher is clear that a policy mix will be required, saying

"It is clear, however, that achieving significant reductions in road transport GHG-emissions requires an integrated approach including:

- More efficient vehicles
- Low carbon fuels
- Increasing use of public transport
- Walking and cycling
- Aids to enable more efficient driving
- Efficient use of infrastructure
- Demand management"

Eddington's report looked at major issues of infrastructure management and found that small scale schemes and demand management could provide the best value for money. This does not seem to have yet been universally accepted in transport policy. Nor were the issues raised by his emphasis on competitiveness really addressed. Rapidly growing levels of leisure travel are a key cause of the problems on roads and at airports – is UK plc being harmed by a double whammy of congestion costs and people spending their money abroad? What are the policy implications?

The overview for transport is promised and previewed in the TaSTS consultation document, which revises the original five objectives for transport set in 1998.

There are now five objectives, set out in para 24 of TaSTS as follows:

- *Maximising the overall competitiveness and productivity of the national economy, so as to achieve a sustained high level of GDP growth.*
- *Reducing transport's emissions of CO2 and other greenhouse gases, with the desired outcome of avoiding dangerous climate change.*
- *Contributing to better health and longer life-expectancy through reducing the risk of death, injury or illness arising from transport, and promoting travel modes that are beneficial to health.*
- *Improving quality of life for transport users and non-transport users, including through a healthy natural environment, with the desired outcome of improved well-being for all.*
- *Promoting greater equality of transport opportunity for all citizens, with the desired outcome of achieving a fairer society.*

There is some initial expansion of the objectives in TaSTS and for the purposes of this report, the main changes in the new objectives appear to be:

- Economic objectives are made consistent with the Eddington report[1], thus broadening them to include reliability, agglomeration (particularly within conurbations) and labour market flexibility, while retaining time savings

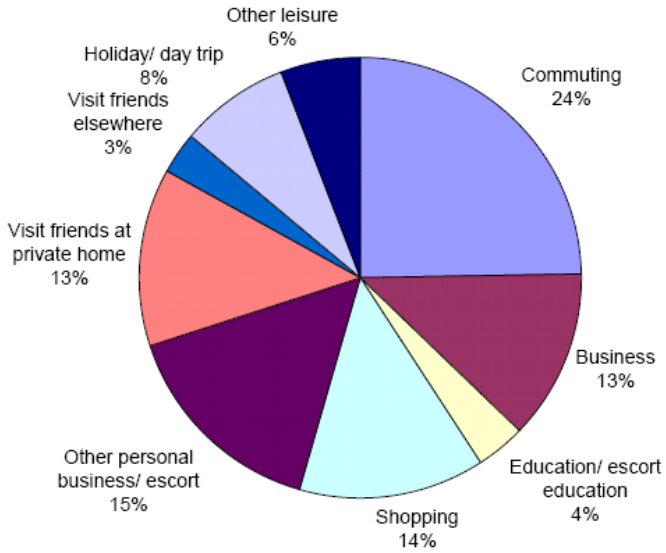
- Greater emphasis on climate change with its own objective additional to broader environmental improvement
- Safety now included in a new health objective, which promotes healthy modes of travel
- Environmental impacts may be split between objectives, becoming part of a more vague "quality of life" objective which is said to also include "range of goods on supermarket shelves", "enjoyment of the countryside" and "seeing the world" (TaSTS para 2.71). Factors such as noise and pollution will also be relevant to the health objective.
- Accessibility is moved into an equality of opportunity objective, which includes vulnerable groups of people and regional differences.

This report, therefore, presents a package which is very much in tune with the increased emphasis on emissions reduction in the TaSTS objectives, and the work of the Committee on Climate Change to define the emission reductions required.

It begins with a brief review of changes since the publication of Part 1 of this research in May 2007 and goes on to address the key issue of carbon budgets for transport. The report then sets out a package of policies designed to achieve the climate change objective, the achievement of which is taken as necessary and thus different in kind from the others.

Before doing so it is important to note one further piece of work subsequent to TaSTS, "Carbon Pathways Analysis", published in June 2008. This breaks down transport demand by mode, distance and purpose and links it through to emissions. It provides a comprehensive starting point for any policy proposals and has been extremely useful for this research. It uses the National Travel Survey (NTS) which provides a snapshot of current behaviour, but also data from earlier years which show the core reasons behind the growth in traffic and greenhouse gas emissions. Thus the main sources by journey purpose are shown below.

Figure 1.1 Emissions by journey purpose



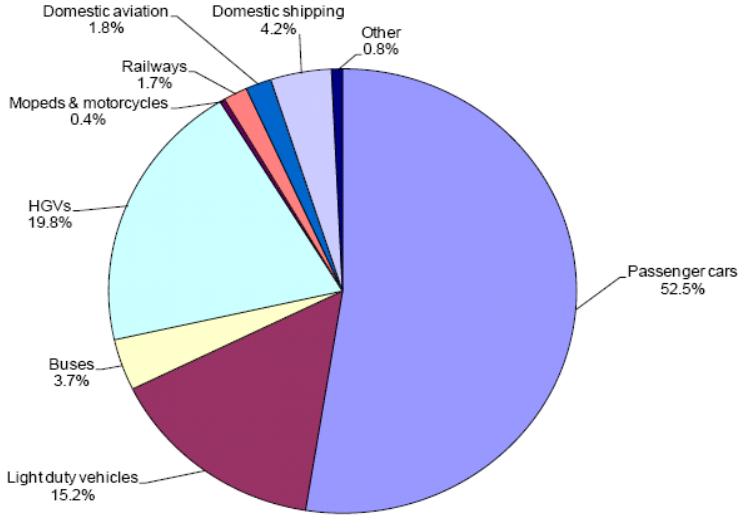
Source: DfT analysis

The same report shows how emissions are related, as is to be expected, to distance travelled and concludes that:

"• most trips are short – 57% of car journeys are under 5 miles. These account for under 20% of CO_2 emissions from cars;
• there are a large number of journeys (37%) between 5 and 25 miles. These account for a similar share (43%) of CO_2 emissions;
• only 7% of trips are over 25 miles. They account for 38% of CO_2 emissions from cars." (para 16)

The final issue is the importance of freight transport, while cars produce 52.5% of domestic transport emissions, HGVs produce 20% and light goods vehicles and vans about 15%. This is shown in Figure 1.2 below. Emissions from cars are, however, relatively stable, while those from goods vehicles are growing.

Figure 1.2 Emissions by mode 2006



Building on Phase 1

As stated earlier, this report forms the second part of the national project to develop a comprehensive transport policy for the UK which addresses the challenge of climate change. Part One, entitled "Perspectives", was published in May 2007 and set out:

- principles for policy development including the issue of targets and budgets
- an analysis of contextual issues including sources of greenhouse gas, biofuels and offsetting
- an example of how policies must be integrated and aware of unintended consequences.

Since its publication there have already been several major developments, including:

- Oil prices have overtaken the initial increases in fuel duty proposed

- Additional evidence has been gathered on global warming
- Carbon budgets in the Climate Change Bill recognise the need for reducing emissions over the whole period from now to 2050
- Carbon reductions will become legally binding in the UK
- A first year "showroom tax" related to emissions has been introduced, although at a lower rate
- VED is to be raised, but at a high rate and acting retrospectively, unlike the MTRU proposal
- The doubts raised in Phase One over biofuels and their impact on food prices have now been widely accepted
- The King Report on low carbon cars (and driving) has been published
- The Gallagher report on biofuels has been published.

These developments are dealt with in the relevant sections of this report, including the next one which estimates what the carbon budgets for transport, and hence emission reductions, should be.

Principles

Before this, it is important to reiterate the principles from the Phase One report, which set out an overall framework to guide the formulation of a detailed policy package.

- Transport policies to combat climate change should be based on three principles:
    - The main objectives must be individually identified and clearly stated. *(Rational).*
    - It must be clear to those who are affected how the mechanism relates to the objective. *(Transparent).*
    - In the course of everyday travel, for those people who reduce their travel by one mode, or incur additional cost, there is an alternative available. *(Equitable).*

- New charges to encourage change in transport use for the purpose of reducing greenhouse gases should not be used for raising general revenue since the aim is not to raise revenue but change behaviour. Income should be returned, for example through lump sum payments (equitable but less productive in GDP terms) or reduced national insurance (less socially progressive but probably GDP positive).

- Policies must be comprehensive and integrated across all modes and take land use planning into account. Issues such as the availability of alternative choices and rebound effects (such as more efficient vehicles encouraging more car use) must be included.

These principles are used to guide the process of policy formulation for Phase 2.

2 Carbon (greenhouse gas) budgets

This section estimates the level of reduction in transport emissions which is required, which in turn determines what the policy package as a whole is designed to achieve.

The transport contribution

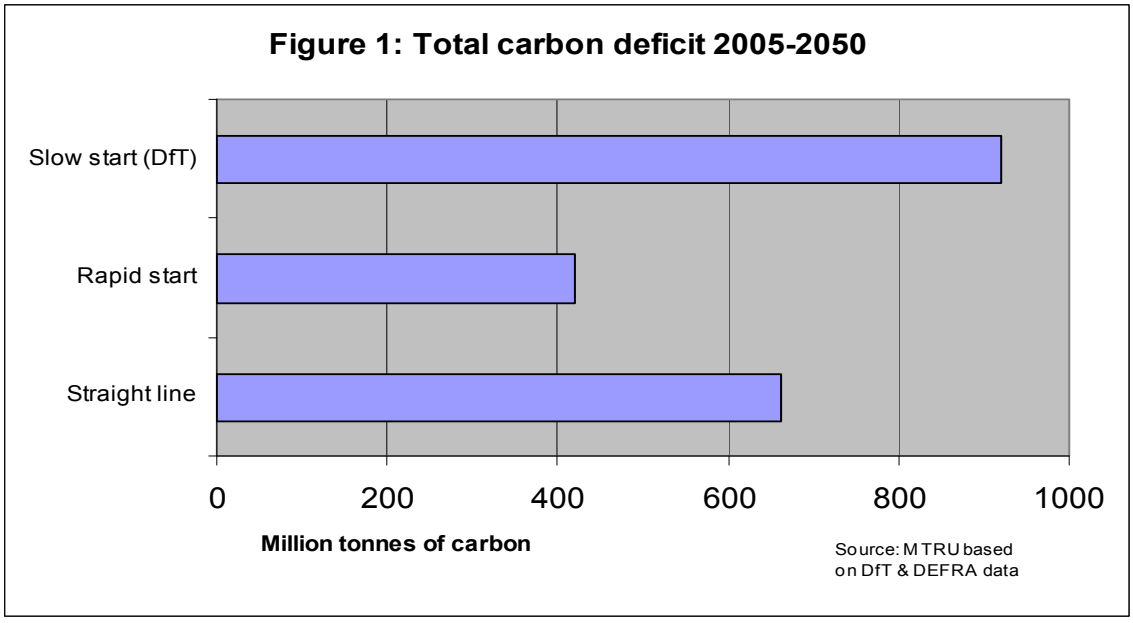
For the purposes of this analysis, the UK transport sector is assumed to have to meet the same target as other non-traded sectors. The reasons for this are set out elsewhere, but two key areas are social equity and substitution. Transport use is strongly related to income[2] and thus to set tougher targets in a sector such as domestic energy in order to compensate for transport emissions would run the risk of penalising those on the lowest incomes. Seeking to avoid additional costs in one sector could lead to an increase in transport if the transport sector is given a less demanding budget limit.

In this sense, if there is a need to allow other sectors a less challenging target, setting a tight budget for transport, where there are sometimes low, zero, or even beneficial cost options for behavioural change, would be a sensible option. Because there are not yet published data on the other sectors, this has not been included in the following analysis. This section uses the totals for all greenhouse gases, but brought into a single number as carbon equivalent figures.

Budgets or targets

Perspectives[3] argued that total emissions between now and 2050 were what actually influenced climate change, not the achievement of a single target reduction by that date. This was quantified and different rates of reduction used to illustrate how much greater the carbon deficit could be if action was not taken as early as possible. Figure 2.1 is drawn from the original report.

Figure 1: Total carbon deficit 2005-2050



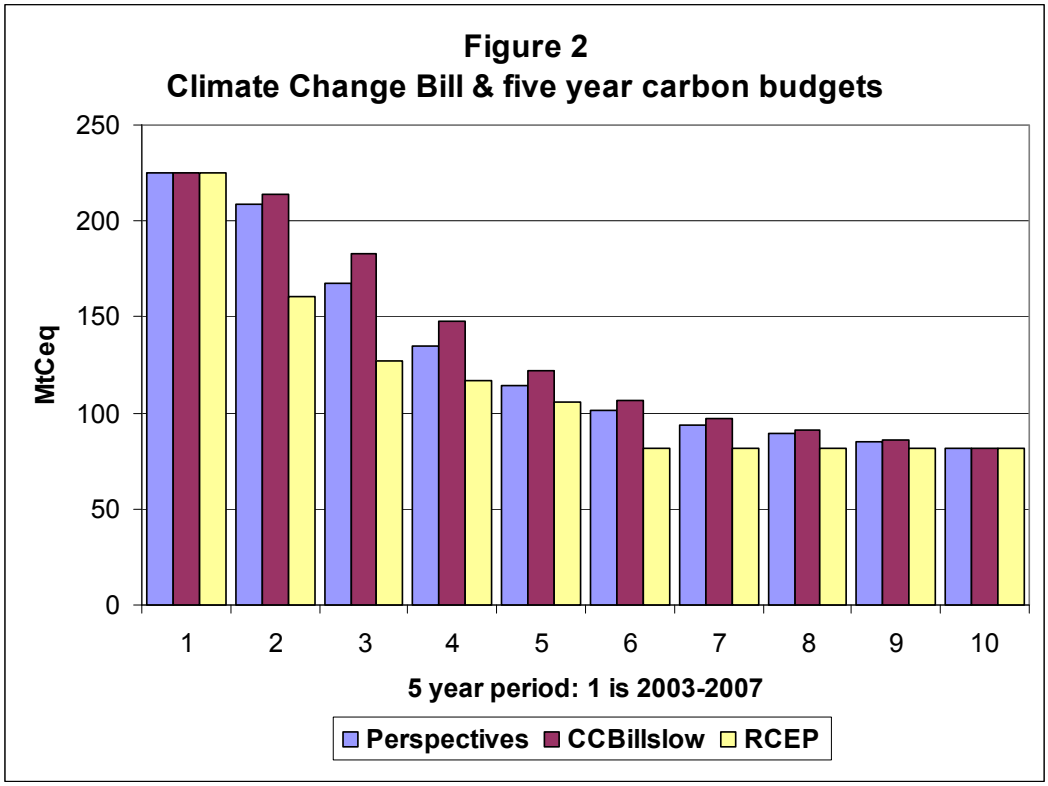
This approach is reflected in the Climate Change Bill to a significant extent. The setting of five year total greenhouse gas emission "budgets", which are legally binding, is far preferable to the earlier end date target. It allows some flexibility but will make success or failure in the short to medium term more transparent. The key will be what emission levels are chosen, but again the use of a 2020 reduction target is a useful guide. This was originally a reduction of 26-32% by 2020. The Bill uses the phrase "at least 26%". The "Rapid Start" option in the chart above was based on a reduction pathway just below the 32% level. This was considered feasible following the outer London pilot study and the work undertaken for the VIBAT report for DfT in 2006[4].

Overall the new approach is in line with the need to achieve reductions throughout the time period and constrain total emissions between now and 2050.

What should the budgets be?

Estimates of what should be possible for transport, through a combination of improved vehicle technology and changing behaviour, have been updated and translated into carbon budgets. These are shown in Figure 2.2 and use the five year budget periods which are in the Climate Change Bill. Some allowance has been made for the recent oil price rise and the King Report proposals for improved vehicle efficiency. The reductions implied by the 2000 Royal Commission on Environmental Pollution (RCEP)[5] report are also included. These were based on a 20% reduction by 2010 (also a Government target at the time) and 60% by 2050, the target which is still being used. Emissions between 1990 and 2007 are pretty much set, so the pattern has been adjusted to achieve the correct RCEP total and the correct interim RCEP target.

Figure 2
Climate Change Bill & five year carbon budgets



The draft budgets from the above Figure are also shown in Table 2.1 below, together with 1990 to 2050 total emissions. For reference, a five year period at the 1990 level of emissions would be 201 million tonnes carbon equivalent (MtC).

Table 2.1

Draft carbon budgets for transport

Period		Million tonnes Carbon equivalent		
		Perspectives	CCB minimum	RCEP base
1	2003-2007	225.3	225.3	225.3
2	2008-2013	208.7	213.6	160.8
3	2014-2018	167.3	183.3	127.2
4	2019-2023	134.7	147.5	116.7
5	2024-2028	114.3	122.3	106
6	2029-2032	101.6	106.6	81.2
7	2033-2038	93.9	97	81.2
8	2039-2042	89.4	91.3	81.2
9	2043-2048	85.3	86	81.2
10	2049-2052	81.3	81.2	81.2
Total	1990-2052	1876.9	1929.2	1717.1

Note: the final period is included to allow for a 2050 target
Period 1 is included for comparative purposes.
Source: Climate Change Bill; DEFRA UK emissions directory, Perspectives, RCEP

The above figures show the extent of the challenge facing those involved in the carbon budgeting process. To reach the total emissions implied by the Royal Commission would need a huge reduction in the first five year period, despite the assumption that a 60% reduction can be achieved in 2030 and the reallocation of most of this into the budgets for periods 2 to 4 (2008 to 2023). Even the budgets implied in Perspectives, based on profiles from the pilot study, result in 9.3% more greenhouse gases than implied in the RCEP. Achieving the minimum Climate Change Bill targets results in 12.4% more than that implied in the original RCEP report.

Cheap carbon reductions don't last forever

This analysis illustrates how the failure to tackle the problem in early years creates an increasingly difficult task. This is compounded by a fundamental misunderstanding about how difficult it is for people to change behaviour. It is likely that the first 10% reduction in a person's carbon footprint in any one week, month or year is cheaper and requires less radical action than the next 10% reduction. Turning down the thermostat one degree or giving up the least important car trip, or one which is the easiest to switch to bus or cycle, is very much easier than cutting home heating bills, or car driving, by a quarter. Thus in any given year there will be a range of abatement costs which rise as the level of reduction rises.

For this reason, delay in taking action is effectively raising the total cost of carbon reduction. This is because many of the "cheap" reductions are time limited and cease to be available, probably on a daily basis. This effect was first articulated as

part of this project last year and is crucial both to the timing of policy change and to any assessment of the cost of carbon reductions. The adoption of a single figure and not taking into account the "lost" low cost opportunities will create greater difficulties and higher costs in the years to come.

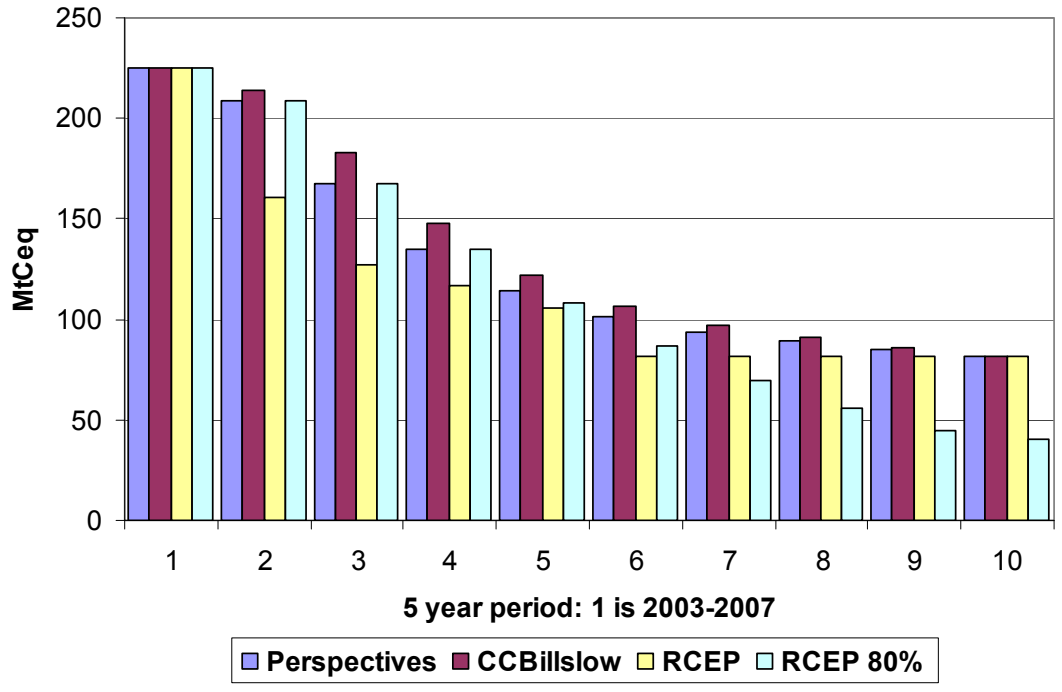
The 2050 target

Given the time lag between policy being implemented and achieving results, the RCEP preferred budget for 2008/2013 is unlikely to be a practical proposition. However, the implication for policy is that short term measures which are as strong as possible will be essential to avoid the need for even greater and more challenging reductions in future years. These must include behavioural change.

The second crucial point is that to match the total amount of emissions 1990 to 2050 which the RCEP envisaged when it suggested a 60% reduction, that target should be set significantly higher. Using an 80% target, the total amount can be matched with a more achievable, but still challenging set of five year budgets. This uses the Perspectives profile at first, but continues to reduce emissions at a similar rate in later years. The additional profile is shown on Figure 2.3 below.

This analysis suggests that, even without any new assessment of the speed of climate change or the likely damage which suggests greater reductions are required, an 80% target for 2050 should be adopted now simply to catch up.

Figure 3
Climate Change Bill & five year carbon budgets



The data on which the above is based are set out below

Table 2.2

Draft carbon budgets for transport

Period		Million tonnes Carbon equivalent			
		Perspectives	CCB minimum	RCEP base	RCEP adjusted
1	2003-2007	225.3	225.3	225.3	225.3
2	2008-2013	208.7	213.6	160.8	208.7
3	2014-2018	167.3	183.3	127.2	167.3
4	2019-2023	134.7	147.5	116.7	134.7
5	2024-2028	114.3	122.3	106	108.6
6	2029-2032	101.6	106.6	81.2	86.9
7	2033-2038	93.9	97	81.2	69.5
8	2039-2042	89.4	91.3	81.2	55.6
9	2043-2048	85.3	86	81.2	44.5
10	2049-2052	81.3	81.2	81.2	40.6
Total	1990-2052	1876.9	1929.2	1717.1	1716.8

Note: the final period is included to allow for a 2050 target
Period 1 is included for comparative purposes.
Source: Climate Change Bill; DEFRA UK emissions directory, Perspectives, RCEP

It should be noted, however, that there may be additional reasons for adopting an 80% target. In these circumstances, the profiles would have to be further revised to achieve greater reductions. This suggests that using known methods of achieving change as early as possible is the most prudent course. In transport, these also happen to be very cost effective. Examples are comprehensive travel planning which can reduce cost to individuals, resource costs and congestion; and improving load factors for road freight.

The principles which should guide policymaking are, however, clear. The value of early progress cannot be overemphasised, both in terms of risk management and in terms of cost.

Conclusions

In order to tackle climate change effectively there has to be some recognition of the failure to make progress when setting the national carbon budgets.

Without any increase in risk identified through the science of climate change the adoption of an 80% target is required to compensate for this lack of progress.

Transport should be prioritised as an area for rapid reduction for the following reasons:

- existing low cost opportunities for behavioural change
- lower impact on the less well off than other sectors such as domestic heat and power
- danger of people buying in to transport to avoid costs of reductions in other sectors.

Transport also has potential for both short and long term technological change which would contribute to the reductions in emissions in the later budget periods. There is much that can be implemented relatively quickly, although time is still needed for technology to work its way through the vehicle fleet (15-20 years). More fundamental changes in the means of powering vehicles are still uncertain and have high cost. If technology raises capital cost while reducing running cost, there could be a serious "rebound" effect and fiscal policy will have to address this issue directly. These issues are dealt with in more detail in subsequent chapters.

3 Land Use, Transport and Journey Length

The recent trends in land use have led to a growth in journey length, though not a growth in journey numbers, and in this sense people are travelling further to do the same things. This is one of the key drivers behind traffic growth and thus emissions. If journeys are shorter, walking and cycling in particular will become much more attractive. The trends are sensitive to a range of policies, especially land use (including parking controls) in combination with Smarter Choices, and are further explored below.

Land use, transport and travel choice

The market for land, and decisions about how it is used, depend crucially on transport. This is a two way relationship – transport demand arises from land use and land use patterns are made possible by the availability and cost of transport networks. However, there is an intervening factor at work - behavioural choice, in other words how people react to the many different combinations of location and methods of travel which are available to them.

Transport here is used as shorthand and must include communications. The latter was once simply a form of transporting information physically, but even in the days of the telegraph the electronic means of doing so have had a special interrelationship with transport. This is now an area of rapid growth and development, where, for example, the internet can be used for shopping or for videoconferencing. Thus the functions of a physical journey can be substituted by electronic means and the need for mechanised travel removed. Some visions of future communities suggest that people may spend more time walking about in their locality, and at other times communicating frequently over the internet with friends, colleagues and clients across the world.

The idea of enhancing local communities, increasing density and encouraging walking has underpinned the “smart growth” movement, particularly in the United States[6]. This approach has now reached the UK[7] and in many ways runs counter to the low density “garden suburb” approach favoured by some UK planners. This in turn was perhaps an over-reaction to the worst excesses of the slums created in Britain’s industrial revolution. In addition, while the intention of the “new towns” was that they would be self sufficient, they were able to use early mass public transport systems to get employees back to city centres. Later, with the advent of road transport, journey patterns became even more diverse, including people living in one new town and working in another. The same transport changes enabled development to fill in between the old radial corridors into cities, leading to the phenomenon known as urban sprawl.

The creation of the Urban Task Force in 1998 was designed to confirm the role of dense urban development, associated with planning for sustainable transport generally, and public transport in particular[8]. This was overtaken in 2003 by the Sustainable Communities Plan[9] which was less clearly focussed and indeed was implicitly criticised by the Task Force members. The main problems they identified were lack of integration with transport, lack of focus on high density urban areas,

confusing lines of responsibility, lack of quality design, and an emphasis on economic factors rather than sustainable development.

The great dispersal

The first use of low cost mass public transport was to move people out of cities to more pleasant places where land was cheap. The creation of "Metroland", to support London's industry and commerce using the Underground is a well documented example[10]. Since mass car ownership has emerged, the picture has changed. The flexibility created by car travel has not simply helped to disperse homes, the places people travel to, such as employment, education and health, have also been relocated. It has also of itself, through the space needed for roads and parking, reduced the density of development and made it harder to serve by any other means.

One of the drivers behind this relocation process is that consolidation onto one out of centre site for public organisations usually means a profitable sale of the land previously occupied in the centre itself. The users not the providers have to meet any increase in transport cost. In recent years the land has often been sold for housing.

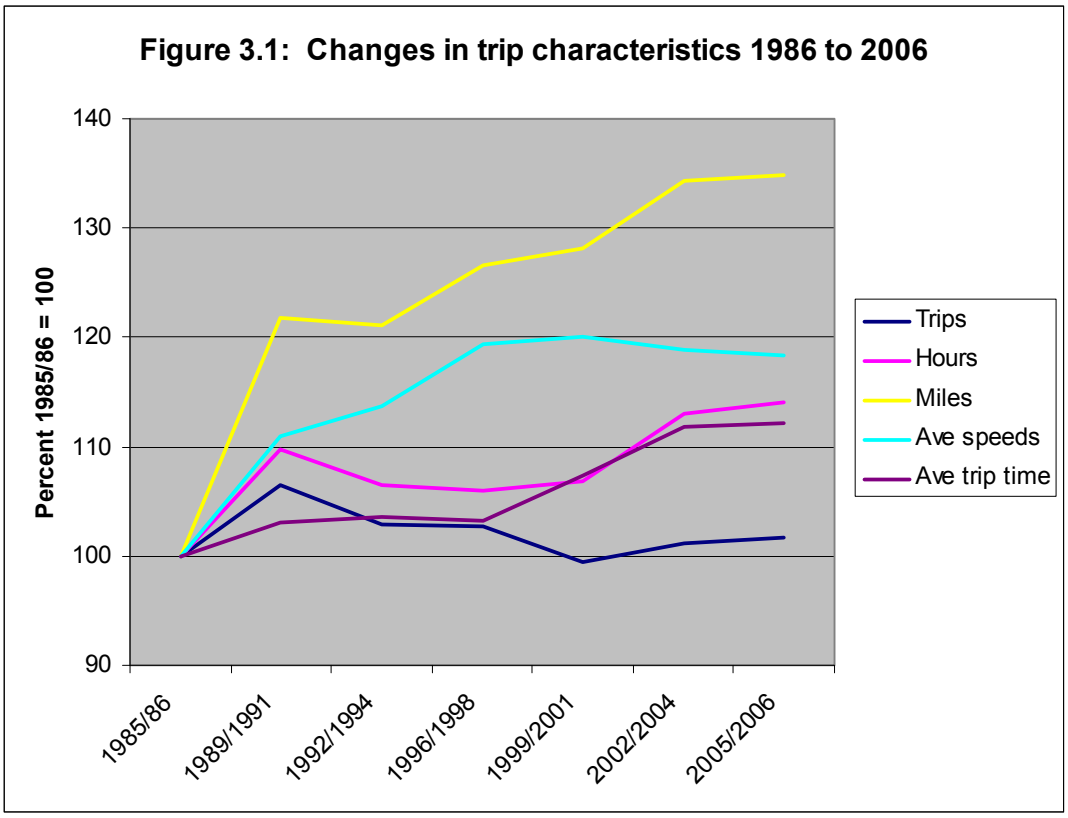
For retailers, land away from town centres has been cheap and people have been willing to drive to them and use their cars as goods vehicles for the return home. Thus it has been possible to transfer some of the costs of choosing where to locate from businesses or organisations to private individuals. Examples of this are centralising retail, leisure, health and education facilities onto sites which are further away from the people who need to use them, and which have access mainly by car.

The relatively low cost of transport and the ability to achieve savings by transferring costs to private transport has been a major feature of UK economic development. The low cost of transport has also been a major factor in the UK and internationally in encouraging distant production to replace local production. This has provoked comment on retailing subjects such as outsourcing of clothing production to unregulated sources and the phenomenon of "food miles".

The impact of dispersal on patterns of traffic

While journey lengths have grown hugely, the number of journeys has been relatively static, as has the total amount of time spent travelling. The key source of data on travel by UK residents is the National Travel Survey (NTS). This is used for a wide range of analyses, including the National Traffic Model (NTM) and the recent DfT carbon pathways work[11].

From NTS it can be seen that in 1985/86 the average number of trips was 1,024, in 2006 it was 1,037, although changes to the survey method mean that 1985/86 figure is slightly too low. Other aspects of people's travel have changed more significantly, and these effects are summarised in Figure 3.1 below.



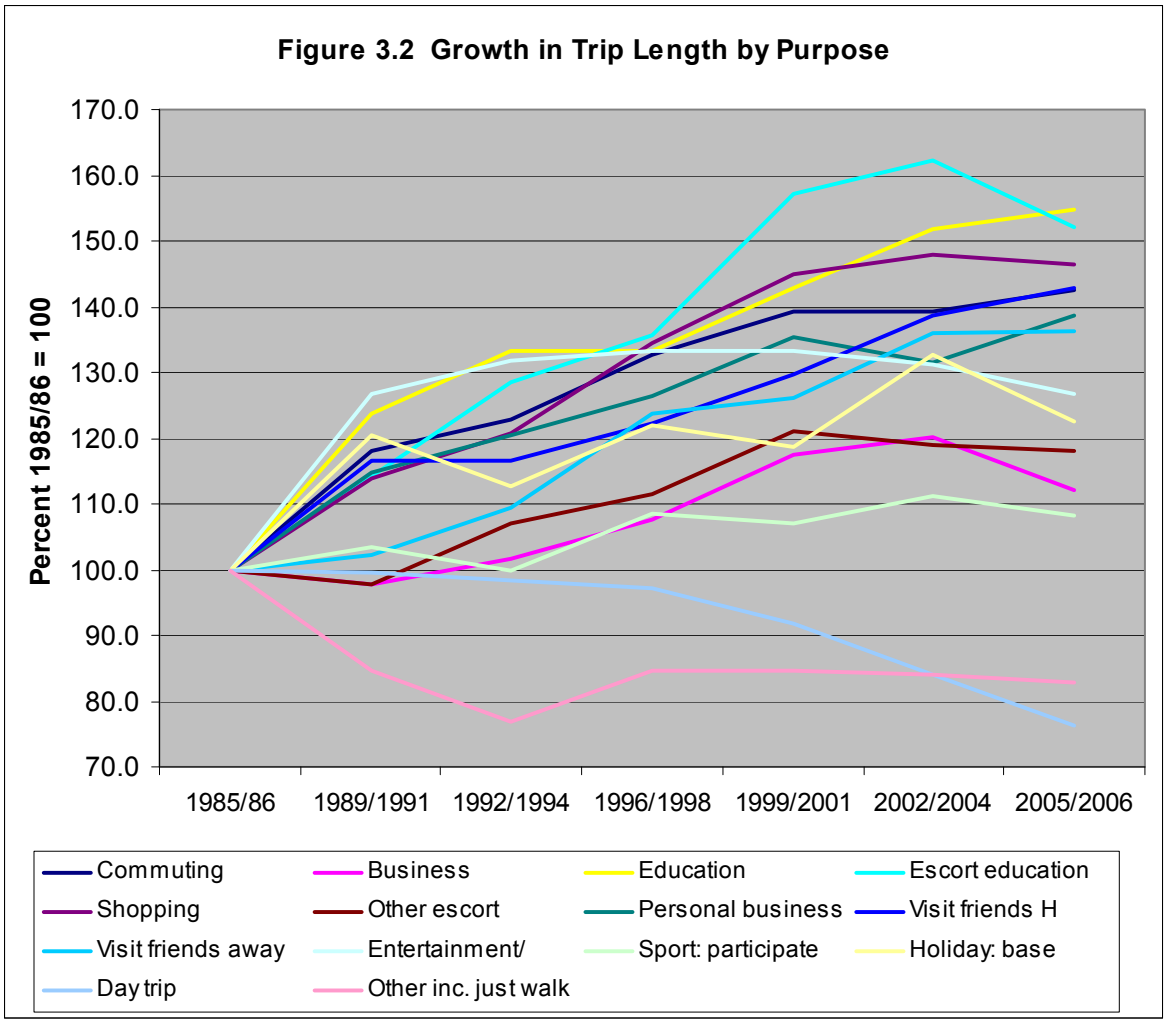
Source: NTS 1991/2001 and NTS 2006, MTRU calculations

What has happened is that for several decades car travel has become faster and cheaper[12] and of course more available as car ownership has risen. In 2006, for the first time since the recession of the early 1990s, this pattern has changed, with speeds falling, distance stabilising and total amount of time spent travelling rising slightly. The growth in trip length by journey purpose is explored further in Table 3.1 and Figure 3.2.

Table 3.1
Growth in trip length by purpose 1985/6 to 2005/6

	1985/86	1989/91	1992/94	1996/98	1999/01	2002/04	2005/6
Commuting	6.1	7.2	7.5	8.1	8.5	8.5	8.7
Business	17.3	16.9	17.6	18.6	20.3	20.8	19.4
Education	2.1	2.6	2.8	2.8	3.0	3.2	3.2
Escort education	1.4	1.6	1.8	1.9	2.2	2.3	2.1
Shopping	2.9	3.3	3.5	3.9	4.2	4.3	4.2
Other escort	4.3	4.2	4.6	4.8	5.2	5.1	5.1
Personal business	3.4	3.9	4.1	4.3	4.6	4.5	4.7
Visiting friends at private home	6.7	7.8	7.8	8.2	8.7	9.3	9.6
Visiting friends elsewhere	4.2	4.3	4.6	5.2	5.3	5.7	5.7
Entertainment/ public activity	6.0	7.6	7.9	8.0	8.0	7.9	7.6
Sport: participate	5.8	6.0	5.8	6.3	6.2	6.5	6.3
Holiday: base	37.8	45.5	42.6	46.1	44.8	50.1	46.4
Day trip	18.6	18.5	18.3	18.1	17.1	15.6	14.2
Other inc. just walk	1.3	1.1	1.0	1.1	1.1	1.1	1.1
All purposes	5.2	5.9	6.1	6.4	6.7	6.9	6.9

Source: NTS 1991/2001 Update; NTS 2006, MTRU calculations

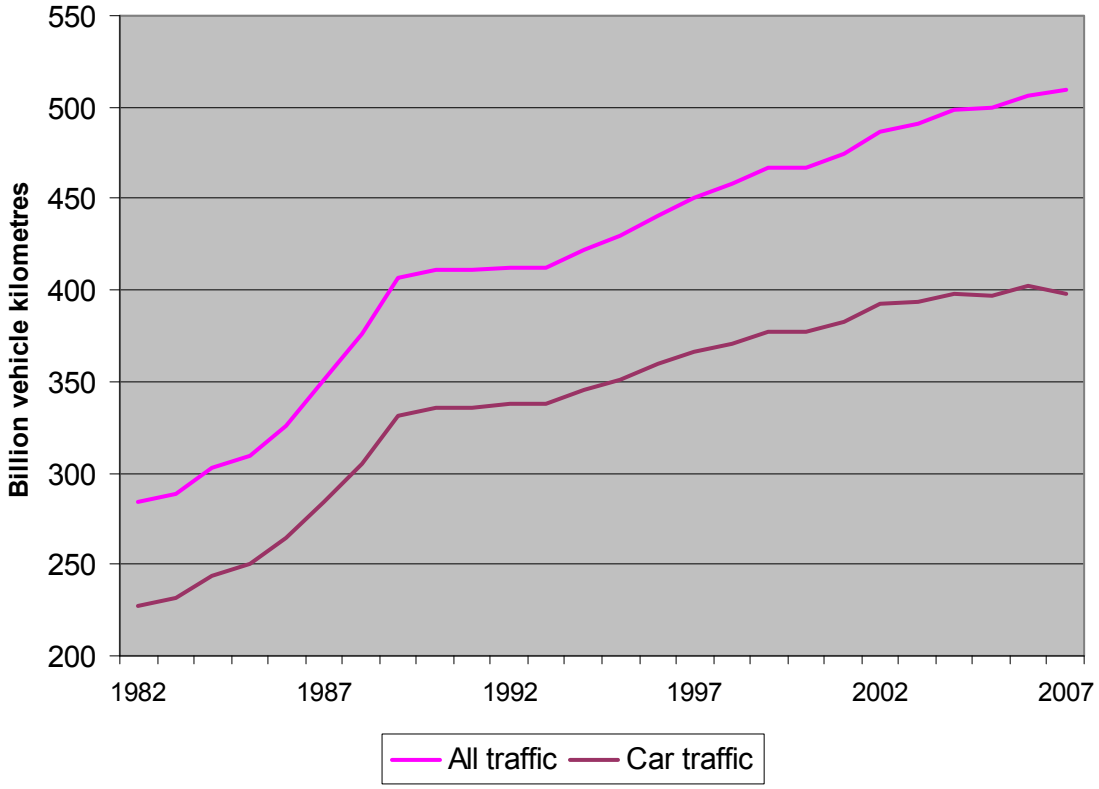


Source: NTS 1991/2001 Update; NTS 2006, MTRU calculations

At the same time as destinations have become more dispersed, high housing costs and uneven availability have diminished the importance of travel cost in the decision over where to live in relation to work or other facilities. This has also extended the distance that people have to travel to keep in touch with each other – very noticeable in the "visit friends away from home" category above. This has also added to the demand for travel. On the other hand, people without cars have seen their opportunities decline, and this has fed the desire to own one.

Thus, excluding travel abroad, people travelled 4,700 miles a year in 1975, by 1985 it had risen to 5,300 miles but by 1995 it was 6,700[13]. Goods travelled further too, and this combination produced a 39% rise in traffic between 1985 and 1995[14]. An overview of traffic growth, drawn from DfT counts up to 2007, is shown in Figure 3.3 below, together with car traffic.

Figure 3.3: Traffic growth



Source: TSGB 1986, 1996 and 2007

Thus recent trends appear to have changed slightly and there are many reasons why this should be the case. For example, it may be that as car journeys became longer, traffic has grown to the point at which peak demands on the road system create sufficient congestion to increase travel time to a noticeable extent. At this point the transport cost both to client and supplier begins to rise, although the car driving client has limited opportunity to choose different locations to shop or get healthcare. In the short term this may explain why people are having to spend more time travelling overall.

This is a simplification of a series of complex interactions which have been extensively discussed elsewhere, but underlying them all has been the growth of cheap road transport. This has been closely associated with the discounting of the cost of accessing sites which are distant from where people live. This has created both environmental costs in terms of local pollution as well climate change, and social costs in terms of undermining local communities.

Much of Government planning policy guidance (PPG) from the mid 1990s[15], such as PPG 13 and PPG6, has been directed towards slowing down or reversing the profound changes caused by this transport and land use process of dispersal. In the last few years the evidence from NTS is that this process has indeed slowed down. The potential benefits from a UK version of smart growth have recently been illustrated in "The Proximity Principle"[16] which advocates higher density, self

sustaining, walkable communities. The current plans for significant numbers of new dwellings offer an opportunity to implement this approach, rather than pursuing traditional low density planning which caters for the car.

Finally, the recent rise in oil price, if sustained, will result in a major shift in the cost of travel, in particular by car. As well as how we create local communities, this in turn will mean a radical reappraisal of the size and location of many facilities and activities which have become so much bigger, and so much fewer.

In fact, provisional figures for 2008 show a small decrease in car traffic (1-2%), almost certainly as a result of high oil prices. HGV traffic has continued to grow slowly, but this is to be expected as the renegotiation of contracts or reorganisation of warehousing to reduce distances will take longer to implement. Motorcycle and bus traffic has grown significantly, but from a low base. Van traffic has also continued to grow.

The following sections set out proposals which would support existing policies on community development, climate change and transport. These will create new patterns of demand for travel and communications and should be viewed as part of a whole package which includes the policies which support changes in travel behaviour (see the next chapter of this report). The outcome of a successful travel plan, for example, is that it will reduce the need for parking. If this is not reflected in the amount of parking granted as part of planning permission, this is simply building in an assumption of failure. It should be noted that choice and flexibility are maintained – each plan can still be different it just has to be effective. A good example of how this can work is a major headquarters development in West London, where the requirement for a travel plan was integrated with fewer parking spaces[17].

Currently the PPG13 maxima are advisory and always subject so called one off exemptions. It is difficult to estimate the impact of making them mandatory but is intended to result in an immediate reduction of at least 20% in the average amount of parking currently permitted.

Land use policy proposals

PPG13 current maximum permitted number of parking spaces in new development made mandatory

PPG13 current maxima redefined as applying to gross site area, not gross floor area

Current PPG13 maxima reduced by 1% of current level each year from 2010 to 2050

In existing developments, car parking over the limit will be charged at £50 per space from 2010 onwards, rising by £10 per year to 2050

PPG6 strengthened and clarified to focus development in town centres not peripheral locations

Minimum public transport accessibility standards set for all inhabited areas according to size of settlement and density

Development size linked to the same settlement size/density bands as for PT accessibility

Minimum development intensity, defined as ratio of floor area to site area, graded according to size – in other words large developments have to achieve high density

Clear support in planning guidance for “Smart Growth” policies for new and existing settlements, especially the “eco-towns” initiative (if it proceeds)

PPS3 revised to to include minimum residential development densities above a floor number of dwellings

New residential planning guidelines for local facilities with 3rd sector endowments rather than one off capital charges

All local plans to identify key walking routes between developments and residential zones and undertake a quality audit by 2020

Location and centralisation decisions for facilities including health, education and leisure to take full account of increased transport costs and emissions and the results of such analysis to be made public.

4 Smarter Choices and Behavioural Change

What are smarter choices?

In the last decade a series of policy measures have been developed which change people's travel choices without using large scale top down policies such as new road or rail infrastructure, or national road user charging. By definition these begin at the individual personal choices of when where and how to travel which make up total demand. It has always been the case that the impact of large scale change has been difficult to predict and part of the reason is the very personal nature of travel choice.

Within this broad family of policies there are two strands which can be identified. The first is where people, usually at home, are engaged in a process of reviewing their travel choices, identifying existing options and removing psychological or information barriers. An example would be making people aware of how a public transport service could serve their particular needs whereas previously they knew it existed but lacked the specific information which would make it a relevant choice. For some people, answering the most basic questions about what fares are and how to pay them (*Do I need the right money? Do I need a pass?*), will remove the barrier.

The second type is slightly different in that it is more purpose and destination based and people's choices about how to get there are the main focus. This enables the process to include the creation of new services which would cause a change in behaviour. This transport access package tends to be different for each location and type of person. For example, it is interesting that for employers in high tech or health industries cycling to work can be very popular. Top of the range bikes, the ride becoming part of a healthier lifestyle, doing it being a social plus, these were factors which many travel planners would not have foreseen. The positive feelings around cycling can rival and exceed those usually associated with the car.

Basics are important in this type of plan. Finding out where employees live and seeing how far their travel needs overlap can lead to new traditional and mini bus services or underpin a car sharing scheme. Guidance and good practice guides are now widely available although the quality of plans can be very variable. A draft British Standard for travel plans is now undergoing consultation. The best plans are remarkably successful and the issue is always how far places without a plan, or with a poorly performing plan, can be brought up to a reasonable level, for example, the top 20%.

The two approaches to travel planning can go on at the same time, and there are overlaps, for example where home interviews reveal a particular local issue such as a poorly sited bus stop or a poorly lit walking route. Some work based travel plans will have an effect just through raising awareness of local public transport. However, the best purpose or destination based schemes are much more proactive. The most developed plans to date have been based on the journey to work, still a major factor in greenhouse gas emissions and congestion. In fact, Smarter Choices can influence all journey types and lengths and is thus a key part

of any low carbon package. This section gives an overview of travel planning and proposals for improving its implementation. Before doing so it is important to stress that the implementation of such plans frequently lower the total transport costs for employees and employers as well as resource costs and emissions. What is required is the championing and funding of transition, followed by a lower but continuing level of support.

Workplace travel plans

Workplace travel planning evolved in the US and then to countries such as the Netherlands, arriving in the UK in the 1990s. Plans are always developing but some of the elements commonly used are as follows.

Car share: companies set up ways for people to contact each other if their journeys could be grouped together, using intranet or informal meetings. A guaranteed ride home is usually included to back up the scheme (this is not taxable). Preferential parking places and other benefits (see later in this list) can also be provided. This can address the issue of longer commuting journeys where these do not have an obvious public transport alternative. Commuting is still the largest contributor to emissions from domestic passenger transport and the potential is great, with significant existing expertise available.

Avoid the need to come to a central workplace: working at home, "hot desking" and using the technological advances in communications and the internet can avoid the journey to work, at least for some days of the week. Some argue that this generates travel during the day but this appears limited. On the other hand, studies show[18] that people regard the commute as part of the working day and this can generate extra working time. This improves any cost benefit analysis greatly .

Avoid the need to leave the workplace: Using some of the same technology as above, travelling during the course of work can be substantially reduced. Videoconferencing is a growth area[19] and has benefits in addition to reducing emissions, including business travel cost, time spent travelling and time spent recovering from international travel.

Expand/improve an existing bus service: identifying where a route is suitable for employees but infrequent, or using low quality buses, can lead to companies sponsoring new vehicles and extra services. Financial support in this case is often time limited – the improved service will become self funding. This can be combined with ticket deals for employees (see below). Bus access to premises, more convenient stops with good walking links are examples of capital spending which supports bus use.

Provide cycling facilities/support: companies provide a package consisting of weatherproof, secure and convenient parking; convenient and good quality showers and lockers; social events such as a user group or "bikers' breakfast" with senior management involvement; provision of training, maintenance advice and purchase grants (see below); including cycling in the travel allowance scheme usually reserved for car use (a tax free figure of 20p per mile has been agreed nationally).

Audit walking access: walking can be a means of travel in its own right, but is also essential for using public transport. Existing routes need to be audited and improved, but also kept clean and well lit. Some may be unnecessarily interrupted or diverted and companies or business parks and estates may be able to create a more direct network. They may also include walking routes in their security camera network.

Reduce public transport cost: While companies paying for season tickets is taxable, doing a deal with a public transport operator to give a discount is not. These can be substantial, up to 50%. Interest free loans can be useful and the loan interest avoided is not taxable.

Tax efficient bus travel: Another option both for public transport and cycling is to use "salary sacrifice" where the cost is met by the company and an amount of salary given up. This avoids tax and national insurance (NI) for the employee; VAT on bikes and equipment; and NI for the employer. It is already common for non-travel benefits such as pensions. One the first employers to offer this was Nottingham City Council[20] however the concession does not appear to apply to trams or light rail.

Green bonus schemes: Perhaps the most sensible approach would be a comprehensive financial package supporting the travel plan – giving employees a credit at the start of the year which they could use for any of their commuting options. These could include the car park, with the charge level set so that the credit did not cover the full annual cost (usually less than half). Such a scheme would benefit car sharers, cycle and public transport users, and people who worked at home or walked to work. At the end of the year any remaining credit would be translated into cash. This provides a very flexible and releases people's ability to be creative in the mix they choose – for example cycling for much of the year, mixing in car share or bus and, on those occasions when there is a powerful enough reason, using a car. Unfortunately such comprehensive schemes are still counted as a taxable benefit, despite this problem being identified over a decade ago. Free use of a car park at work is still untaxed.

Travel planning can include most journeys

It is important to note that workplace travel planning may be the best known form but comparable schemes are available across all journey purposes, and examples are given below.

Education: school initiatives such as the "walking bus"; better walking routes (improving protection from traffic, creating good lines of sight and direct routes, and even using safe call in houses en route); better cycle routes; free, secure and convenient cycle parking; properly supervised school buses with flexible routes.

Shopping: zero cost home deliveries in the local area as part of planning permission; public transport fares deductible from shopping bills; local shop reward schemes (equivalent to supermarket points); local shops used as pick up points for home deliveries (improving efficiency and convenience of home shopping).

Leisure: innovative schemes such as tickets for sporting events including free local public transport; leisure centre entry fees offering the same; free, secure and convenient cycle parking; pre-booked only car parking; deliberate policy to improve and increase utilisation of local facilities including parks, including safety.

Escort: this is a strongly growing area where journeys are too diverse for conventional public transport and where safety and security is an issue, this suggests targeted demand responsive services, for example in evenings in areas of low demand and linked to stations in the late evening.

Residential: one of the fastest growing and best known residential schemes is the introduction of car clubs. These can be "retrofitted" in many areas and provide access to car use without creating the perceived virtual zero cost of marginal car travel. This leads to a wider range of choice and lower car traffic overall[21].

Point of sale advice: the use of internet purchasing could automate the process of providing travel advice, for example buying a flight involves entering a postcode and this could be used to provide advice on how to get the airport and offer a discount on sustainable modes. At the moment marketing appears to be limited to car hire. Travel advice websites currently focus on specific journeys, more general advice is sometimes needed, for example visiting an area for a few days either on holiday or to see friends or relatives.

Understanding the journey: for all purposes, understanding the nature of the journey is important, for example shopping may require suitable bus access for bags, trolleys and buggies; travelling on holiday may need ease of interchange between short and longer distance public transport and removal/avoidance of obstacles such as stairs.

Current models simply ignore travel planning

The impacts of travel planning schemes are well documented in relation to work, with a set of research reports and good practice guides published by DfT in 2002[22]. From the mid 1990s there has been detailed information available from individual examples, and support from voluntary associations of different workplace practitioners[23], there are currently Government sponsored networking[24] and major organisations which disseminate good practice and promote workplace travel plans[25].

In 2004 an overview report was prepared covering a full range of travel planning options for DfT[26]. This found that overall a high intensity policy in this area would result in a 15% reduction in car travel overall and 24-26% reduction in peak periods in urban areas. It is the standard DfT reference work on smarter choices for policy making and appraisal.

Despite this, there has been no attempt to reflect these findings in transport models, neither those used for road traffic or road building schemes, nor the DfT's National Traffic Model (NTM) which is used for all transport forecasting. There is currently some work being undertaken by DfT to consider how to model smarter

choices. However, the problem remains that the impact of such policies has been hugely underestimated at the national level because of this omission in the methodology. On the other hand, practitioners at the local level have had to make estimates and have used simpler methods, some of which are described below.

Trip matrix approach

- Benchmark values for the impact of smarter choice policies are derived from existing studies for different journey purposes.
- A level of penetration is assumed related to amount of money spent (again using existing studies).
- Factors are applied by journey purpose for zones where the policy is implemented.

This is often confined to the journey to work, but does not have to be. For example a videoconferencing package can influence work based trips. The problem with leisure or shopping equivalents is getting enough good data to create reliable benchmarks.

Mode choice penalty/reward

Penalties are often present in models where generalised cost comparisons might suggest a higher use of public transport, or even walking and cycling. Removing the penalty can be interesting as a way of assuming the persuasive power of personalised travel planning.

It is also possible to test out a reverse mode penalty (i.e. a bonus) to see what level is required to make change. Policies can then be put in place to create the bonus effect. This can be supported with interviews/survey work with potential switchers. The use of positive mode penalties is common for rail and LRT schemes.

Detailed flow studies

It is possible to do work on predicting possible change at a far greater level of detail by looking at flows which are very specific in terms of either location or purpose or both. These will tend to have at least a clear destination or origin and be more accurately timed and costed than a simplified transport model based on zones and limited road and public transport links. Walking and cycling is not usually included in such models. For example, this can be used to design bus and cycle links to business areas, industrial estates and airports, and how to market them.

While undertaking this process, it is possible to find some non-car based offers which are already very good and people just don't know about them or there is a specific obstacle to be overcome.

Again benchmarking can be used to derive a high/low forecast, or make the alternative offer very attractive and very well publicised.

Conclusions

Smarter choices have more reliable data on their substantial effects than many aspects included in everyday modelling. Generated traffic is an example which is

included through technical formulae but is in fact subject to wide variations. Despite data being available for some time, behavioural change has thus been hugely undervalued in the cost benefit appraisal of individual schemes as well as national policies. In particular its impact on climate change and its cost effectiveness have been very seriously underestimated, both by DfT and DEFRA.

The combination of land use policy, parking provision and smarter choices is a coherent and powerful policy package. It is now possible to return to the previous section and produce an overview of how this combination could work. It also reveals the modes which need to be improved. A schematic view is given below.

Table 4.1
Summary of main responses in land use and smarter choice package

	▼ Smarter choices across all journey purposes ▼ encourages mode switch and e-subsitution						
	Work	In work	Shop	Leisure	Eductn	Escort	Visit F/R
Walk	✓	✓	✓	✓	✓	✓	
Cycle	✓	✓	✓	✓	✓	✓	✓
Bus	✓	✓	✓	✓	✓	✓	✓
Rail	✓	✓		✓			✓
Car share	✓				✓		
E & Home Substitution	✓	✓	✓		✓		
	▲ Smart land use enables working closer to home ▲ + businesses closer together + improves local facilities, thus reduces trip length and enables switch to walking and public modes						

How much impact could be expected?

The key issue of a combined package is the assessment of what the potential could be. Given the willingness to change of some of the current car drivers (see the car section) and the power of limiting destination parking at the same time as providing a wider range of attractive alternatives, partly designed by the potential users, the high intensity estimate of the current DfT report seems too modest. Rates of development and redevelopment are hard to predict but are usually in the range of 2 to 4% per year. By 2020 this would mean a changeover of around 30% and by 2050 most major developments of today would have rebuilt at least once. For example, there are very few large leisure centres, warehouses, retail outlets or office blocks around today that were constructed in the 1960s and have not been either replaced or rebuilt.

Leaving to one side the uncertainty over visits to friends and relatives and holidays, 70% of car passenger kilometres would be affected, and they represent 76% of emissions from cars[27]. The combined impact of standards for new development, the use of "smart growth" urban planning, the introduction of parking space charging, and the high intensity improvement in alternatives to car travel and their marketing is designed to constrain traffic growth to current levels and go on to achieve reductions. Allowing for growth, this could be x% by 2020 and around y% by 2050. This does not allow for the impact of the oil price being significantly higher than $80, or for any improvements to public transport (short and long distance) outside the land use and travel planning package. These are considered in later chapters, following on from the consideration of the impact of changes to vehicle technology.

Policies for behavioural change

A national funding scheme for smarter choices would be established deploying £200million a year for 10 years with a phased start up. It would be open to any organisation to deliver the programme, with encouragement to local authority, third sector and commercial partnerships.

Programme to be purpose based with specific initiatives for:

shopping: (including home delivery, local collection centres, local outlets, local sourcing)

schools: (including walking and cycling initiatives but with school safety zones and non-statutory school bus initiatives in rural areas)

workplaces: (including established techniques to encourage video conferencing, car share, public transport, cycle and walking, new green cashback scheme exempting up to £300 per employee per year if paid into approved scheme)

leisure: build on existing entrance/public transport ticket, as well as range of access improvements by sustainable modes (also see planning guidelines to create more local facilities)

Long distance in UK travel & communications initiative for business – looking at ease of planning and booking journeys, identifying obstacles through pilots, £50million over 3 years leading to specific scheme.

5 The role of vehicle technology and low carbon fuels

While the previous section looked at changing behaviour, a tremendous amount of effort has been expended by Government (in the UK and elsewhere) on analysing how the efficiency of vehicles, especially cars, could be improved. This section draws on this body of work, but adds some sense of proportion as to what can be achieved, both in terms of the emissions from cars bought in any future year and in terms of how long this takes to work through the total number of cars owned.

The costs and benefits of using a car, and its place in meeting travel demand, are considered in a later section. This includes policies which would improve conditions for motorists, while reducing overall demand.

To put technology in perspective, there are about 27 million private cars in the UK at the present time. It takes about 15 years for most of them to be scrapped, but some are still around after 20[28]. MTRU uses a spreadsheet model based on such data to estimate how changes to new car emissions would work through the fleet and this produces comparable results to DfT published target dates. It provides a reasonable "top down" prediction of how long an efficiency standard such as the EU target for new car sales takes to have an impact. At the moment this is 130gms per km by 2012. The UK Government is pushing for a tough follow up target of 100 gms/km by 2020.

Top down EU targets

In the consultation document on options to achieve the EU 130gm limit[29], some of the problems of adopting isolated policies on emissions reduction reveal themselves very clearly. Because manufacturers of large cars would have to make draconian changes to meet a fixed limit, while those who make small cars would only face modest targets, the Commission has proposed a complex formula based on vehicle weight and applied to each manufacturer individually. This is the fairest approach for car companies but also creates uncertainty for them because their target may change according to what cars people buy. In addition, a general shift to buying heavier cars would mean missing the target, so the Commission proposes an adjustment using something called the "autonomous mass increase" – **AMI**. This means that if the average mass of all vehicles sold in the EU goes up, every manufacturer's target will be tightened. This has the effect that targets for each manufacturer will depend on purchasing patterns across the EU.

The complexity and uncertainty of this proposal illustrates the problems of not pursuing an integrated approach. The key omissions are:

- lack of a clear fiscal framework to support the limit
- no account of the interaction with demand management and mode switch options
- no estimate of how the balance between small, medium and large cars might change
- failure to understand how averages can fall in the context of growth in total car sales.

The total emissions depend crucially on the average efficiency of the whole car fleet and how far each type of vehicle is driven. This is only indirectly linked to the average for new cars sold. Setting this target has to be accompanied by national Government actions on use and monitoring of the impact on the total fleet.
If manufacturers as a whole fail to achieve the target (which is for an EU average of 130gms by 2012), then they will pay a fine. The EU proposal for the level of fines is in the following Table.

Table 5.1
EU proposed fines on manufacturers per car sold

	2012	2013	2014	2015
Penalty per gm/km over target per vehicle sold	€20	€35	€60	€95

Thus the key to the whole system is how much it costs the manufacturers to achieve the target and whether they would pay the fine. The fines would go to the EU budget, although some argue that they should be divided up according to the sales in each individual member state. For example, if car sales in several countries show a sudden move towards heavy German models, the German car company would be fined and if the money went to the EU a significant proportion of it would go the countries which had caused the target to be exceeded.

At this point it really should be asked whether it would better for all states to agree the EU target and apply a gradually increasing sales tax to make it worthwhile adopting the new technology. This would probably have to be set just above cost of adopting it and could start low. The important point is that it is the mass of cars sold (which are currently within 20 gms each side of the average) which need to be influenced. This is quite clear from the SMMT annual reports on car sales and efficiency. Applying a sales tax does not require the annual bureaucratic adjustment in response to an unregulated market proposed by the Commission. It is quite likely to be needed anyway.

Perspectives put forward a detailed proposal for the UK market and there is no reason why such a scheme could not be used or adapted to support the EU target. Translating it into the EU consultation framework is illustrated in the first row of Table X below. The rest of the Table shows the EU proposal and the original from *Perspectives.* It should be noted that the latter used a moving average to allow for a gradually phasing in of the approach.

Table 5.2
Penalty per gm/km over target per vehicle sold

	2010	2011	2012	2013	2014	2015
MTRU sales tax, in line with EU approach >130	€5	€10	€20	€40	€60	€80
EU consultation proposal for fines >130	0	0	€20	€35	€60	€95
Original MTRU sales tax (moving average)	€75 >160	€75 >155	€75 >150	€75 >145	€75 >140	€75 >135

To translate the fine/tax regime into a real world example, the following Table shows how much in total a car emitting 160gms/km would be charged. This should be the average new car level in 2009/10.

Table 5.3
Tax or fine for car emitting 160 gms/km

	2010	2011	2012	2013	2014	2015
MTRU sales tax, in line with EU approach	€150	€300	€600	€1200	€1800	€2400
EU consultation proposal for fines	0	0	€600	€1050	€1800	€2850
Original MTRU sales tax (moving average)	0	€375	€750	€1125	€1500	€1875

The revised approach allows for better phasing, for example low cost improvements are worthwhile at an earlier stage. The original approach appears tougher on larger cars in the early years, but they tend to be much more expensive. A similar approach should be used to move towards the UK proposed target of 100gm/km by 2020. The original proposal was also that VED should be at a lower level than is currently proposed by the UK Government, and this is still supported if the sales tax were to become more substantial (as above).

Rebound effects

One of the problems with making vehicles more efficient is that it reduces the cost of driving and thus generates more traffic and encourages less fuel efficient driving techniques including speeding. Thus the improvement needs to be balanced with a rise in fuel price. Given what has happened to the price of oil, including a trebling within 12 months followed by a halving in six months, and the undoubted fluctuations that will occur in future, this creates a serious problem for the transport policymaker.

For example, if the price of oil had taken a one off rise in price it might be possible to reduce fuel duty (including for rail, heating and other uses) by a modest one off amount to reflect the immediate and unexpected pressure. The duty escalator could then be set to recover the amount rapidly in the next few years, and then exceed it. This would allow people more time to adapt to the high oil price, both by choosing to buy more efficient vehicles but also by reducing the carbon intensity of their transport/communications activities.

It is, however, the case that driving techniques, including observing the speed limit, can produce immediate savings of up to 10%. Avoiding the least necessary journeys is another option which has low cost, can be done very quickly, and becomes attractive at high fuel prices. Thus a rise has the effect of reducing emissions at relatively low cost.

For this reason, and the high degree of volatility of the oil price, if any reduction in fuel duty were to be made, it should be modest. The Chancellor has postponed

the increase of 2p and a further 2-3p from duty should not diminish the behavioural change benefits while providing some relief. However, this would have to be accompanied by a steady increase which would recoup these amounts quickly and go on to raise the price of fuel each year to 2020. This would put it back in line with the efficiency improvements, both avoiding the rebound effect and further encouraging the purchase and use of the most efficient vehicles. There remains the not insignificant issue of how any such reduction would be funded, although a one off windfall tax on oil producers is an obvious possibility, if politically contentious.

The problem with this is that oil prices are likely to be volatile, because supply and demand are so closely matched if the world economy is growing, even slowly. Thus, if a high price reduces demand the resulting over supply will lead to a fall in price which may then cause a bounce back in terms of demand and thus price. However, there has been a major consumer shock which will influence vehicle purchase and use and it is quite likely that the oil price would have to fall significantly and stay low for this to be mitigated. The world economy is also almost certainly in recession. This is likely to cause a fall in oil price.

A more responsive approach which varies fuel duty in line with the oil price would avoid such problems but is both complex and the level is unknown. There is continuing discussion over schemes such as the fuel "regulator" or "stabiliser". There are many problems with such an approach. For example, it is unlikely that it could respond fast enough to the current market changes. There are issues over international purchasers of fuel. The exact cost is unpredictable and likely to be high. Another major drawback is that once established it would be easy to manipulate and it would very unfortunate if people were given a false impression that future rises would always be compensated for. For this reason, if any further alteration to fuel duty is made, it should be on the basis of a one off delay, followed by rapid restoration of a rise designed to keep pace with improved vehicle efficiency. Overall, such an approach is not recommended in the report.

Possibilities for vehicle efficiency improvement and biofuels

Short to medium term

There are many "near to market" vehicle technologies, including:

- efficiency improvements to existing engines;
- various hybrid options
- stop/start, which stops the engine when the vehicle is stationery;
- reducing car weight;
- regenerative braking;
- reducing tyre rolling resistance.

In the short to medium term the highest efficiency cars would probably have to be hybrid vehicles and models are now being planned which could also be plugged in to domestic supplies overnight. The analysis in *Perspectives* revealed the policy implications of high levels of hybrid use. The greatest benefits are in congested conditions and over 50 mph there are diesel cars which are more efficient[30]. This means that mode switch is probably more important for longer distances but also

that road user pricing based on congestion would not be well targeted towards climate change. Fuel duty is more effective in this regard. The issues of the major change in the pattern of fuel consumption – meaning that low speeds are for more fuel efficient than before - are explored further in Chapter 12.

There is currently much interest in the plug in hybrid vehicles or PHEVs. These would be charged up overnight from the domestic electricity supply. This charge would be used for the first 10 to 40 miles of travel. After this, an efficient small engine will take over, either working with electric motors or charging the batteries. Examples of this are the Prius+ (a conversion) and the Chevy Volt, which is due to be launched in two to three years time. Electric power can reduce city pollution levels, particularly for shorter trips, but for this to become the standard for all cars, some questions have to be asked about the new source of power – in the UK this is the National Grid. This is discussed in more detail below. There are also serious issues over design and supply of suitable batteries.

Long term options

In addition to "near to market" technologies, for example engines which stop when the vehicle is stationery, or super efficient "2nd generation" petrol engines, the long term vision for car travel appears to be based on electrically powered vehicles, either directly using batteries or indirectly using hydrogen fuel cells. There may be hybrid battery/fuel cell options.

Biofuels may play a part but have lost ground recently in the futurology stakes due to the high land use emission costs. The Gallagher report, for example, found that a UK wheat to ethanol scheme which ploughed up grassland would take 72 to 123 years to have a climate change benefit. If a UK forest was replaced, the payback time was 293 to 514 years. Gallagher in fact recommends a cut off point of a 10 year payback. Very few schemes across the world would meet this criterion.

This is without the issues of pressure on land for food purposes, or for local power generation. The latter has better payback because there are lower processing and transport costs. None of these schemes are properly assessed against the alternative of growing new forests for carbon capture instead of crops for biofuel, although the implications in Gallagher are that this would be cost effective. The analysis in *Perspectives* showed that planting trees rather than biofuel crops was in many cases better for the climate.

This may all change if 2nd generation biofuels have a very different profile. Examples are the gasification of biomass (Fischer Tropsch process) to produce power and synthetic diesel, or if there is a breakthrough such as oil producing algae on a mass scale. Again these will need to be properly assessed in terms of land use effects and alternative uses.

In terms of vehicle technology there are many assumptions and unanswered questions in the recent analyses of future vehicle technology, as well as the underlying issue of power generation. Without describing them all in detail, the key areas of uncertainty are:

Batteries:

- Can they achieve a high power to weight ratio?
- What is their production and scrappage emissions profile?
- Are there any commodity bottlenecks?
- How long will they last?
- What are the safety issues?
- How much will they cost?

Biofuels:

- Will the 2nd generation fuels (such as gasified wood or oil producing algae) be practical on a large scale?
- How much damage will the dash for biofuel do to existing carbon sinks (pasture and forests)?
- How much will 2nd generation fuels cost?

Fuel cells:

These have all the same issues as batteries, plus

- the cost of providing a completely new infrastructure for supplying roadside hydrogen under high pressure.

The conclusion for this report is that the uncertainty surrounding the longer term, technology based, panaceas mean that short to medium targets and actions should not be postponed. One of the uncertainties is illustrated below.

The electric future: implications for electricity supply

This next section does not go into the intricacies of grid capacity, power losses, battery charging losses, need for residual charge etc. It simply explores the issue of how a reasonable estimate could be prepared for how much extra power generation would be necessary, if any, to replace current petrol or diesel engines.

There have been several studies, in the UK and the US, on how many electric vehicles could be supported by the existing electricity generating systems. For example, calculations can be made of how much power is needed to drive a vehicle 20 to 30 miles (an average daily distance), and thus how big the battery needs to be. From this, the charging rate and time need for charging per day and per year can be calculated. This provides the power requirement. Alternatively an average miles per kilowatt hour for a typical electric vehicle can be used and applied to the annual total for distance driven. It is immediately apparent that calculations based on such a high level of averaging and the implied very consistent daily driving behaviour do not reflect real world driving patterns.

A short range (first 10km) plug in hybrid would probably have a battery of 9 kilowatt hours capacity – in other words to charge it would take the equivalent of boiling four and a half kettles for an hour, plus whatever is lost in charging up the battery. The Prius+ conversion is of this type. The Chevy Volt (due on sale 2010) is currently designed with a 16 kilowatt hour (kWh) battery although they are still being tested. An electric vehicle without a supporting internal combustion engine would need at least 50 kWh (the Tesla Roadster has 53). As might be expected with new technology, the launch dates for these cars have been delayed so real world energy consumption data is scarce.

The National Grid operates with reserve capacity to allow for bringing power stations on line, repairs, breakdowns and excessive peaks. Overall the theoretical capacity is just over 70 thousand million watts (70 Gigawatts). In 2007, the usual winter peaks in the UK were around 55 Gigawatts, in summer about 40-45 Gigawatts. Overnight, demand falls to around 20-22 Gigawatts.

If the UK system were run at peak levels every day of the year, about 480,000 Gigawatt hours are available per year, or 1,320 per day.

Taking total car and taxi kilometres, it is possible to calculate how much power is needed. This in turn depends on size of car and performance. Using industry standard values between 64,000 and 80,000 Gigawatt hours a year would be needed, assuming zero loss battery charging. This is about 13-17% of total capacity or 16-20% of total annual electricity demand in the UK. This calculation appears to be the basis for assertions that the impact on power generation would be modest.

However, there are several critical assumptions underlying this calculation. One is that car travel demand is even throughout the seven days of the week and for every week of the year. This is clearly not correct. The second is that people will want to recharge their vehicles at exactly evenly distributed times of the day. In fact, a large number of people are quite likely to want to recharge their batteries, even if only partially, at more or less the same time, for example when they get home from work. This is exactly when peak domestic demand also begins.

Looking at another way, the 27 million cars in the UK at 50 kWh each per day would need about 1,350 Gigawatt hours to charge them all up, although not all of them would necessarily need a full charge. Over 24 hours, the existing capacity could almost cope with this demand, but nothing else. In fact, most studies suggest off peak charging (midnight to 6 am). This immediately has the effect of inflating the impact of car charging fourfold. The six hour capacity of the system is 330 Gigawatt hours, less than a quarter what is required. The night time consumption for other purposes is also needed, about 130 Gigawatt hours. It seems unlikely that all cars will need fully recharging, so if only half charging is needed this would bring the requirement down to about 2.4 times the current power generation capacity. This figure is based on the same data that also produces the 16% extra load which is often quoted.

However, even if the cars do not need fully charging, there would be a serious problem if every car owner decided to plug in the car charger at the same time, or even within the first two hours of the off peak charge period. Assuming an 8 kilowatt charge rate (six hours to charge the all electric car) and half the cars plugging in within two hours of each other, this would create a peak power requirement of 108 Gigawatts, added to the base off peak load of 22. This would again create a need for 2.4 times current capacity but it is independent of the amount of top up charge required. To leave a decent margin of error, perhaps the risk of 80% plugging in within the same 2 hour period should be catered for, requiring 3.5 times the current capacity.

A major US study[31] considered the energy needs of plug in hybrids, rather than full electrification, and that, for initial capacity calculations, the demand to recharge them was spread evenly over 24 hours. It set out the major impact of restricting the charging period to over night[32]. It also assumed that coal fired power stations usually used for peaks would be run all night.

Adjusting their figures for full electrification and a 6 hour charging period, this study would in fact only allow for 5-10% of US light duty vehicles to be supplied using the existing system. This is in line with the six hour results in the above calculation for this report, but rather different to how this study is often quoted[33] – that 70-80% of all US cars could be electric without the need for extra generating capacity. It does not address the peak load problem.

It should be noted that the recent SMMT workshop on electric vehicles, with a goods and car manufacturer leading discussion, concluded that such long charging times were not acceptable.

"Even recharging through a conventional 35 amp three-phase supply is a bit like trying to refuel your car with a hypodermic, because the energy transfer rate is so low," said Simon Thing, engineering director at Lotus. Most domestic electricity supplies are a factor of magnitude below that capacity"[34].

In the UK analysis, it should be noted that no allowance has been made for traffic growth, so that by 2050, the electricity capacity would have to be significantly greater. Nor is there any discussion of the ability to park cars close to a personal or public charging point for the required time. In urban areas, the number of charging cables crossing pavements could be a major problem. Urban delivery vehicles which return to base overnight may be the more feasible option.

Thus, in order for the all electric future to come about, there are two important conditions. Either the generating capacity has to be increased several times over, or the charging times of individual cars would have to be managed very closely. They could, for example, be pre-booked, or not permitted, as the peak operating load was approached. This would require new technology in the vehicles but in the longer term is probably feasible. This would, however, limit the flexibility and availability of car travel to a huge extent. Alternatively the capacity of the electric fleet could be limited.

Thus the ultra low carbon all electric option for cars in 2050 does indeed exist. It may, however, require a four fold increase in power generation between now and 2050 and this must be very low carbon. Given that we will have to replace about 35-40% of our existing capacity by 2020 and have problems in doing so, the all electric option clearly needs some further work.

It should be noted that the equivalent for fuel cells, with hydrogen generated through electric power, would probably need significantly more power due to system losses, but would be more capable of load spreading. On the other hand, completely new infrastructure for the pressurised hydrogen would be required through out the UK.

The overall conclusion is that future technologies need to be considered with considerably more care and caution and that at an early stage of development major problems are often underestimated or not identified at all. What is most likely is that a package with different technologies could make a contribution to emission reductions, but this would be much more limited in its impact than the total decarbonising of road transport, even by 2050.

Given the importance of total emissions between 1990 and 2050, and the poor record of reductions so far, technology can and should make a contribution. Using the MTRU spreadsheet this could amount to around 25% by 2020, assuming complete achievement of EU targets and the new 100gm/km limit suggested in the King Report. Even before the current slow down in new car sales, this was an optimistic assumption. Allowing for traffic growth, this would amount to a total reduction for cars of about 5%, very similar to the DfT's assessment.

Thus there is nothing so far that suggests that efficiency improvements to cars will remove the need for significant behavioural change in the transport sector.

Policies for technological change

First year charges on cars related to their level of emissions to increase annually to 2020 and applied per gram above an efficiency reference level, at least 130 in 2012, 100 in 2015 and 90 by 2020.

Efficiency reference level to rise annually as technology becomes available and thus the charge on less efficient vehicles will also rise in real terms.

Air conditioning and other power consuming devices to be included in gms/km calculations.

Vans brought within car standards scheme.

Fuel duty to rise in line with predicted improvements in efficiency to avoid rebound effect.

VED increases to be slowed down as the least effective means of changing purchasing behaviour.

6 Local transport: Walking

Walking is the most fundamental mode of transport and is essential to access all other modes. For shorter journeys it is the mode of choice – 78% of all journeys under a mile, and 56% of all under two miles, are on foot. Replacing car journeys with walking is beneficial for the environment, reduces congestion and helps keep people healthy.

A key argument about walking policy is that, while worthwhile, journeys are short and thus of low significance, with a low impact on carbon reduction. This has been the subject of considerable discussion and it is still worth running through the reasons behind the inclusion of walking as an important element in the national policy package.

Long was once short

The section on car use shows how much average journey lengths increase when they are transferred to motorised modes, especially car. This is because the choice of destination tends to change at the same time as car ownership grows, enabling people to travel further in the same time and at low marginal cost. It is extremely difficult to unravel the interlocking elements which undermine walking, for example:

- land use changes (fewer, larger facilities)
- car use changing choice (longer distance for the same journey purpose) and
- worsening conditions for walking (due to traffic itself but also to designing streets for the car).

The combination of policies set out for land use and the financial recycling of eco-revenue will create and encourage shorter travel distances for many activities. The cost of car travel is also bound to increase. As the journey distance necessary to fulfil a particular purpose, for example shopping, decreases, walking (and cycling) will become the mode of choice. It already dominates people's choice of travel mode at distances below one kilometre.

A further element in walking policy is the quality and interest value of the environment. Swiss studies show that people are happy to walk further when conditions are safe and have a variety of activities along the route. In terms of townscape this could mean the type of shopping centre where there are peripheral smaller shops, good planting and public art on the routes to and from housing.

Sight lines are important as are the removal of barriers. This vision of an interesting place to walk through has been missing in many developments, although recently there have been good small scale examples of treating areas leading in to fully pedestrianised spaces, for example Winchester and Bristol.

Thus the issue is how many journeys could become shorter and switch mode at the same time, precisely the reverse of what has happened in the recent past. This is why walking conditions and quality are still central to any transport policy to reduce emissions, or indeed to reduce congestion.

Understanding walking

In broad terms there are four different types of walking which are important for any transport strategy. These are:

- carrying out a whole journey on foot (for example home to shops)
- walking to get access to public transport (for example to a bus stop or station)
- walking as an important activity in its own right (for example meeting in the street, window shopping)
- walking purely for pleasure (for example in the countryside, through urban parks, places of cultural or historic interest).

New methods for assessing how "walkable" urban spaces are at the present time, and how they can be improved, have been developed and need to be brought into the centre of the new policies[35]. Many of these consider line of sight, streetscape, and the level and variety of activities en route, all of which are important to people when they choose whether or not to walk and decide how far they are willing to walk. Local authorities and national Government will be able to use these techniques to design and bring forward a programme of improvements which will range from local access to workplaces, shops, stations, and bus stops to pedestrianisation of key public spaces. The shorthand term is the "permeability" of public and private space. This means both the removal of obstacles and the positive provision of good walking conditions.

Overall the issue is to create what one study called the five "Cs"[36]. Walking should be:

- **Connected** - easy to travel between places without obstacles
- **Convenient** - direct routes and line of sight, no detours
- **Comfortable** - smooth well maintained footways, no steps, wind tunnels or sun traps, good lighting
- **Convivial** - friendly, busy streets which are interesting to walk in, meet people, go shopping or sit down
- **Conspicuous** - easy to read street and "you are here" signs, clear names including bus stops and shops

Walking and health

It is not the task of this report to measure the health benefits of walking and translate them into quantified monetary benefits. There is consensus enough that walking and, to an even greater extent, cycling, are the two modes which have the unique quality of benefiting human health[37]. Establishing exercise each day through walking or cycling as a means of travel would make a significant contribution to improving health, not only increasing people's well being, but saving money on healthcare and improving productivity.

The issue here is how to encourage its incorporation into everyday life and to make conditions safe, mainly from motorised traffic.

Encouraging walking as transport

Very modest increases in spending, together with more developer funding and commercial partnership and a new integration of local authority efforts could result in a steady and measurable improvement.

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. This is likely to involve reappraisal of crossing positions and timings. The concept of negotiable space, where eye contact is made between driver and pedestrian needs to be fostered by slower speeds and wider use of non-signalised methods. This includes maintaining zebra style crossings and increasing their number as well as raising street entries and removing guard rails. Schemes such as Kensington High Street have made a significant start in this regard.

One problem here is the assumption that bus priority means replacing zebras with signalised crossings, particularly in High Streets. This should be avoided wherever possible since it has an adverse effect on walking conditions and either encourages dangerous crossing not at signals or reduces footfall and thus the economic viability of the centre. Everyone taking the bus to the shops has to get off and walk around the centre. Not everyone walking came on the bus.

The second is to look at the other end of people's journeys and analyse conditions for walking around the key places which 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 which 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 come 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 attitude changes after dark, when security concerns become important[38]. The current change from summer time in October exaggerates the impact on walking and is counter productive in terms of road accidents[39]. The change was instituted a long time ago to allow early morning agricultural activity in natural light. This is no longer appropriate, and organisations such as ROSPA support a three year trial of setting clocks an hour ahead of the present system (single and double summer time – SDST). They estimate that this would save 104 to 138 road deaths a year[40].

Walking in its own right

Returning to the original analysis of the different purposes which walking can fulfil, one key element which has been the subject of changing attitudes in Government, and in the transport and urban design professions is the functioning of local streets. As the base mode, walking is critical to the social activity of residential areas and the commercial activity of town centres. For example, footfall is a key factor in retail turnover.

The Commission for Architecture and the Built Environment (CABE), English Heritage and the Institute of Highways and Transportation co-operated in the "Streets for People" meetings in 2004-06 and subsequent report[41]. Both have continued work in this area, including professional training and development[42].

Government guidance for local streets was also revised in 2007[43] and this reflected the significant reappraisal of the importance of walking in local streets. It does not, however, apply to trunk roads. It contains the following hierarchy, which in turn reflects in particular the work undertaken in the city of York in the 1990s.

Consider first	**Pedestrians**
	Cyclists
↓	**Public transport users**
	Special vehicles (e.g. emergency, waste)
Consider last	**Other motor traffic**

Source: Manual for streets, Table 3.2

This strongly supports the proposals about walkability contained in the land use chapter.

Streets and main roads

As mentioned above, the Manual for Streets (MfS) does not cover trunk roads and this raises the long running debate over how far local areas can be improved while allowing other roads to be prioritised for motorised traffic.

The implications of most of the work leading up to MfS is that networks between places such as residential streets, schools, shops, open space and other activities are just as important as the areas themselves. This brings together policies for walking as a mode of transport, and walking in its fundamental role in sustaining local communities. The two are clearly interlinked. The creation of environmental "cells" outside which traffic is dominant will promote walking as social activity, but not as a mode of transport. This is recognised in MfS[44]

Between the pedestrianised street and the motorway there will be many different mixed environments for motorised traffic and pedestrians. Motorised traffic includes buses, vans and HGVs as well as cars. In general terms the provision of the safest possible environment for walking (and cycling) means separation or

traffic control, mainly slowing vehicles down[45]. Traffic flow need not be much reduced to achieve significant improvement, but it needs to be moving significantly slower. The use of technology in cars to promote this (such as driver operated speed limiters) is another area where development is urgently required.

Policies for walking

In addition to the walking accessibility of individual sites and the permeability of new development set out in the land use chapter:

Government Guidance to include:

- scheme appraisal required to reflect the hierarchy in the Manual for Streets
- the impact on walking conditions and levels of use to be assessed in all appraisal of local schemes
- use of new techniques to measure walkability

New funding specifically to cover local street audits for walking both where people start and where they finish their journeys

Encouragement of innovative travel bonus schemes as part of Smarter Choices to make walking more attractive for all journey purposes

Avoid changing clock times in October and implement a trial of SDST

Funding for research and development programme with the motor industry into a range of options for encouraging slow car use, from driver alerts to speed limiters.

7 Local transport: cycling

Overview

Cycling has much in common with walking, but it also has fundamental differences. One shared problem is that transport planners have failed to represent the importance of walking or cycling in their models or in the appraisal of road infrastructure schemes. This has led to the joint categorisation of "slow modes" which disguises the important and separate roles which they can perform. Slow is particularly inappropriate for city cycling, which is often the fastest means of travel during the morning peak.

While walking is dominant for the shortest journeys, cycling extends the range of non-motorised travel, with reasonably fit adults easily cycling up to 5 miles[46], for example on journeys to work. Some commuters will cycle up to 10. The average trip length for cycling is 2.4 miles[47].

Cycling offers travel at least as fast as a local bus and often faster. It is by far the healthiest means of transport, more so than walking, and can supply the 30 minutes of daily moderate/intensive activity recommended by the NHS[48]. The idea of incorporating cycling as part of life's travel activities is widely promoted and is frequently a successful part of a Smarter Choice package[49] (see earlier chapter).

The NTS shows young people aged 5 to 15 around five times as likely to cycle than adults, for example 45% of young people cycle once or more a week compared to 9% of adults. For all ages this figure is 14%. By comparison, local buses are used once or more a week by 28%.

Cycling safety

On the other hand, cyclists are at threat from motor vehicles of all types where they share roadspace, and are often without protection of their own priority schemes. This is illustrated by the relative danger to cyclists compared to other modes as shown below.

Table 7.1
Proportion of fatalities & KSIs by mode, number of journeys and distance travelled

	Walk	Cycle	Motorcycle	Car	Local bus
Journeys	24.0%	1.6%	0.3%	63.5%	4.7%
Distance	2.8%	0.5%	0.5%	79.8%	3.3%
Fatalities	21.8%	4.7%	19.4%	52.3%	0.6%
KSI	22.4%	7.8%	22.9%	46.1%	1.4%

Source: TSGB 2007 Table 8.2 (2006 data), excluding LGVs and HGVs, NTS 2006 data

This analysis reveals why local authorities have sometimes been hesitant to encourage cycling unless physically separated facilities can be provided. In passing it illustrates the dangers associated with motorcycling. While car use has

dropped slightly in recent months, probably in response to fuel price rises, motorcycling has increased significantly. There are serious road safety issues concerning both existing motorcycle use and any increase caused through emission reduction policies.

Reducing emissions through cycling

The emission savings from cycling are very clear and particularly relevant if they replace car journeys up to 5 miles. They can compete with the car for journeys in the 2 to 5 mile category which walking in general does not. This category currently accounts for 14% of car CO2 emissions according to the DfT. This is not quite the complete picture, since land use policies and rising fuel prices will tend to shorten journey lengths, and improved conditions for cycling should increase the journey length over which cycling is viable.

Setting targets for cycling growth, and devising schemes to achieve it, has proved difficult because of the low level of cycling for transport, as opposed to leisure, purposes. The Government estimates that 3.1 million people cycle for pleasure every month.

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 cycle parking and priority schemes.

Extending cycle parking

Many authorities already have 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. A comparison should be with high quality bus stops which have some weather protection, lighting and information.

Improving journey quality

The next area which is critical in delivering increased cycle use is cycle priority and protected road space for cycling. In the past 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 cycle route is very undermining. Painted lanes, especially where these appear to take up half a car lane at traffic signals, are mostly unsatisfactory.

Earlier cycle networks, where they exist, need 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).

Information, training and marketing

As part of travel planning support some authorities are 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, a travel bonus account and shopping discount (and/or home delivery) described in the smarter choices chapter 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. A recent study, detailed below, has confirmed the value for money of cycle initiatives.

Overall cycling expenditure is still relatively low and needs to be enhanced so that the process of upgrading and extending cycle routes is accelerated. Despite this comment, some authorities have achieved significant growth and, for example, TfL has set up a Cycling Centre of Excellence to pursue the improvement of cycling in London.

Government initiatives

In order to achieve an increase in cycling, Government has set up "Cycling England" and funds its programme of improvements. The latest settlement is for £140million over the next three years. This is to support:

- Cycle training for 500,000 10 year olds
- Connecting 500 schools via traffic calmed or traffic free routes
- Cycle parking and infrastructure
- 11 new demonstration projects and more work in the existing six towns
- Doubling the number of cycle to school "champions" to 40
- Miscellaneous small projects to encourage cycling.

There is also cycle expenditure through Sustrans on the National Cycle Network and other projects and various other sources of funding including the Lottery.

Cycling England has commissioned a study[50] of the value of cycling and this reported in 2007. Overall, benefits were calculated at 3.2 times the costs. These consisted of health, pollution (including climate change) and congestion, and the study points out that a 50% increase in cycling would be worth about £1.3billion a year.

This is in line with the TfL Business Case for a 10 year programme costing £416million[51]. Here the benefit to cost ratio was between 4.8 and 6.2 times the cost. The scale of this programme was significant, spending only 11% less than the current national budget in London. However, its target was to treble cycling levels in ten years (2005 to 2015). Cycling in London has in fact increased by about 90% so far, although the full programme has not be confirmed to 2015. The balance of proposals was quite detailed and co-ordinated with TfL's travel planning initiatives and a summary of the key elements is set out below.

Table 7.2
Example package and indicative costs

Measure	Costs	Outputs	Outcomes
Strategic network	£176m	1000km network complete by 2012	+ 165,000 daily trips
Local network initiatives including Greenways	£60m	Up to 300km of local networks	Included in local parking
Site specific safety schemes	£18m	Junction treatments	Accident reductions, supports other
On street cycle parking	£24m	40,000 stands	+ 108,000 daily trips
Parking at schools and colleges for 10% of students	£25m	50,000 stands	+ 98,000 daily trips
High density housing initiative: includes cycle parking and adult/teenage training, help with purchase	£13m	20,000 secure spaces, 10,000 training places	+ 25,000 daily trips
Workplace parking, training and purchase schemes	£24m	150,000 stands: 1/3 funded through travel plans	+198,000 daily trips
Parking at public transport interchanges	£4m	10,000 spaces	+ 27,000 daily trips
New bike stations	£14m	6,000 spaces	+ 11,000 daily trips
School based training, events and bike recycling scheme	£15m	20,000 small bikes recycled, 120,000 children trained	Included in school parking increase
Promotion, information and marketing	£20m	Cycle maps, events, advertising	Supports other measures
Total Revised programme	**£416m**		**+ 632,000 daily trips**

In addition, the six smaller demonstration towns have shown that this ability to increase cycling is not limited to the largest cities. Each town received £500,000 a year for three years (Aylesbury £300,000 a year). The results of the independent monitoring were summarised by DfT as follows:

- "in Aylesbury, the number of people saying they are using a bike as one of their

main modes of transport has risen from 3% to 14%
- in Brighton, a personal travel planning programme has led to an increase of 172,000 cycle trips per year in an area of 10,000 households
- in Darlington, the proportion of children cycling to school has risen from 1% to 4%
- in Derby, cycling has increased by 11% on the Pride Park riverside path since
  2006, and by 38% since 1998
- in Exeter, 72% of people think that it is now easier to cycle than it was 2 years ago
- in Lancaster, the number of parked cycles counted in the city has increased by 48%"

"A sustainable future for cycling", DfT, pages 19-20

The work undertaken in the demonstration towns, and in London, show the huge potential for increasing cycling in a relatively short space of time. The issue here, as with Smarter Choices is how to roll out a programme which will achieve comprehensive national coverage. It is possible that the Cycling England programme at three years is too short, and that a steady increase in funding over at least ten years would result in more progress. This is not just a funding issue, as with most transport planning the deployment of trained and enthusiastic staff is key to the success of any programme, especially for behavioural change. Cycling England and DfT should consider not treating the next 11 towns as demonstration projects but as the first in a full scale programme.

Policy proposals

Cycle parking standards to be introduced for existing town centres, and at workplaces, leisure and educational facilities through the travel planning initiative – automatic 100% funding from national budget

Second generation priority networks for every town over 15,000 population, based on safe links from homes to workplaces, schools, health centres, parks and other leisure centres – expanding Cycling England programme and extending to 10 years

Completion and extension of current National Cycle Network

National bike hire scheme similar to VELIB based at stations and in city centres – pilot schemes in different areas including London, different towns and rural stations by 2010, national scheme by 2015, full demonstration funding.

8 Local travel: the car

While walking is the base from which all journeys start, and the most widely available mode, the car is the next most popular for local travel.

In terms of number of journeys (as opposed to distance travelled), these two modes, in their own way, dominate our transport choices. Over all distances, the most used is the car, with its share of 63.5% of people's journeys. Next is walking, with 24.0%. This changes when distance is taken into account, and this is further explored in the long distance travel chapter later in this report.

However, for local journeys, the picture is one where walking dominates, this is illustrated by showing the mode shares for journeys by distance in Table 8.1 (cumulative) and 8.2 (by individual distance band) below.

Table 8.1
Journey mode share by distance: cumulative totals 2006

	All under 1 m	All under 2 m	All under 5 m	All under 10 m
Walk	78	56	35	29
Cycle	1	2	2	2
Car driver	12	23	34	39
Car passenger	7	14	19	21
Bus	1	3	7	7
Rail	-	-	1	1
Taxi/minicab	-	1	1	1

Source: NTS 2006, MTRU calculation from Table 3.4

Table 8.2
Journey mode share by distance: by individual category 2006

	Under 1 m	1m to 2 m	2m to 5 m	5m to 10 m
Walk	78	31	4	-
Cycle	1	3	2	1
Car driver	12	36	51	56
Car passenger	7	21	28	27
Motorcycle	-	-	-	1
Bus	1	6	12	10
Rail	-	-	1	4
Taxi/minicab	-	1	2	1

Source: NTS 2006, MTRU calculation from Table 3.4

Why is the car so popular?

Next to walking and cycling, the car is the most immediately available mode at people's homes. It offers private space, requires little physical effort, and is protected from the weather. It is perceived as safe and, until recently, cheap to

use (although expensive to own). Motoring costs have fallen consistently over the previous decade compared to public transport. Between 1996 and 2006, motoring cost in creased by 19% while public transport fares rose 40%[52]. Other important personal aspects of car ownership such as status and use of travel time are explored later in this section.

The only exception to this overall ease of use is where parking is distant from the origin or destination point of the journey. Most cars are parked very close to home and can be parked relatively close to many destinations. However, parking in some areas is seen as a hassle, and search time as well as cost has been included in some transport modelling. Motorists do not pay for most parking at their destination, even in London[53].

Direct charges on road use have been much explored, but only central London (plus a small Western extension) has a scheme in place. Workplace parking charges can be implemented by local authorities but there is no scheme in place. Nottingham City Council has formally applied to the Secretary of State to introduce a scheme, with the proceeds used to extend the tram system[54].

Driver attitudes and reducing climate change

Before exploring car ownership in more detail, it is important to set out an approach to car use which can be included within an overall sustainable transport policy package. The reason for raising this issue is that policy seems to be characterised as either being pro or anti car. In fact, the individual choices of car owners and users are critical to the success of any policy package, apart from one based on externally imposed rationing. The key issues are understanding the reasons behind car use, and of being fair to drivers.

The latter has become an issue, particularly since the decriminalisation of parking in the 1990s. This is now known as Civil Parking Enforcement (CPE). This has simplified legal procedures, improved the level of enforcement, and enabled people who consistently flouted the regulations to be identified and further action, such as clamping, undertaken.

However, there have been serious side effects, particularly where the implementation of parking controls has become a profitable enterprise instead of a sensible control over road space or part of an overall policy which seeks to reduce congestion and improve the environment. Even allowing for the British trait of opposing authority generally, some of the recent conflicts between local parking and traffic authorities and motorists have become quite extreme and often legalistic[55]. Part of the reason is that the speeding up of any appeals process and the pressure created by the removal of a reduced payment if such an appeal is lodged.

A Select Committee on Transport report in 2006[56] investigated these issues and recommended as follows:

- Clear performance standards in applying parking restrictions must be established

- It must be made clearer to drivers what regulations are in force and how compliance is to be achieved
- Appropriate recruitment, remuneration and training is needed to ensure a professional parking service throughout the country
- The process for challenging penalty charge notices must be made much more transparent
- The impact of the parking adjudication service must be increased and its profile heightened
- Scrutiny of local authority parking departments is woefully inadequate and needs to be strengthened
- Local authorities must develop parking strategies which meet local objectives fully, focusing particularly on congestion, road safety and accessibility.

The Government has now published Statutory Guidance on the civil enforcement of parking[57] which seeks to address some of these issues. However, this has the problem of mixing statutory obligations, duties (some of which are very general), advice and good practice. In para 3.3 it sets out policy guidelines as follows:

"Enforcement authorities should design their parking policies with particular regard to:

- managing the traffic network to ensure expeditious movement of traffic, (including pedestrians and cyclists), as required under the TMA Network Management Duty
- improving road safety;
- improving the local environment;
- improving the quality and accessibility of public transport;
- meeting the needs of people with disabilities, some of whom will be unable
- to use public transport and depend entirely on the use of a car; and
- managing and reconciling the competing demands for kerb space."

In para 3.6 it makes it clear that "*raising revenue should not be an objective of CPE, nor should authorities set targets for revenue or the number of Penalty Charge Notices (PCNs) they issue*." In para 3.8 it says that the aim should be "*100% compliance with no penalty charges*". However, in para 3.9 it says that schemes will not be subsidised by local or national taxpayers. Excess revenue will continue to be available to local authorities for a range of local transport expenditure[58].

In order to meet criticisms over a lack of proportionality, two tiers of penalty have been introduced. In most authorities the low figure is still £40-50.

It remains to be seen how far this will resolve the issues but clear problem areas remain. The first is that there is still a conflict of interest between the local authority maximising revenue and exercising its discretion. The second is that there is insufficient recognition of the fact that most drivers are not experts in traffic regulations. The committing of what is in essence a technical or timing offence not related to the objectives set out above, and how to deal with such acts, is not really addressed.

This returns to the principles set out at the beginning of this report. People should have a clear idea of why policies have been implemented and what effect is intended. Being fined a significant sum for exceeding parking time for a short period does not deter people from using their car, it makes them angry and resentful. Transgressing technicalities, for example over markings within permitted parking bays, and confusing signs, are examples of where drivers are being alienated rather than engaged.

One of the fundamental requirements of travel planning is to listen to why people make their choices on how to travel and to seek their views on what would cause them to change. Creating a sense of common purpose will require a more positive attitude to motoring, and there is no reason why this should not accompany a reduction in car use. Traffic regulations need both proportionality in application and clear exposition of the reasoning behind them. The new guidance does not have sufficient guarantees that this will be achieved and further action is required.

Differentiating traffic regulations

A final side effect of the move to fixed penalties and penalty points has been a lack of differentiation between traffic offences and a diminution in the public mind of the importance of all regulations. Speeding in a residential area, for example, is extremely dangerous and can result in death or serious injury. This is true even at a relatively low percentage over the limit. Percentages appear to be a useful indicator rather than fixed amounts, the lower the speed limit the more important it will be to drive below it. There needs to be greater distinction between offences and within them and this implies a broadening of the spectrum.

Together with this there needs to be a further attempt to create understanding of why traffic regulations are imposed and speed limits are introduced. This will not eliminate irresponsible behaviour, but it will minimise it and make it less socially acceptable.

The policy implication of this is that there should be recognition of the importance of car use, a consultation process with drivers, both listening and explaining and the creation of a better understanding, for example of the consequences of road accidents. This is a different approach from using normal marketing and advertising campaigns although not incompatible with them.

Understanding car ownership

First and second cars

Considering the impact that cars have had on the transport system it is surprising that most analysis focuses on relative cost and generalisations such as “maximising choice”. There is some work exploring the complex motives behind car ownership and car use (two different areas). This reveals issues such as the need for personal space, which in turn can be used for anything from loud music to enjoying a cigarette. This so-called “cocoon” effect was first noted in 1990[59].

The status of ownership is important and in some ways may work in favour of greener cars. Both status and rite of passage elements are important for young adults, although the high cost of learning to drive, owning and very importantly insuring a car are now significant for this group.

An earlier axiom of transport planning was that car use was a valid target for demand management but car ownership was somehow outside the rational judgement of how to travel. Most recently the latter idea has been challenged by the use of car clubs, now rapidly growing in the UK.

One important and obvious factor in this is the growth of car ownership in households which already have one (or more). Second cars undertake lower annual mileages and are probably smaller.

This has major implications for policies to improve vehicle efficiency. For example, if people are given incentives to buy small, efficient cars it will probably encourage second car ownership (especially if they escape road user or parking charges). Westminster has withdrawn parking concessions for low emission vehicles for this reason.

This is one of the reasons that *Perspectives* proposed a salesroom tax which was zero if cars met an efficiency standard and not an efficiency rebate. It also pointed out that what matters is not the average new car efficiency but the total emissions from all the cars bought and owned. A sudden surge in small car purchases with no change in buying large cars would cause a fall in the average emissions but a rise in the total capacity to emit greenhouse gas.

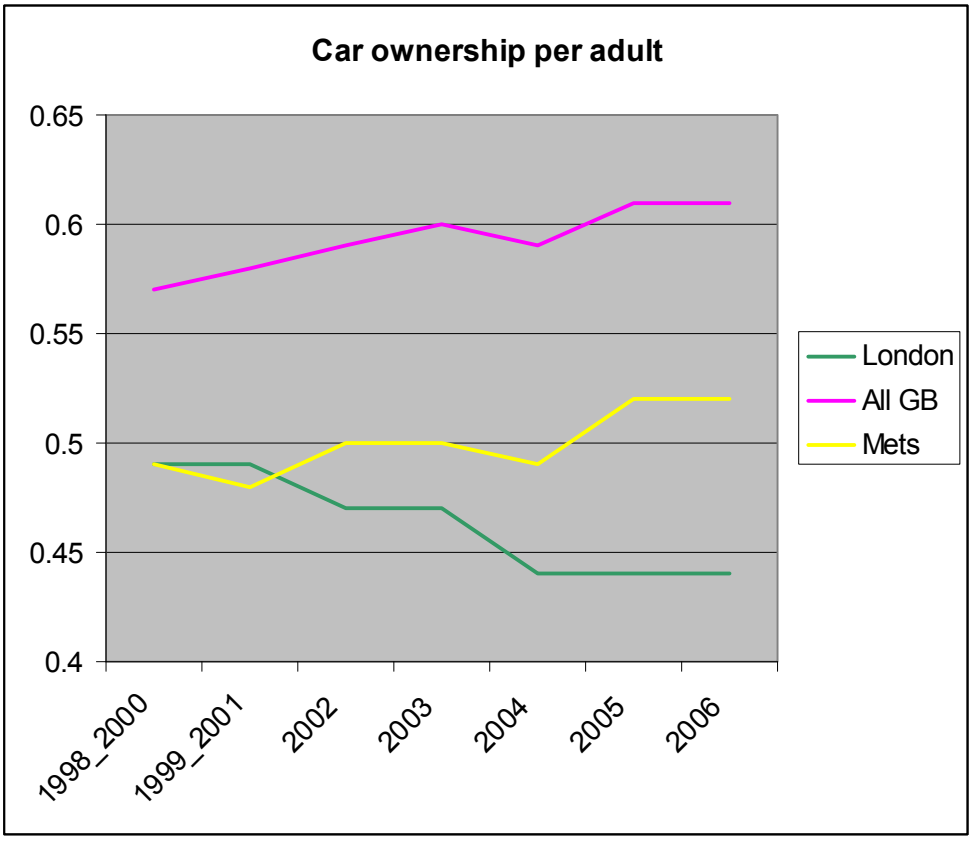
Conversely, a fall in total car purchasing caused by people not replacing small second cars could result in an increase in average emissions but a fall in total capacity to emit.

There may be some small increase in emissions if the single, larger, car is used more, but overall second cars still undertake significant mileages. The issue is that many households see owning a car as very important, but may view the second car as part of a travel choice package which may be more amenable to change. Even in rural areas, where multiple car ownership, and older, cheaper cars, are common, schemes such as demand responsive transport can tackle the need for occasional travel and there would otherwise be no alternative. In these locations the car club option may be difficult to implement. In more densely populated areas there are many alternatives and the car club approach can be more appropriate.

The London example

In the UK there is a real world example of much lower than expected second car ownership on a major scale – London. What is remarkable is that there is a consistently lower level of car ownership than the national average in households of similar size and income. It also appears to have declined slightly over the last decade while nationally growth has continued. This is illustrated in Figure 8.1 below.

Figure 8.1



Source: NTS 1999/2001, 2002, 2003, 2004, 2005, 2006

In fact, London now has half the number of households with 2 or more cars than the national average. Cars per adult (17 or over) has fallen 10% over the decade, while nationally they have grown by 7%. London is in fact about where the national figures were in 1985/86.

There is no definitive evidence of the balance between the land use and transport factors behind these choices. Clearly, London has a mix of frequent public transport and high route density. It also has positive policies towards fares and service quality and spends a significant amount of revenue on achieving them. However, it also has a high level of facilities for leisure, shopping and business plus strong public transport links into central London. It is also the case that driving in London is not generally considered pleasant, and people would like to avoid it.

Overall the lesson is that a prosperous urban area with good public transport and a wide range of local facilities can achieve a transport mix where the car is not so dominant as elsewhere. The issue is how far the conditions which have brought this about can be created in other areas, and this in turn supports the land use recommendations in Chapter 3.

Integrating car use into local transport

The car will have a continuing role in local transport and this requires policies to integrate its use with other modes, particularly walking and cycling. Sometimes this will be possible through separate routes for the latter, but these need to be direct and on the street frontages. This is because the safety, security and general attractiveness of these modes is more affected by the travel environment and creates less danger to activity such as street play[60].

Much of the framework for integrating cars is contained in the previous sections on walking and land use. The creation of awareness and a sense of common purpose is unlikely to be total but it should be possible to improve significantly on the current position. It is worth bearing in mind the DEFRA study on how consumers react to changing their behaviour to combat climate change[61]. This identifies three key groups of people who are:

- Keen to act and high potential to make change – need information and available choices
- Willing to act and some potential to change – need above plus financial and other encouragement
- Unwilling to act – need all the above plus changes in regulation and active discouragement (financial or otherwise).

Much of the section on driver attitudes above addresses people in the third group and seeks to make them more willing to change behaviour.

In relation to parking, there may be ways in which drivers could have some of the hassle removed, particularly for journeys where using the car is particularly important. Bookable parking schemes and real time parking availability are examples.

Training and awareness programmes for drivers are already in existence and these should be improved and supported further, particularly during the full time of licence holding. These need to be properly validated and monitored.

In the context of the fuel duty increases proposed, there would be no need for national road pricing to be introduced. Congestion will be reduced by the overall policy package.

Finally there is the issue of equity in relation to people enjoying the benefit of using a car – in other words the well off not “pulling up the ladder of car ownership behind them”[62]. Here there is already a market led growth in the development of car clubs, which reduce the financial barriers to car access. Instead, the use of a car is booked and the cost per mile is higher (and better perceived) than for car owners. This allows a better comparison between modes and generally in lower car use but with more people participating. There needs to be some national consistency to allow for longer distance travellers who want to mix public transport and car use, as well as people making car journeys when it is particularly useful to them.

As part of a national travelcard scheme, the credit could be used for car club payments. It may also be possible to allow for an extra credit for non-car owners.

Policies to engage the motorist and respect the role of the car

New initiative to create better understanding of why people drive, and among drivers, of why specific traffic controls and management schemes are implemented

National action to promote schemes such as bookable parking and information including the funding of trial schemes

In relation to parking, target deliberate and persistent offenders rather than, for example, people who make occasional minor parking errors, and investigation of the equivalent to a police "caution" for one off minor offences

Removal of income to local authorities in excess of that needed to operate parking schemes to the eco tax rebate scheme

Greater differentiation of traffic offences with wider spectrum of fixed penalties and greater focus on dangerous behaviour

Investigation of national, free motoring "package" possibly including GPS, car security, information and training – developed with established motoring organisations and insurance companies

National car club initiative with common means of payment, possibly with national free "unique need" car access scheme.

9 Local travel: bus services

A picture of extremes

Perhaps the most obvious fact about bus use in the UK is the huge variation between the best performing areas and the worst[63]. For example, London has increased bus use so rapidly that it has obscured declines elsewhere in the UK. This has been through a combination of integrated transport planning (controlling both routes and fares throughout Greater London) and high levels of subsidy. The latter has been used to simplify and reduce fares as well as raise quality and increase service levels. All services are designed by Transport for London (TfL - London Buses), and tendered, but for operation only. These services are protected from any on road competition from other operators because TfL is also the Licensing Authority. Fares are retained by TfL, who have introduced the Oyster smartcard for bus and rail.

Other individual urban areas as far apart as Brighton, Nottingham and York have also achieved consistent and high growth rates for public transport use[64]. Individual corridors and routes can also experience significant growth. This has, however, been against the overall trend. In particular, the major conurbations, which had strategic level government abolished in the 1980s, have seen a serious decline in bus use. This is all the more surprising because they have retained at least some of their public transport planning capacity through the Passenger Transport Authorities and Executives (PTAs and PTEs).

However, these organisations do not have anything resembling the powers and resources of the London system. Instead, private companies design and operate their own commercial routes, with the PTA identifying gaps in service provision and funding services to fill them. Despite this, they have been innovative in their approach, particularly in the provision of targeted services including demand responsive transport. The issue of local rail and rapid transit systems, which also fall within their remit, is considered separately in this report. A summary of some key trends in bus use and funding in the PTEs and London over the last decade is set out below.

Table 9.1
London and PTE area bus trends

	English PTE areas				London			
	Support	Bus kms	Fares income	Trips	Support	Bus kms	Fares income	Use
1996/97	£106m	692m	£483m	1310m	£12m	342m	£455m	1230m
2006/7	£128m	584m	£650m	1109m	£625m	465m	£772m	1993m
Change	+21%	-16%		-15%	+5100%	+36%		+62%

Source: TSGB 2007
Support is in current prices

A tale of two types of cities

This Table shows clearly the contrast between London and the rest of England's biggest cities. Since the restoration of strategic London Government, an integrated package has been pursued based on:

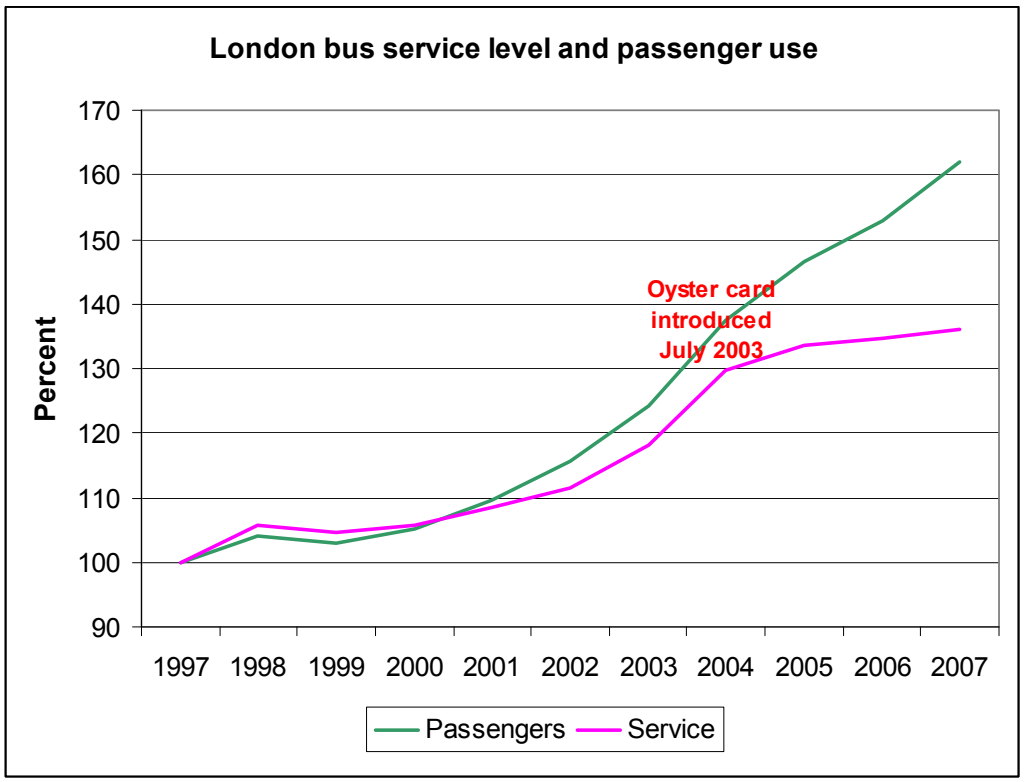
- fares reduction and simplification
- higher levels of service
- co-ordinated citywide bus priority measures
- increases in quality, ensured through tender specification for all services.

The results have been:

- fares have fallen slightly in real terms (TfL figures)
- only 2% of bus fares are paid in cash
- significant increase in passengers
- dramatic increase in operating subsidy.

The chart below shows the deliberately planned increase in service, measured as bus kilometres, and the associated rise in passenger numbers.

Figure 9.1



Source: TSGB 2007

In the PTEs by contrast

- integrated fares are limited in extent
- fares have risen
- bus priority has to be negotiated with other authorities
- service levels have fallen.

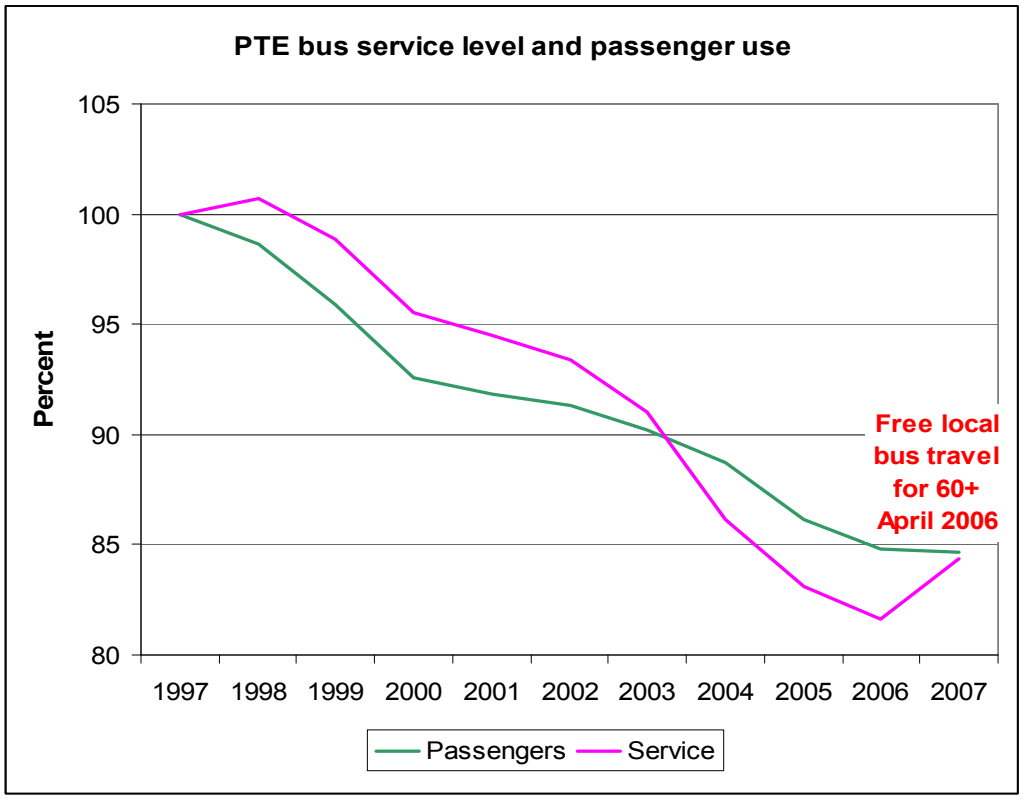
The results have been:

- average fare per trip have more than doubled (DfT figures)
- decrease in passengers
- increase in revenue support.

In the PTE areas, the services will be reacting to a commercial environment and tend to follow a loss of demand or, more importantly, a loss of profitability. In London, the increases were planned as part of a clear policy. This was related to policy for the Underground, where expansion of service was more difficult and governed by external factors resulting from the introduction of the Private Finance Initiative.

The chart below shows the fall in passenger numbers and the associated fall in service, again measured as bus kilometres.

Figure 9.2



Source: TSGB 2007

Creating a citywide approach

The key question is if the London results are so positive, why has the exercise not been repeated? Apart from requiring revenue support, there are organisational issues that have to be addressed. The PTEs still operate under a deregulated regime where stability has to be created by agreement, often between several different parties with different agendas.

Thus the London style solution would require an increase in revenue support but also a guarantee that the service pattern and its use would not be subject to disruption through the inter-competitive actions of individual operators. This could easily result from the lack of overall control which PTEs can exercise and resulted, for example, in the action of bus operators in relation to the Sheffield tram.

There is considerable diversity of view as to how far the solution needs to go towards the strategic authority approach, as in London. What should not be disputed is the need for action. It would be possible to achieve what is set out below by voluntary agreement, but there must be some resolution of this problem which has been evident for over a decade. Proceeding towards a strategic solution which is binding may even provide the motivation required for such mechanisms to emerge.

Currently the Local Transport Bill which is at an advanced stage in its Parliamentary procedure intends to make it easier to create "Quality Contracts" which are longer term (usually 10 years), legally binding agreements between authorities and bus operators. Whether operators will participate willingly and what they will require in return remains to be seen.

What is required is for the PTE to prepare a preferred service pattern (bus plan) including existing services. Ironically, the Bill removes the duty to prepare a bus strategy, but this plan would effectively be more detailed and form the basis for a Quality Contract. This would fall within their new duty to prepare a Local Transport Plan which includes both policies and an implementation plan (Part 2, Section 9). This must include introducing a smartcard which is compatible with any national scheme, and simplified fares and this should be in Government Guidance (see Section 38 of the Bill).

Operators could ask to run their existing services within a quality contract, and could do so without subsidy and keep the fares. These would however, have to come within the new area wide fares system. Any existing services which were also in the plan which were not taken up, plus any new services required by the plan would be tendered. There should be a reserve power to set up wholly owned or arms length companies to run the services in the event of low tender competition or high pricing. Companies could come forward with new services providing they did not adversely affect with the services in the bus plan. This would reverse the "adverse impact" test as currently set out in the Bill (Section 19) but is essential if any significant injection of public money is to be made. The removal of the "competition test" from the draft is a very positive step forward.

An additional element for tendered services (or existing services if operators preferred) could be to set patronage and income targets, and then allow operators who exceeded them to retain a substantial share of the extra income. This approach was actively considered for London contracts to encourage more initiative in marketing and service quality. In the event, TfL decided to pursue a traditional regime, but with very tight tender quality conditions backed up with fines and bonuses. This has worked well but has proved expensive. In the PTE areas the existing fund of operator expertise and current independence also suggest that a stronger element of operator initiative would be appropriate.

Thus the proposed structure is more of a partnership arrangement than in London but would introduce a much higher level of overall planning and co-ordination than available in PTEs at present.

With such a regime in place it would be safer to introduce a major increase in revenue support from central Government. This would be conditional on a specific increase in bus kilometres and a proposal for fares simplification. An off bus purchase scheme would also be a condition of the increase.

For example, a 34% increase in bus kilometres in the PTE areas would cost about £268mn[65]. It would need to be phased in over several years. A 10% general reduction in fares would cost about £65mn, with simplification assumed to cost a similar amount. This should be implemented while the service levels are rising. There would be additional system operating and marketing costs, for example a 50% rise in PTE's current corporate costs would need £17mn. Overall such a package would cost £415mn a year when fully implemented, less than half the support per head of population given to London.

This would produce an increase in service levels very similar to that achieved in London between 2001 and 2004, combined with a fares reduction and simplification and the introduction of a smartcard. While this may not produce the same impact as in London, even a cautious prediction of the outcome would suggest an increase of passengers of around 30% - 330 million new passenger journeys a year. This would bring bus journeys up to 1440 million a year, still way below 1985/86 when the PTE areas had as many bus passenger journeys as London does today. Ironically, at that time, London only had as many bus journeys as the PTEs do today.

To move from a position where PTEs carried almost twice the numbers of passengers as in London to one where London now carries almost twice as much as they do is an extraordinary reversal in a short space of time. It is a testament to the profound failure of bus deregulation in England's largest cities outside London. Fortunately much of the organisational structure which is required for a properly planned and proactive bus policy is still in place.

Other major towns and cities

Outside the PTE areas and London the picture has been variable, with successes in rural areas as well as towns and cities. Overall the picture is one of decline, but far less severe than the PTEs. This perhaps reflects the different, broader range of powers which have been available to local transport authorities preparing their local transport plans.

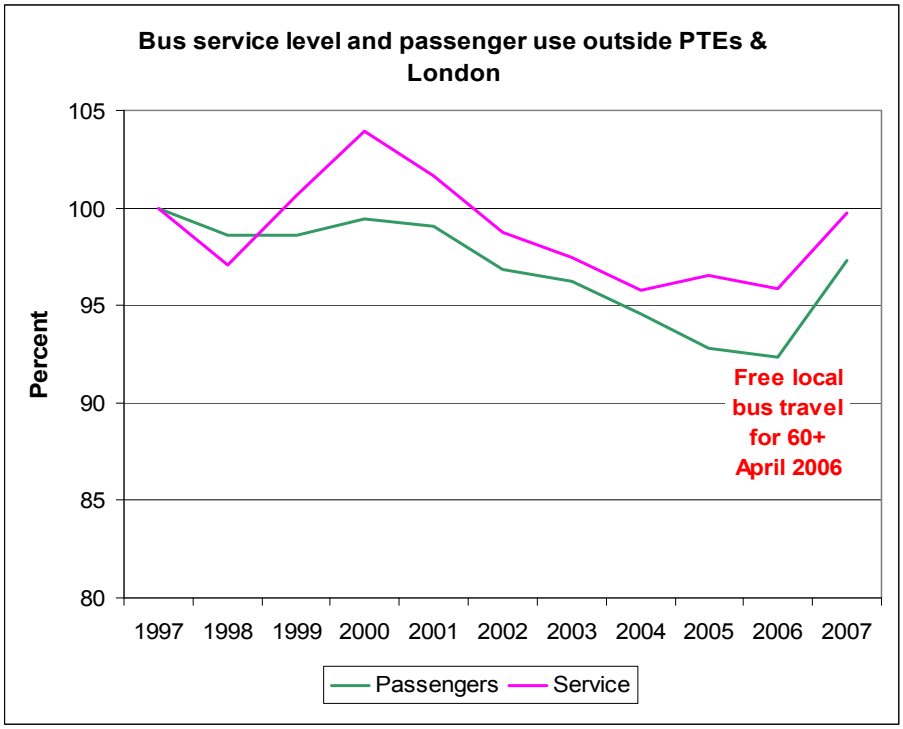
Rural and then Urban Bus Challenge Funds plus the increased rural bus grant should have pushed service levels consistently higher. However, there has been major price inflation for tenders, with too few operators competing. Practices such as tendering high without spare capacity and if the tender is won dropping a less profitable service, have not helped tenderers. The overall picture over the last decade is set out in the Table and Figure below.

Table 9.2
Bus trends outside London and the PTE areas

	Support	Bus kms	Fares income	Trips
1996/97	£83m	1116m	£866m	1304m
2006/7	£253m	1113m	£1424m	1269m
Change	+305%	-0.3%		-3%

Source: TSGB 2007 (Current prices)

Figure 9.3



Source: TSGB 2007

It is worth noting that fares information is supplied in DfT bus statistics but is difficult to interpret. The total fares income and number of trips are available to provide an average income per trip. This is now more comparable because all contain elements of free travel within the national concessionary fares scheme. This was more varied in 1996/97, particularly outside the PTEs and London. The overall fare per trip is shown in Table 9.3 below.

Table 9.3
Average fare per trip English area types

	London	PTEs	Rest of England
1996/7	37p	37p	66p
2006/7	39p	59p	89p
Change	+5%	+51%	+35%

Source: TSGB 2007 (Current prices)

The current Local Transport Bill also assists other local authorities in setting up PTA/PTE style arrangements and Quality Partnerships. The final form of the Act is not yet known but it is close to approval and the removal of the competition test (see above) makes it easier for all local transport authorities in England to implement Quality Contracts. What cannot be predicted is the attitude of operators and whether this will cause problems of non co-operation or legal challenge.

Of particular interest is the attitude of such authorities to revenue raising schemes either for congestion charging or workplace parking charges. The first example of the latter is planned for Nottingham starting in 2010. The Order has been made and is with the Secretary of State for approval. The income is specifically linked to Phase 2 of the Nottingham tram network. If successful it could provide a less contentious route than congestion charging for controlling car commuting. This is far more likely if the money is put into clear public transport improvements.

The final issue that needs to be addressed is why local authorities vary so much in their ability to sustain and promote public transport. This has many aspects one of which is the need for staff who are able to plan positively rather than plan for decline. The Challenge Funds revealed strong differences in approach between authorities. Some saw the opportunity for developing new services and reorganising their bus system and many of their Challenge schemes have become part of, and influenced, their mainstream bus provision. Examples are the positive development of demand responsive services in Lincolnshire and Hampshire. Elsewhere the Challenge funded services were treated as a separate entity and have had a lower survival rate.

There are also divisions between types of users, with existing users with no car available wanting to retain their familiar service, rather than see it changed very much. On the other hand, attracting new users, especially those who have a car available, requires higher quality services, often with an innovatory approach. They also need to be well marketed. Every year has its success stories[66] but the problem has been understanding how they can be replicated on a larger scale.

This leads to the question of how bus services are currently supported by local and central Government.

Bus service support

Government support for bus services is very substantial, representing 40% of the bus industry's total income[67]. It is, however, of several different types and varies between London and the rest of the country. The main sources in 2007/8 were:

Concessionary fares outside London:	£725mn
Concessionary fares in London:	£167mn (2006/7)
Bus Service Operators Grant (fuel duty rebate):	£413mn
Local authority supported services	£330mn
London revenue support	£650mn
Rural bus grant	£ 56mn

There is a small amount of residual expenditure from earlier Challenge funds at £ 11mn
In 2008/9 the concessionary fares scheme will become national, costing a further £212mn

In addition, there was £300mn of local authority capital spending on items such as priority schemes, interchanges and bus garages.

It is immediately clear that this support will have a range of different effects, with concessionary fares being the largest. In 2008/9 it will form about half of the national revenue support. The next largest element is bus revenue support in London, followed by the rebate given to all local bus operators according to how much fuel is used.

The Government has recognised this and asked for comments on the long term future of revenue support, as well as reforming BSOG so that it creates an incentive, rather than disincentive, for operators to use fuel efficient vehicles.

The concessionary fares scheme plus high growth in London will generate sufficient bus travel for the Government to meet its growth target for national bus use of 10% between 2000 and 2010. The real challenge, however, is to channel the totality of support (and possibly increase it) so that there is real growth in most areas of the UK.

The concessionary fares scheme, which was not justified on transport grounds, is unlikely to be changed although it has a major impact. However, BSOG has been the subject of attention for some time and is capable of significant improvement.

Reforming BSOG: the Government consultation

At the moment operators receive a large rebate on their fuel duty (about 80%) for public bus services (commercial or otherwise) and this provides a broad brush, national support mechanism with low administrative cost. Unfortunately this is actually a poor proxy for the service delivered to the public and, even worse, goes against carbon reduction policies. Buying a hybrid bus makes much less sense if fuel is being subsidised. In fact, overall bus support would fall if operators bought fuel efficient vehicles.

Thus the Government is considering several options for the reform of BSOG[68]. The simplest would be to change to a payment per vehicle mile for buses on registered local services. This would almost double the incentive to operators to be more fuel efficient while retaining a simple method of supporting them. The problem is that this would favour rural areas, where buses travel longer distances at faster average speeds. It might be possible to have different rates for urban and rural areas, but defining these would then become a serious problem. In reality there would have to be a range of different areas and BSOG rates, introducing considerable complexity.

Another alternative would be to base the payment on passenger numbers or even passenger kilometres. These numbers are more difficult to gather and more open

to error and abuse. A national smartcard might help, but this is not yet agreed, let alone with an implementation date. There can also, however, be unintended consequences where indirect routeings raise passenger kilometres. This system would strongly favour urban areas where services are more intensively used.

The Government has therefore considered a complex system of giving BSOG as now but with an efficiency "cap" to limit the BSOG per mile and possibly other incentives for improved standards such better driving techniques (such as SAFED). There would also be a distance based grant for low carbon buses to avoid discouraging their use. This option is essentially a hybrid distance and fuel subsidy system which would increase the administrative burden and has a high risk of failure because efficiency is not directly encouraged.

Another Government consultation option is the transfer of BSOG to local authorities which have Quality Contracts in place. This would simplify the system and allow efficient allocation of support. However, outside PTAs and London, the grant may not be ring fenced for buses. In the long run, if this could be resolved, the rolling together of as much bus support as possible into an integrated package is an attractive option but needs to be part of longer term reform.

Meanwhile there is the problem that a major part of bus support takes the form of subsidising fuel used and thus emissions. In summary, the passenger based system and the distance based system would have a strong bias to either rural or urban areas, and the other proposals are complex and may be ineffective.

BSOG: a new approach

One approach not considered so far would be to base the grant on vehicle hours run on local services. This is as easily available as distance data from the service registration document. Service hours are just as predictable as vehicle kilometres and this would in fact avoid the current BSOG problems of defining "dead" mileage. In urban areas buses move more slowly so a distance based grant would pay them less. A time based grant more closely replicates the current distribution.

This can be illustrated as follows in a simplified example. An urban bus in typical conditions may achieve 12 mph and 10 mpg. A rural bus achieves 20.4 mph and 17 mpg. In any hour both use the same amount of fuel and receive the same BSOG at present. While not a precise fit, a grant based on time in service would better approximate the current balance while removing the perverse effect of discouraging fuel efficiency.

This would also remove the current discrimination against demand responsive (DRT) services. These find it hard to predict exactly how much distance will be travelled and thus do not receive BSOG quarterly in advance, but annually in arrears. This is serious anomaly and would be addressed by basing the grant on hours of operation. All bus operations could then receive their grant on the same basis. In fact the Government wishes to pay grant in arrears for all services in future, although this could create some serious cash flow problems, especially for smaller operators.

This could be combined with the reform of moving BSOG to TfL as soon as possible, and to other PTEs as Quality Contracts are implemented.

Even the hours based system is likely to create some anomalies and any reform may create gainers and losers. It is therefore recommended that a small increase in the level of BSOG outside London is implemented concurrently with the changeover. A 10% increase would cost about £33mn. Because the hours based system is more predictable, it should be possible to continue the quarterly in advance payments (including DRT) and thus avoid cash flow problems for operators.

Bus priority

As road congestion has increased, bus services have become less and less reliable as well as slower. In response, local authorities have implemented various measures to give buses priority. Many of these use advanced management techniques which bring buses to the head of the traffic queue, often with a minimal impact on other traffic. In practice, these techniques require a very high level of sophistication and local knowledge, a combination that is difficult to achieve.

As well as being perceived as delaying other traffic, priority measures have not themselves consistently delivered the required level of improvement. This is still an area which is developing, despite a growing number of good practice examples. One of the reasons is that the obvious solution, to protect buses from the worst congestion, is often ineffective.

From the work done in the 1990s it was realised that dealing with congestion "hot spots" is not the best way to implement bus priority[69]. A whole route approach is essential, since any slight variation in the schedule will become magnified. This happens because an early arriving bus at a stop picks up fewer passengers and thus leaves the stop even earlier, while a late arriving bus picks up more and leaves the stop even later. Without real time control, bunching is the natural state of a bus service, particularly in congested conditions and on long routes.

In response, operators may shorten routes, either permanently or by turning buses round early, both tend to be unpopular with passengers.

Thus a whole route approach, combined with the ability to adjust running times to even out headways, is required to deliver the best service. This is extremely difficult in a deregulated environment but can be done in a franchising situation, where private companies run the services but have to tender, and have control over the whole of a single corridor. Real time bus control has been common in urban European bus operations of this type for some years[70]. New mobile phone and GPS technology has made bus tracking and control much easier and cheaper and can be linked to real time passenger information. This in turn can be provided at bus stops, on the net or through mobile phones. This is an area of rapid development at present and should assist in raising the image of the local bus, providing, of course, that a good service is actually provided.

The key problem in delivering priority and information has been the framework within which negotiations take place between local authorities who implement priority measures and private bus operators. The situation is different in London (see above).

The first instrument which Government proposed in the Transport Act 2000 was the Bus Quality Partnership. These were voluntary and have had rather variable application and success, often depending on local special relationships. The other approach was the Bus Quality Contracts, which could be more permanent and binding and resembled the London approach more closely. There were very major barriers to setting these up and they proved too difficult and complex to implement. The new Transport Bill will create a more proactive role for local authorities and ease some of the conditions which had to be met. It remains to be seen whether this new compromise will deal with the barriers to achieving a stable and effective partnership between private operators and local transport planning authorities.

In summary, over the last decade, the attempts to deal with the inadequacies of deregulation in the 1980s have been weak and the proof is in the continuing decline of bus use. National targets for improvement have only been achieved by creating free concessionary travel and through strong growth in London, which has a completely different regulatory and financial framework.

Creating new local services: new technology and the DRT example

A final point to be made is how variable the adoption of new technology has been in local bus services. Vehicle tracking systems have assisted in delivering reliability and passenger information and thus encouraged use. Such systems are being introduced on an ongoing basis. Another example of new technology in the design of bus servcies is demand responsive transport (DRT).

Beyond the traditional bus

Conventional bus services have fixed routes, stops and times. In a sparsely populated area, for example in the countryside, this means the bus has to go round every village that it is meant to serve even when no-one wants to travel. This can lead to torturous routes, low frequencies and poorly used services.

In response to such problems in both rural and urban areas, a more flexible form of bus travel has been devised which matches the service more closely to the customers' needs. It has been given the name demand responsive transport - DRT for short.

The taxi is perhaps the simplest form of demand responsive transport. It is very convenient but not cheap. The challenge is to create comparable levels of quality, convenience and affordability in the form of a new type of bus service. New developments in technology - satellite tracking, on-screen information in call centres and buses, and routeing software, have made it possible to create services which respond directly to the requirements of the individual passenger.

In essence, within a given zone, a customer telephones a call centre from their home and requests a single or return trip to go to a nearby town, interchange or local facility. The call centre communicates with the driver of the bus, and the passenger is fitted on to a service round. These may be regular (for example hourly) or entirely according to demand. A pick up point and time are agreed and the bus collects the passenger within a 'time window' of, say 10 minutes, rather like a taxi. Some buses travel anywhere to anywhere within a zone, while others have some sort of core route from which they deviate.

The bus is shared with other passengers with similar requests within a given zone. The journey may take longer than a taxi, but the advantages are that the service can be of high quality, almost door to door and be available on a regular basis. Even taxis can be hard to find outside central urban areas.

In addition to this, the computer booking process allows for personal stops to be created, for example very close to home, often without any visible sign by the roadside. These do not hold up the bus because it does not have to visit them unless requested. As well as getting close to door to door travel, booking in itself creates better security for the passengers. And, in addition, drivers tend to like the services and enjoy the extra responsibility of seeing that their passengers, many of whom they come to know, are safely home, shopping and children unloaded.

Schemes also tend to use smaller buses (8 - 25 seats) which are better suited to lower levels of use and can get down narrow, twisting roads and turn round, more easily.

Effective and efficient

As well as the potential for improved service to the passenger, DRT makes it possible to serve a wider area with fewer buses. There is an element of negotiation and rescheduling in fitting passenger requests onto existing service patterns. This is the key to increased efficiency. European and UK experience suggests savings of 50-60%[71].

A variety of applications

Dispersed demand is not just a rural phenomenon. Other examples are: low density housing in or around urban centres, night travel in urban or rural areas or getting people to and from stations or long distance bus and coach services.

In transport terms, DRT fills a gap between the big bus and the taxi. It may still require financial support, but in the right area it can offer better service at the same cost.

UK experience

Yet again, the use of DRT has been extremely variable, with strong good practice examples in a wide variety of locations and on the other hand some of the Challenge Fund services being cut as soon as the funding ran out. One problem has been that there was hardly any central support or even monitoring as part of

the Challenge Funds. There needs to be a bus innovation project within DfT to discover why some schemes have worked so well and why others have been abandoned. Proper advice and support could then be offered.

DRT is also particularly well suited to the integration of existing health and local authority networks. Examples of this can be found in Manchester PTE and Brighton PCT. The use of DRT can create higher levels of public transport accessibility for less cost than conventional services. National Government needs to take more of a lead in producing advice and publishing good practice.

Involving local people

The Local Transport Bill has several proposals for passengers to be represented formally in the Quality Contract process. While this appears to be a positive move, there are issues in regard to the expansion of bus use as opposed to its retrenchment to preserve the wishes of existing users. There needs to be a more proactive approach to create genuine involvement at the local level. Community area initiatives and public bus surgeries are examples of how this can be achieved.

Local involvement in delivering services can develop from the community transport (CT) sector, or from community groups directly. There are CT companies which have become very successful in the last few years, with examples in West London, West Midlands, Sheffield and Manchester. There is an active and effective Association (the CTA). DfT has increasingly recognised the value derived from this source in providing mainstream services as well as targeted local journeys. The Local Transport Bill has proposals which would widen the scope of CT operations (under Section 19 and 22 permits). DfT is currently consulting on the detailed regulations which would be needed if the Bill becomes law[72] (closing date 17th October 2008).

The community transport sector delivers both non-public services to people who would otherwise have problems travelling and more mainstream services. This illustrates the importance of a wide spectrum of provision and a flexible approach in the regulatory and fiscal framework.

The new Community Interest Company (CIC) is another way in which transport could see 3rd sector providers come forward. This would also improve the level of competition for tendered services and allow profits to be put back into meeting local transport needs.

Unfortunately, support for CICs has been generally weak and there is low awareness of their nature or their requirements. Some business insurance companies do not currently recognise them. There is also an unfortunate tension between some local authorities and local people who, because they run a tendered service, may want more of a say in service design. The tendering process itself means that some authorities who are supportive are extremely nervous about helping a bidding CIC on the grounds that existing operators may object.

Such problems need to be recognised and it is proposed that a new national gateway should be created with links to support on the setting up and corporate

responsibilities of transport CICs. This could help to reduce the local tendering conflicts of interest. There should also be funding available to help with set up costs such as accounting systems and the first company returns, licensing procedures and BSOG (or replacement) applications. This is simply not available through existing channels. The position in relation to tenders needs to be clarified and local authorities can then be given a strong encouragement to develop this sector.

The total sustainable travel offer

While the maintenance of individual services is important, in terms of carbon reduction a route by route approach does not reveal the true picture. The need for a reasonable network to be available, not just for peak times, is not the first priority for commercial operators and is beyond the current powers of most local authorities, as set out earlier in this section.

Any analysis of the reasons for the rise in car use recognises that once the entry cost of owning a car (purchase, maintenance, insurance, VED) has been met, the marginal cost is low and perceived as being even lower. It is also the case that growth in ownership has been in households buying second, third or fourth cars. This tends to derationalise car use – creating more journeys with solo drivers. In fact, much of the predicted growth in traffic comes from lower car occupancy.

Thus policies which seek to address use will also have to address the issue of growth in car ownership, particularly multiple household car ownership.

This in turn reinforces an important understanding of the way that people perceive the availability of sustainable alternatives. A total package which can cater for all journeys without using a car can be more powerful than taking individual journeys and offering a specific alternative. A combination of a variety of destinations within walking and cycling distance, availability of attractive public transport, and access to car use when most needed (for example through car clubs), will reduce car ownership and produce a greater variety of mode choice. Inner London provides a well documented example of this pattern, where households of a particular structure and income have lower levels of car ownership than comparable households elsewhere. This reflected in their patterns of travel.

For this reason, the total package may have some minor elements which appear redundant or under used. In fact redundancy is common in transport, much of the trunk road network is little used and free flowing for much of the time and many rural roads do not have the level of use to justify the cost of their maintenance.

This can be illustrated by the following example. A journey to a town centre which was undertaken by public transport may have required a late evening bus or train service for the trip home. This may have been much less well used than a service earlier in the day. However, removing it would mean that public transport could no longer deliver the total journey and thus both parts of the journey would have to be undertaken by car. If the person involved does not have a car, and the journey they wish to make is important, they will motivated to get one. The more journeys that require a car, the stronger that motivation. Once a car is bought, it is far less

likely that the person will use other public transport services and quite likely they will not use them at all. It will also make walking and cycling less likely. Thus removing what looks like an underused bus service is part of a process that leads directly to the transfer of a large number of journeys to car from public transport, reducing its efficiency and even the viability of previously well used services. Walking and cycling are also reduced and people make longer journeys overall. It is also the case that in the current regulatory framework for buses, with the split between commercial and non-commercial services, there is low opportunity for cross-subsidy to provide a complete network and avoid this effect.

This is one of the reasons that public transport planning is more complicated than selling an individual service. It is the reason that this report includes policies which will improve local bus and rail planning and lead to the creation of minimum public transport access standards, starting with those applied to new development. This is discussed further below.

Public transport accessibility standards

Thus the final issue which is linked to land use policy is the creation of minimum access to public transport for the vast majority of the country. Tools to measure this are already available. These are the equivalent of the earlier minimum parking standards, which in turn were part of ensuring that new development pays for the provision of necessary access improvements. However, they are also useful in terms of providing genuine alternatives to car use.

It is important that PT access standards are not just measured during the working day, and this is part of the "pathways" analysis which breaks down carbon reduction into elements which can be tackled directly. The growth of evening escort trips, where one person acts as an unpaid taxi driver, is strongly related to the availability of evening public transport services.

The level of accessibility needs to be linked to the type of area, and the type of area should be linked in turn to the scale of development. Thus an area which has low PT access because it is rural will not then be subject to planning applications which can only be served by car. Apart from the genuinely remote and very sparsely populated areas, an hourly opportunity to travel (this can be DRT and thus not be taken up every hour) seems the least that should be provided. More densely populated urban areas should have a 10 to 15 minute frequency as the norm. PT accessibility mapping is standard for most authorities and should be part of the preparation of local bus service plans.

Such accessibility standards include all services, DRT, local bus, transit schemes and rail. The latter two modes are the subject of the next section of this report.

Local bus policies

Introduction of national travelcard

Introduction of public transport accessibility standards for rural as well as urban areas

Fuel duty rebates (BSOG) scrapped and replaced with hours of service run grant – set at level where no operator faces a reduction (effectively increasing rural grant and encouraging fuel efficiency)

PTEs to receive increase in bus subsidy up to 50% of London level per head of population, leading to >30% increase in service kilometres, 10% general reduction in fares and simplification (costing further 10%)

Reform of local public transport planning in urban areas to include a new duty to integrate, to provide a comprehensive network and new reserve powers to ensure participation (this is partly in the new Local Transport Bill)

10 Local travel: rail and rapid transit

In terms of providing for people's local travel needs, rail and rapid transit provide higher capacity public transport options but also appear to have a better image in terms of reliability and quality than traditional bus networks. For example, in situations where bus and rail offer competitive travel times and cost to a car journey, the bus is unlikely to win many passengers while rail will do significantly better[73]. Traditional rail systems which serve existing major cities are sometimes referred to as "suburban" because they effectively link suburbs or satellite communities to a major centre. National, longer distance rail services can also be used by local travellers for this purpose, and operating companies use peak pricing to control, for example, commuting putting pressure on long distance capacity.

Most of these heavy rail networks are long established and issues such as reopening of rail links are considered in the longer distance section on rail. The rest of this section reviews the position on lighter rail and bus systems.

The rapid transit spectrum

The reality is that there is a continuous spectrum of speed, reliability and quality between local bus and the highest capacity transit systems. One problem in developing the right solution for each individual area is that decisions on which form of transit to be implemented are often taken at too early a stage in option development. Choices are sometimes limited to a specific system without recognising the availability of a wide range of alternatives. This tends to mitigate against innovative forms of either road based bus transit or low cost rail options. The latter are sometimes called "ultra light rail" (ULR)[74].

The key factors which distinguish rapid transit are the amount of reserved track and priority and the control of vehicles to ensure even headways and reliable services. Image and quality need to be addressed in the design of the vehicles, whether on road or rails.

One problem has been the perception that rail based systems have to be only slightly less highly engineered than main line trains, resulting in high costs and high energy consumption. The costs include the cost of building track strong enough to take heavy trams and power supplies with enough capacity to run them. In some situations this level of engineering will be fully justified. In others, rail based designs which have vehicles more like buses would be preferable. These need not have overhead power supplies and are far less demanding in terms of foundations and underground services if track is required on urban streets.

For this reason, bus rapid transit has aroused significant interest, with vehicles designed to look like trams and with track which can be separated out from normal streets and thus protected from other road traffic. The problem is doing this in a sufficiently consistent manner throughout the route. As seen in the bus section above, bunching is the natural state of a long bus route where any part of the route is congested or subject to irregular delays. This has to be addressed by direct real time control and whole of route priority measures. The simplest way of achieving control, as used in rail based systems, is signalling, preventing trains from entering

a specified section of track where another train is still present. This could be applied to bus based transit, but the availability of GPS systems means that controls can be implemented at far lower cost and with a greater degree of fine tuning.

The implementation of heavy tram schemes has been held back by fears over cost overruns, despite strong performance according to DfT criteria. For example, South Hampshire Rapid Transit had a benefit to cost ratio of over four. A second issue has been unreliable predictions of demand, although this has been at least partly explained by the lack of co-ordination with other services and the competition from parallel bus routes.

Busway schemes have been implemented and planned but two of the most recent examples (Luton and Cambridge) have been on previous railway alignments. They were contested by local organisations and some local authorities who preferred rail based alternatives, including an ultra light option.

Overall the picture appears to be inconsistent, and national policy has not generated a genuine mix of transit schemes which have been tailor made for individual circumstances. The ultra light rail schemes have been very small scale and bus based transit has had problems because services can be compromised through bus deregulation and on-street priority which has not been fully implemented because of conflicting demands on roadspace.

This argues for three key changes in the development of transit systems.

Fair assessment

The first is that they should be fairly assessed in terms of their cost benefit analysis and business case (this is dealt with in the later section on appraisal).

National framework

The second is that the Government needs to stimulate the implementation of a range of transit schemes and should invite bids to do so. There should be specific encouragement to come forward with innovative schemes, such as ultra light rail and bus rapid transit (BRT). These offer lower construction cost and risk and need to be implemented and then monitored, both in terms of performance and just as importantly in terms of public perception. This need not take the form of a Challenge Bid process but an evolution of current arrangements. National Government should take a much more proactive role and have clear objectives, rather than acting as a passive assessor for financial approval.

As elsewhere, there is a need to develop skills and experience in this area, but this can only happen if there is a consistent programme of implementation. There is also an issue of public image, and confidence in local authorities, in the sense that the expectation generated at the start of the decade has not led to a number of schemes on the ground which could establish a wider base. There are of course, individual success stories, the most recent of which is the Nottingham Express Transit, which is a rail based heavy tram with significant (4 km) street running[75].

Some of the potential problems from a lack of bus and rail integration have been avoided (such as those in Sheffield) because Nottingham had a dominant operator who were originally City owned, and they are one of the two partners who operate the tram. This solution is not available everywhere.

Understanding the intermediate mode

The third issue is that a time consuming argument between bus and rail rapid transit needs to be avoided. The use of short sections of isolated and discontinuous rail alignment could be a valuable part of a BRT scheme, but the wholesale replacement of a line which could be reopened is likely to be expensive and limiting in terms of future development. In many cases the use of a cheaper ultra light rail alternative can provide a short to medium term solution capable of development and expansion.

Overall there is the impression that there is almost a "missing mode" in many parts of urban Britain. This should sit between the local bus and the national rail network. It should be integrated with development, for example eco towns will struggle if they do not have access to such systems. In many parts of Europe tram systems were not removed and it has been easier to develop and modernise them. In the UK this argues for a larger number of low cost transit schemes to complement the relatively low number of full scale rail tram options. These should be designed to be capable of expansion and development, for example by building an off street ultra light rail track to a heavier duty standard while adopting the lowest cost option for on street running.

Making progress

National Government is the main arbiter of most of these schemes through its financial support and controls. As part of the TSTS process, or parallel with it, there needs to be a national discussion involving all transit suppliers, bus and rail, to work out how to make some real progress in terms of number of transit schemes and number of people who have access to them. The idea that rapid transit is a mode with a diversity of expressions, rather than a rag bag of competing and mutually exclusive modes, would be helpful in moving towards filling this serious gap in public transport provision.

Planning

One further logical reform which follows from this analysis is that the way in which rapid transit schemes go through the planning system should be consistent. For example, the differences in regulatory and planning requirements (including Public Inquiries) between bus based and rail based networks need to be removed.

This report suggests that a national target, to treble rapid transit use by 2020 from today's levels, should guide the development of a national policy. This would be the equivalent of about a dozen new rapid transit schemes, compared to the current seven[76] outside London. A summary of their current use is given in Table 10.1 below.

It should be noted that some schemes share lines and stations and fulfil a role more closely resembling suburban rail links. This is illustrated by the variation in the average distance per passenger in the table.

Table 10.1
Use of 7 UK tram schemes 2006/7

	Croydon	Glasgow	Man-chester	Midland Metro	NET	Sheffield	Tyne & Wear
Million pass.kms	128	42	208	51	43	42	295
Million Passengers	25	13	20	5	10	14	38
Average kms/pass	5.1	3.2	10.4	10.2	4.3	3	7.8

Source: TSGB 2007

Policy proposal and programme cost

The overall target is difficult to cost without specific schemes. However, the additional expenditure would be of the order of £150-200mn a year, assuming that the schemes over and above those currently planned would focus on lower cost implementation. This does not include money already allocated for new and expanding lines (for example Nottingham Phase 2). It should also be the case that developer contributions, focussing on capital cost, should be easier to negotiate for specific rapid transit schemes.

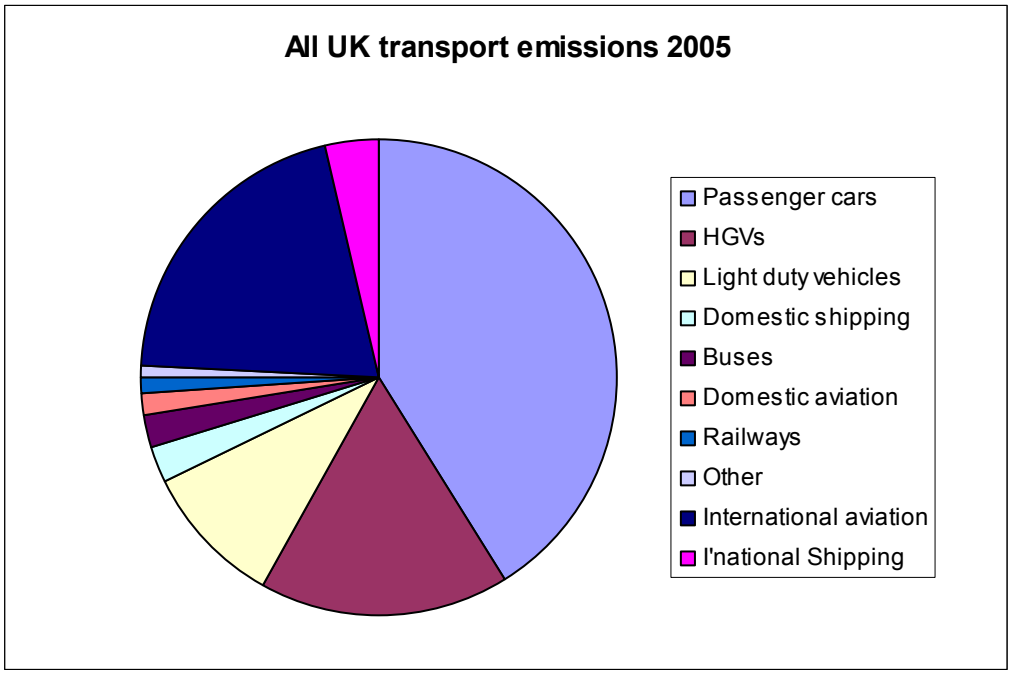
11 Longer distance travel: Aviation

Introduction and context

There are two critical issues to be addressed in relation to aviation policy. The first is assessing the real costs and benefits of aviation to the UK economy, and the second is dealing with the significant environmental problems caused by aviation, including climate change. This is important because the Government forecasts a continuing major growth in air travel, which has already more than doubled between 1990 and 2006, reaching 235 million passengers a year. This is predicted to grow to over 490 million a year by 2030. This has led to consideration of new airport capacity to match, especially in the South East.

At present aviation is a major source of national greenhouse gas emissions, defined as flights taking off from the UK. It is growing very rapidly both here and across the world. The current UK position is shown in the chart below. By 2020 aviation is likely to be the single largest source of transport related emissions.

Figure 11.1



Source: DEFRA data

The issue here is whether such rapid growth is realistic, either in terms of the amount people would have to increase their flying, or in terms of policies which seek to reduce emissions and other environmental damage.

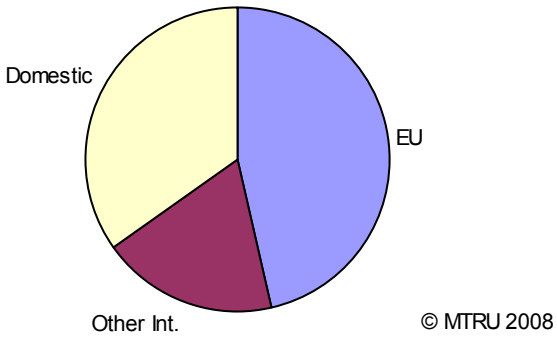
A key issue for this report has been whether bringing aviation more into line with other taxation, either in transport or the economy generally, would cause a sufficient shift in travel to address some of these problems. The indications are that this is the case and the rest of this section looks at two areas of reform which would seek to normalise the tax position and encourage alternatives. The latter could be other modes such as rail, or substitutes for travel such as high quality videoconferencing. The issue for leisure travel is how far it can grow, not just in

relation to climate change but in relation to affordability, both personal and in terms of the export of expenditure (effectively foreign tourism has the same impact as increasing imports).

Differences between domestic and international aviation

Domestic aviation is relatively small in its impact on emissions, in the same area as the total for rail or bus, as shown in the chart above. While this is still worth tackling, domestic aviation is a major driver behind airport expansion, because it requires a large number of landing and take off slots. These amounted to 36% of landing and take offs in 2006. This is shown in the chart below.

Figure 11.2
ATMs 2007 all UK airports



Policies therefore fall naturally into two sections, the first for domestic flights where climate change benefits are worthwhile but modest and there are clear alternative means of travel and major collateral benefits in terms of freeing capacity.

The second is international aviation, where the climate change impact is already serious and growing rapidly, and the issue is whether the forecasts are realistic and what broader substitutes are available.

Domestic aviation growth is in fact already slowing and the CAA believes that this reflects speed and reliability improvements to rail services following the recovery after the Hatfield crash[77]. This effect pre-dates the rise in oil price. A reduction in domestic aviation could alone take much of the immediate pressure out of airport expansion.

In terms of international aviation, growth since 2005 is not uniform and has been focussed on so called no-frills operators and non-UK residents. Government forecasts appear to be based on earlier data and on a range of other relatively uncertain assumptions about improving aircraft efficiency and reducing airline costs.

Without going into individual case study airports, it has been clear for some time that the tax and charging position for aviation generally is poorly related to any identifiable Government objective. Aviation does not meet its environmental costs, even those that have been identified such as noise and air pollution.

Its tax position is privileged in that its users pay no VAT while the airlines claim it back. Nor does it pay any fuel duty. Money spent in the UK economy on aviation is thus a tax loss to the Government apart from air passenger duty (APD) which is considered below. Many of the benefits accrue to non-UK residents.

There is a further important complication in that emissions at high altitudes have an exaggerated impact on climate change – this is known as "radiative forcing". A common assumption has been to multiply the impact of emissions by 2 to 2.5 times, although studies have produced multipliers between 1.9 and 4[78]. Thus emissions from aviation should be adjusted upwards to take this into account.

Current taxation of aviation

Because of its international nature, aviation is subject to treaty agreements, the most well known of which is the 1944 Chicago Convention. This is often used to argue that individual nations cannot apply taxes to fuel used for international flights[79]. Even if it were possible, airlines may well start to plan their routes so that they could avoid the tax by flying to countries which did not apply fuel duty.

There is one compensatory charge levied in the UK, the Air Passenger Duty (APD)[80]. This is considered to be outside the Chicago Convention because it is levied on people buying a ticket to leave the UK and thus not directly a charge on fuel. However, it is precisely for this reason that it is poorly related to environmental damage or climate change. For example, passengers on noisy inefficient aircraft pay the same as those on the most modern and efficient models. It is sometimes said that this compensates for the lack of VAT and fuel duty, although VAT alone would certainly raise significantly more than APD.

In fact, APD is slightly related to distance travelled and thus climate change impact. This is because it has two rates, the first is for the EU nations plus some of their dependencies, and specified countries such as Norway, Iceland and Turkey. This is currently £20 per person. The second is the International rate, which covers everywhere else, and is currently £80. There is also a capacity related rate in that the lowest priced seats (which take up less room) are charged at half the standard rate APD (£10 and £40 respectively).

A common criticism of this approach, also made by some of the airlines, is that it fails to reflect the inefficient use of aircraft. Where there are empty seats there is no charge. It also gives no incentive to reduce fuel consumption. The obvious method of charging would be to tax fuel, since fuel use is directly proportional to CO2 emissions, but this is generally held to contravene the Chicago Convention. The UK Government has consulted[81] on how to improve APD to respond to these concerns, as well as the general issue of aviation and its external costs. A key intention is to move to charging aircraft rather than passengers. The new approach would be implemented in November 2009.

In due course the illogical position created by the 1944 Convention may well be addressed, but it will be a long drawn out and highly politicised process. The Kyoto protocol recognised this and does not include international aviation.

For this reason, this section considers methods which would be better related to environmental impacts but do not depend on a tax on fuel for international flights, or a mile by mile charge related to fuel consumption.

Ways forward

While there is widespread agreement that reform is needed, the simple approach of taxing fuel, even for some international flights, would require at the least an EU level agreement. Meanwhile it is intended to put aviation within the scope of the EU emissions trading scheme (ETS). This is a market in permits to emit amounts of greenhouse gas which are given to companies or organisations. At the moment it focuses on power generation and energy intensive producers. A fixed number of permits are issued for a specific trading period and companies who emit less than their permit can sell the surplus to other companies who have not reduced their emissions. There are major issues over how generous the permit issuing has been and this approach was criticised in Phase 1 of this report.

It remains to be seen whether the practical difficulties of mixing the very different sectors of aviation and power generation in one trading scheme can be resolved. In any case, it is not clear that the scheme will produce any stable and meaningful price for carbon in the medium term due to the ongoing special pleading for extra permits. Much will depend on the base year chosen for aviation.

In the mean time, the current APD is to be reformed. To avoid legal problems and to keep the approach simple, the Government has suggested using maximum take off weight (MTOW), or landing and take off (LTO) emissions, either carbon or nitrogen oxides, as a basis for charging. This could be combined with a modest adjustment for distance. The consultation suggests an EU zone, plus two international zones, up to 3,000 miles from the UK with one price, which would be increased for all flights over that distance.

The Government has also stated that it wishes to increase the charge which replaces APD (as yet unspecified) by 10% in the second year.

One further issue is that of flights not currently subject to APD. These include freight, transfer and transit passengers. The latter are people who may leave their aircraft, but not the airport, while it refuels. They tend to be quite small in number, less than 1%. People who fly to an airport on a short flight to get on a longer distance one can be a far higher proportion. DfT estimates for Heathrow suggest 25%[82]. There is significant disagreement over whether these passengers simply congest the airport and pollute its locality and should be minimised, or whether they contribute to the economy by ensuring a wide range of destinations are available from “hub” airports. One important point is that hubs operate in a European context and their location should relate to the destinations served.

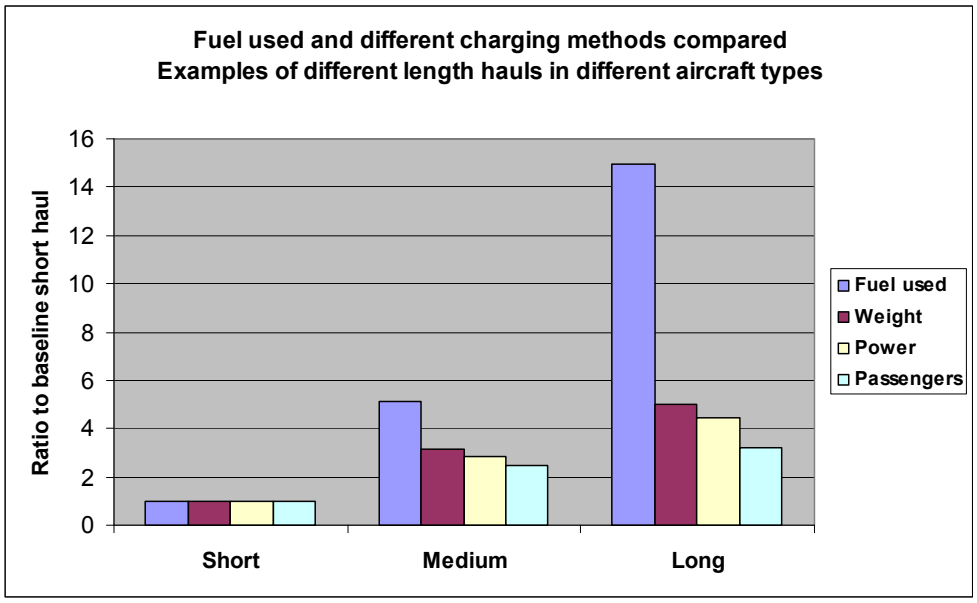
The rest of this section considers different approaches to resolving the twin problems of the generally low level of charging for an important emissions source and its weak correlation with the amount actually produced.

Could a non-distance related charge work?

While it may seem obvious that a per passenger flat rate charge cannot reflect distance, this is not entirely true. The reason is that different aircraft types have to be used for different lengths of flight. The huge amounts of fuel that have to be carried for long distance flights mean that these aircraft tend to be much heavier, with more powerful engines as well as more passengers. Fuel represents a far higher proportion of their take off weight, up to a third, about twice as much as a small aircraft. However, these smaller aircraft, which use less fuel per passenger, cannot fly very long distances.

Thus APD does slightly reflect distance travelled but this is highly dependent on aircraft type. For the purposes of this paper, two other widely available factors were considered, maximum take off weight and engine power (measured as thrust). The detailed workings are available on request, but the results are summarised in the chart below.

Figure 11.3



Source: EEA corinair data[83], Airbus and Boeing aircraft published specifications[84]
The haul lengths chosen were 1,550 miles short, 3,400 miles medium, 6,750 long
Aircraft are assumed to be full and using a standard 2 class configuration
*All flights are **outside** the European zone*

The conclusion is that using passengers as a basis for charging (as APD does) is poorly related to increases in fuel used, especially for longer flights. Weight is best, followed by power, but neither solve the problem.

The two zone approach used by APD does help significantly to raise duty on longer distances compared to some shorter flights, but this is more related to EU membership and EU agreements than distance. For example, the use of an

extended EU plus zone also leads to anomalies such flights to Turkey and the Canary Islands (around 1800 miles) having lower APD than those to closer North African destination (Tangier is just over 1100 miles). Much closer EU destinations have the same APD (Milan is about 600 miles).

While splitting the EU into two zones would help, it is not clear that this would be possible within EU regulations. Established commercial zoning systems, such as Air Miles[85], split the current APD European zone into three. There are four other zones for the rest of the world.

It is clear that current charges do not reflect actual emissions and that a distance element is crucial, whether weight, capacity or power is used to calculate the charge.

The final problem is in relation to the encouragement of fuel efficient aircraft. The basis for any charge, whether weight, capacity or power, is only indirectly related to this factor. However, it would be possible to apply a lower rate of duty if an aircraft manufacturer could show significantly lower than average (taken as 2008) flight emissions per tonne of take off weight. This is the preferred option in this report but may be subject to challenge because of the Chicago Convention.

Creating a baseline: domestic flights

There is one type of flight where the UK has control over charging for use: those entirely within the UK. While some flights which cross the sea need separate consideration due to the lack of alternatives, the vast majority of UK flights compete with the traditional surface modes: coach, rail and private car. Rail and air times are particularly close. It seems entirely illogical that fuel duty, which is said to be an environmental charge (for example for road track cost calculations) should be paid by some competing modes, but not by the most environmentally damaging one. The charge would be doubled until further data is available on the exact multiplier for high altitude radiative forcing.

It should be noted that APD is here considered as a substitute for VAT, and thus makes a contribution to general taxation. It is not strictly an environmental charge. However, it is preferable to VAT because it is better related to environmental damage. The fuel duty should be additional and seen as creating a more level playing field with the other modes in relation to climate change.

Thus the preferred option for domestic overland flights is to keep a fixed charge equivalent to current APD, but reformed in two critical ways. The first is that it should be based on capacity or weight, rather than passengers carried. This should be the same as the international flight basis. This removes the anomaly of it being cheaper to fly an aircraft with a few passengers than a full one. The second is that all aircraft departures should be charged, including freight, transfer and transit passengers.

Flights to the EU and beyond

Moving on to international flights, it is clear that the current extended EU zone is illogical, but difficult to change. A two zone system is preferred, but this would probably be difficult to implement due to the overlap with EU regulations. Thus a flat rate capacity charge of 7p per kg MTOW is proposed, approximately equivalent to £35 per economy seat. This reflects the greater average distances than domestic flights and lack of fuel duty.

There are so many different fares on the same flight that it is hard to distinguish a "typical" percentage change. In addition, the airlines will have discretion as to their pricing and revenue management. Using the Civil Aviation Authority (CAA) averages, European fares would rise by about 19%.

For flights outside this EU based zone, the current flat rate of APD favours longer distance flights and penalises some flights to close EU neighbours, for example in parts of North Africa and Eastern Europe. A two zone system is too coarse to remove such problems.

For this reason, four zones and four charges are proposed as shown below. They have been expressed initially as economy seat capacity to allow for easy comparison with the current APD.

This tapers off in terms of impact at longer distances and should avoid distortions in the choice of refuelling stops. The rate could be reduced if an aircraft manufacturer can show significantly lower than average (taken as 2008) flight emissions per tonne of take off weight. The reduction in rate of duty would be proportionate to the emissions reduction.

Table 11.1
Non-EU zones for direct international flights

	Up to 2000m	2001 – 3000	3001 - 4000	Over 4000
Per economy seat capacity	£55	£70	£85	£100
Per kg of MTOW	10p	12p	14p	16p

Because of the differences between weight and passenger capacity, the above will not be precisely equivalent. However, the seat capacity figures have been produced to allow comparison with APD and allow impact on fares to be assessed.

It should be noted that these calculations are complicated by the way in which different aircraft are used for different length flights. For this reason the figures above have not been constructed using averages across all aircraft types. Instead, they have assumed smaller aircraft for shorter distances, larger for the hauls. This has been based on the limits inherent in the industry standard data which is also used for fuel consumption (Corinair). This is the same data set used by the UK Government in its consultation paper.

In this case, typical economy fares for flying to North Africa would go up by 10%, to New York by 15% and to the Far East by 10%. This would still mean that the total charges (including existing APD) would still be less than adding VAT to fares.

Implementation

Given the wide availability of alternatives, the new domestic system should be brought in as soon as possible, probably 2010.

For other flights, it is suggested that the changes to the structure of the charge is also implemented in 2010, but the increases phased in over 5 years. The reasons for this are to allow for:

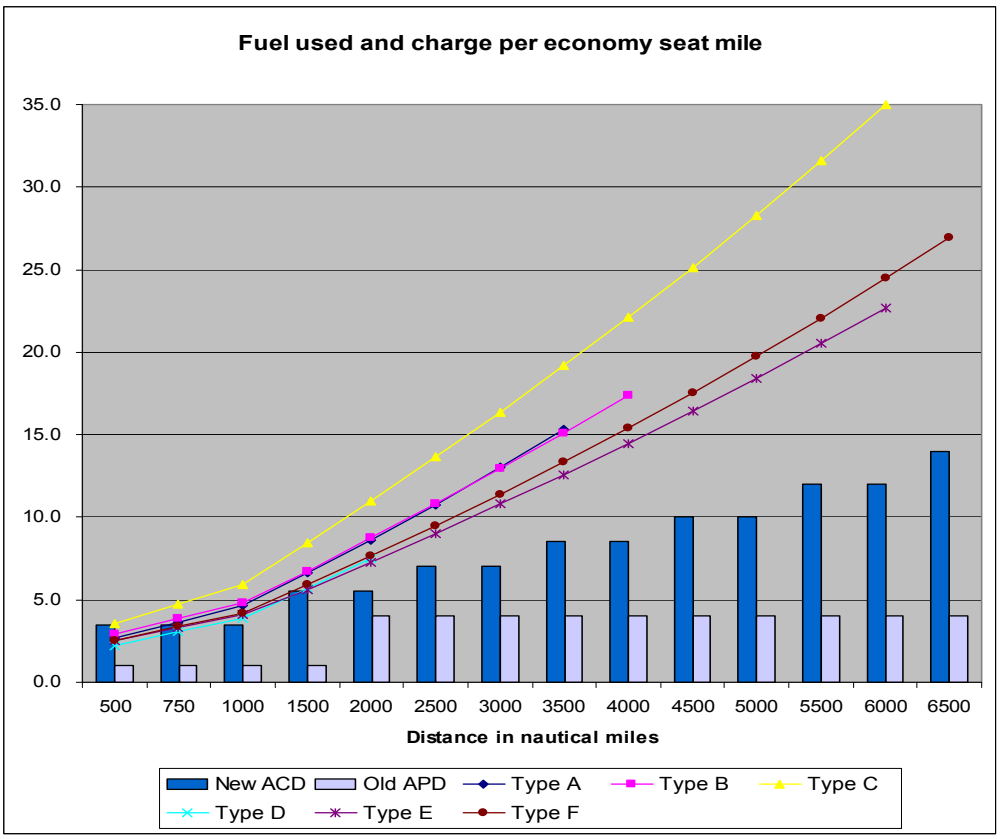
- people planning a special journey a long time in advance
- minimising any one off surge in demand just before the price rise
- time for adaptation by airlines and other transport operators
- clear price signals to the market to encourage energy efficient operation

What is the overall impact of the new approach?

The following two figures try to make the proposed changes as transparent as possible, given the wide range of fares, the different balance of economy and premium seating, and the use of different aircraft for different lengths of flight.

Using Corinair data for fuel consumption, it is possible to review how much fuel different aircraft types use over different distances.

Figure 11.4

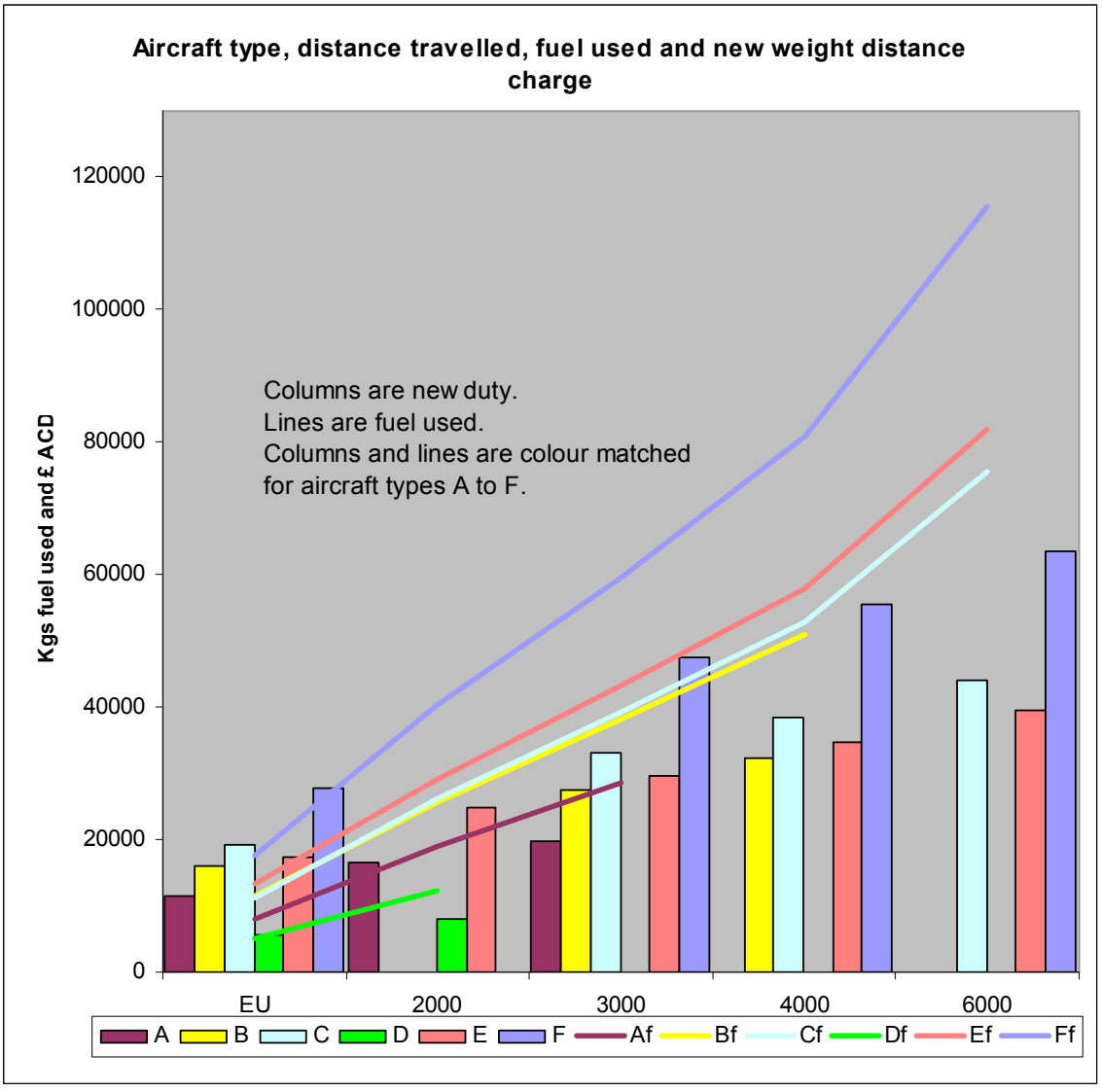


Note: Aircraft types A to F are representative Airbus and Boeing models for short medium and long hauls, sources as Figures 11.3 and 4.

The impact of the stepped approach created by the new ACD zones is immediately apparent. Even four zones do not precisely track the fuel used, however they allow for a great improvement over a two zone approach. They avoid the distortion caused by the sudden change of the original APD at the EU zone boundary, and the way that APD provides no tracking at all of rapidly increasing fuel use.

In the second figure below, a more direct comparison is shown between actual aircraft types and a weight based charge. This pairs the fuel used by an aircraft with the actual level of charge based on its weight.

Figure 11.5



Note: Aircraft types A to F are the representative Airbus and Boeing models used for Figure 11.4, in this case paired so that A is the charge applied to aircraft type A and Af is the fuel used by the same aircraft using Corinair data. The columns show the most likely distance for which each aircraft is used, again using Corinair. All aircraft are shown for the shortest distance as a base comparison. EU is based on a 750m flight.

This proposal is not perfect in matching emissions (or local environmental damage) to charges but is a very significant improvement. It may prove an acceptable compromise in view of the problems of international and EU agreements. These include the Chicago Convention, but also many one to one national treaties.

It should be noted that this approach would effectively remove the need for a carbon charge and have a major benefit in terms of slowing down aviation growth and avoiding airport and surface access congestion costs. It would also reduce local environmental damage, in particular noise and air pollution.

What should be done with surplus revenue?

While the charges proposed would increase Government revenue, it is not proposed that any excess over current APD is used as general tax income. They are genuine environmental charges, and the tax objective is to minimise revenue and maximise greenhouse gas reductions. To improve public acceptability they should be recycled in the most direct manner possible. They should therefore form part of the eco bonus scheme.

Potential local and international problems from new charges

The first point to be made is the obvious one that flights which do not need to come to the UK, and particularly to Heathrow, are likely to be discouraged. It is hard to see how, given the large scale local environmental problems and that Heathrow is so congested, the reduction in aircraft using it as a refuelling or transfer point is anything other than an advantage. Any such passengers do not leave the airport and there is thus no tourist gain. Heathrow supports a wide range of destinations and it is extremely unlikely that this would be affected because of the very strong local demand. It is interesting to note that the development of direct flights from regional airports, rather than flying to Heathrow and transferring, would be encouraged. Alternative means of travelling to Heathrow would also become more attractive, for example from cities such as Manchester and Bristol. Such modes could even be improved using allocated revenue from the charges proposed.

As regards what other EU countries will be doing, most are already concerned about aviation growth, sufficiently so to agree that it will be included in the trading scheme. Some already charge VAT on some flights. In a sense, this proposal provides a parallel and supportive approach to any inclusion in the scheme. For trading to be effective, high prices may have to be charged. The UK would already be on the reduction pathway required to meet its trading requirement.

This means that it is unlikely that the UK in general, or London in particular, would lose out relative to other areas. Expansion at Heathrow is widely opposed by London local authorities and by the Mayor. The approach set out in this report is also entirely in line with the Mayor's climate change policy, which identifies transport and aviation as an area for urgent action.

As regards wider patterns of change, international aviation agreements are very complex. One example is the anomaly which gives greater freedom to US airlines to operate in Europe than European airlines in the US (the gateway problem).

Such factors make it difficult to predict exact operational changes. The US/EU balance may, if anything, be slightly helped by a distance related take off charge.

A further operational issue is whether there would be distortions in where aircraft refuel in order to reduce the charge. The system set out in this report has been designed with this risk in mind. Having more zones and a large final zone (all flights over 4000m) means lower price thresholds and thus less incentive to change stopover points. In addition, the cost penalty of having to land and take off (fuel, time and fees) means it is unlikely that the levels of charge proposed would have the effect of operators inserting an extra stop to reduce the charge.

As regards efficiency improvements, the availability of a reduced rate will raise the importance of this factor in the airlines' purchasing decisions. This cannot be achieved without the knowledge that higher charges are being brought in. The phasing proposal will help in this regard. It is important to note that there is some discussion over whether the optimistic targets for annual improvements in aircraft efficiency, for example those contained in the recent Heathrow consultation document, will be met without direct financial encouragement.

Outcomes

This report is being written in the context of a significant rise in oil price, even since the changing trends in aviation use were identified. The outcome for domestic aviation would appear to be a continuation of the decline and the growth in alternative modes. Between 2006 and 2007 it fell 1.4% and has fallen by 6% in the early months of 2008.

Rail improvements in Europe, combined with the Channel Tunnel and new rail link, will also have an impact on some EU flights. Examples of what can happen are available from the French high speed rail network. The Paris to Brussels Thalys takes 1 hour 25 minutes for 186 miles and this has led to the dropping of all scheduled air services. Between Paris and Marseille (486 miles), the TGV has 69% of the air/rail market (2006), up from 22% before the high speed service was introduced (2001). London to Edinburgh is less than 400 miles. Table 11.2 below shows flows for 2007 between the most relevant EU destinations.

Table 11.2
Flows between near distance EU cities and London airports
Passengers in thousands per year, Source: CAA data[86]

	Paris	Brussels	Amsterdam
Heathrow	1,790	689	1,799
Gatwick	2	60	670
Luton	329	-	321
London City	117	47	262
Stansted	1	-	258
Total London area	**2,239**	**796**	**3,310**

Table 11.3 shows flows between all UK airports and the three nearest national markets.

Table 11.3
Flows between near distance EU countries and all UK airports
Passengers in thousands per year, Source: CAA data

	Belgium	Netherlands	Luxemburg	**Total**
From all UK airports	1,624	8,353	251	**10,228**

This market has also been subject to change over recent years, for example Heathrow passengers to Paris, Brussels and Amsterdam fell by 9%, 7% and 3% between 2007 and 2006.

A recent MTRU study[87] using standard elasticity values found that a package of proposals could reduce demand by 26% by 2030, as shown in the Table below.

Table 11.4
Summary impacts of demand reduction factors in 2030

	Million passengers	% reduction
DfT base forecast (unconstrained)	490	
Oil price impact on fares	417	15%
Improved rail competition	446	9%
Enhanced videoconferencing package	480	4%
All above	364	26%

Source: MTRU estimates

Thus for international aviation the outlook is very difficult to assess but it is clear that an oil price above $100 a barrel (twice the level assumed for previous Government forecasts) will have a major impact and most airlines are planning on this basis. No frills operators are already cutting winter services significantly.

Overall these figures indicate that:

- significant slowing of aviation growth is possible
- efficiency improvements could stabilise emissions even if modest growth occurred
- levels of growth which avoided serious climate change problems would not require new runway capacity

Policy proposals

A per aircraft charge should replace current APD, based on maximum take off weight and distance bands.

A double fuel duty charge should be placed on GB domestic flights in addition to a weight distance charge.

The EU distance zone should be split into two bands but this may be difficult to negotiate. A single zone is therefore proposed in the short term.

Outside the EU a four zone system would strike a reasonable balance between complexity and boundary problems, such as those currently experienced.

Significant increases in the level of charge are proposed, although these do not fully reflect the emissions caused. To put this in perspective, the total charges (not just the increased revenue over existing APD) would still not exceed the application of VAT to international air fares. It would, however, be much better tuned to environmental damage.

Excess revenue from any aviation charge imposed for environmental reasons should be recycled. This could be to those who currently suffer airport pollution. Alternatively, income from leisure flights could be recycled to the general population and from business flights to businesses.

12 Long distance travel: Car

Introduction

Although the car is the main mode currently used for long distance personal travel, the uncertainty over how to plan for its future use has never been greater. Changes in vehicle technology are coming forward which are probably more far reaching than for a century. These are seen as critical to the achievement of climate change goals. Most of these, including currently available solutions such as hybrids, have completely different patterns of fuel consumption. They can use less fuel per mile on slow local journeys than for faster journeys on motorways – the opposite of current patterns[88]. The link between congestion and extra fuel use is also largely broken with this and other technologies such as electric or hydrogen fuel cells. Slow speeds become even more fuel efficient than at present. This has very significant implications for policy, in particular:

- the way in which faster travel has simply been used to travel further,
- the relationship between congestion charging and climate change, and
- reducing maximum speeds.

Speed, congestion and fuel consumption

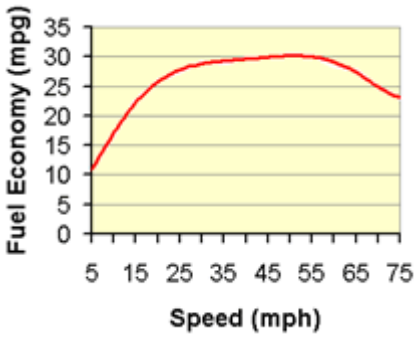
Fuel consumption figures vary according to many different parameters, but the basic shape of the fuel consumption curves are illustrated in Table 12.1 below.

Table 12.1
Patterns of fuel consumption at low speeds

Speed mph	MPG Golf	Prius
10	15	70
20	29	82
30	40	87
40	47	85
50	41	65
60	34	57

The above are not under comparable conditions and are to show the pattern of consumption only

Graph for "typical" US saloon



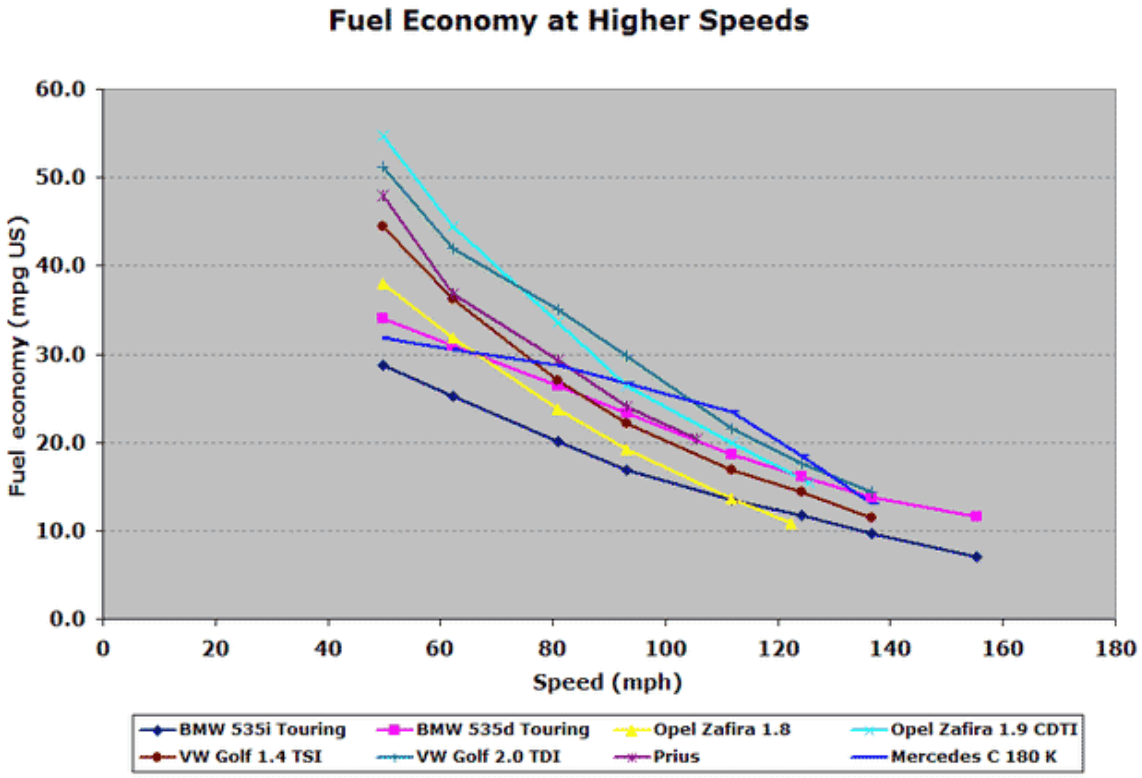
Sources: US Department of Energy, metrompg.com

It should be noted that the non-hybrid examples are conventional engines, with no simple improvements such as stop-start. It is the relationship between fuel consumption and speed which is the key issue and which will be so different in future.

This analysis is crucial to policy development for two reasons. The first is the application and enforcement of existing local speed limits especially below 30 mph, and the second is the possibility of enforcing the existing maximum limit of 70 mph or introducing a new national maximum speed limit of, for example, 60mph.

The relationships between speed and fuel consumption at higher speeds are illustrated by the chart below which is from test track comparisons sponsored by German magazine Auto Bild[89]. The purpose was perhaps to show how efficient conventional cars could be at high speeds. However, an even more important conclusion is that the type of vehicles which are being introduced to achieve the desired fuel efficiency improvements are coincidentally far less effective when used for high speed driving.

Figure 12.1



Source: Auto Bild May 2006, speeds actually tested were 80, 100, 130, 150, 180, 200, 220, 250 km/h

The safety arguments for lower speeds in local communities have widespread support and were included in the local travel chapters on walking and on car use. For longer distances, there have been studies proposing either proper enforcement of the current limit, or a lower limit, again with proper enforcement. This can be through camera, or possibly vehicle, technology.

As well as fuel savings (and thus emissions reductions) there are clear safety benefits.

There are two obstacles to introducing such policies: arguments over the precise costs and benefits of a lower speed policy; and public attitudes.

Analysing the impact of speed control

In analysing the impacts of speed reductions, there seems some consensus about how to calculate the number of drivers affected (not all exceed the limit) and

accident severity. All agree that road deaths and severe injuries would be reduced because the severity of accidents rises with speed. There are two areas of difficulty: the exact relationship between speed and fuel used; and accurately assessing the costs. The latter include:

- time costs of slowing down car users,
- value (excluding taxes) of fuel and emissions saved, and
- enforcement, especially capital cost of equipment such as cameras.

Time costs

Some studies, including recent analysis in relation to climate change[90], undertake a cost benefit analysis of the type usually applied to road schemes. Because the slower speed means longer journey times, applying the standard DfT values for time can make the proposals look costly, especially those based on lowering speeds to less than 70mph.

In fact, these costs are often omitted, partly because the lower speeds would change journey lengths to match journey times (the effect clearly displayed in the National Travel Survey and discussed in more detail later in this section). The other point is the moral and political paradox created by applying a survey based time value to the disbenefits of obeying a legal limit in order to justify not enforcing it. As stated earlier, the limit has a clear rationale in that it prevents a number of road deaths and serious injuries.

Real fuel savings

The next problem seems to be that fuel savings have so far been costed at low oil prices, in particular follow previous assumptions about oil prices falling by 2020, from 22p per litre (petrol) to 19p per litre. This is equivalent to around $50 a barrel, half that of today[91]. Even use of today's values would result in a major change to the cost benefit assessment, especially in 2020 when the cumulative extra benefit would exceed £2.5billion for fuel alone.

Enforcement costs

The final oddity in the calculations is the huge sum, £4.6billion (in studies higher) allowed for the capital cost enforcement. This mainly relates to introducing speed cameras throughout the motorway network. This means that a cost benefit analysis based on 2010 shows huge disbenefits, although by 2020 the benefits have overtaken this major cost[92]. A DEFRA document referring to speed limit enforcement appears to reach a different conclusion[93] so that in 2020 there is still no net benefit. This major cost has been challenged by recent CfIT work[94].

The CfIT report argues that a package of enforcement, including public awareness, would be far cheaper and almost as effective. The argument that the cost of enforcement rises as total compliance is approached, so that the last 10% of non-compliance is by far the most expensive, must be accepted here. However, there are other developments which make the enforcement of speed limits a logical part of managing the trunk road network.

Active Traffic Management (ATM) is a process which has been trialled (most recently on the M42) and is now to be rolled out across many sections of the UK trunk road network. The Highways Agency list the benefits[95] as:

- increased capacity,
- reduced journey times,
- increased journey time reliability,
- lower emissions and lower fuel consumption.
-

Integral to ATM is the use of variable mandatory speed limits, by slowing traffic down, the flow is made more regular and thus capacity increases, and congestion is reduced. Accidents cause less disruption because of the active management in regional control centres, and safety is improved anyway through the control of speed and real time matching of limits to road conditions.

The roll out of ATM should include the capacity to enforce speed limits, since the key to success is the feedback of information to the control centres, This could and should include provision for improved enforcement of existing and variable speed limits. The benefit to cost ratio of ATM is very high and thus the assessment of speed limit enforcement or reduction should include only the marginal cost of using the ATM programme. Given that speed control is so important in ATM, and is needed in any case, this marginal cost would only amount to the administration of the enforcement process. Digital enforcement cameras were part of the M42 pilot.

For this reason, the enforcement of existing limits should be pursued both within and outside the ATM programme, but always in a manner compatible with it.

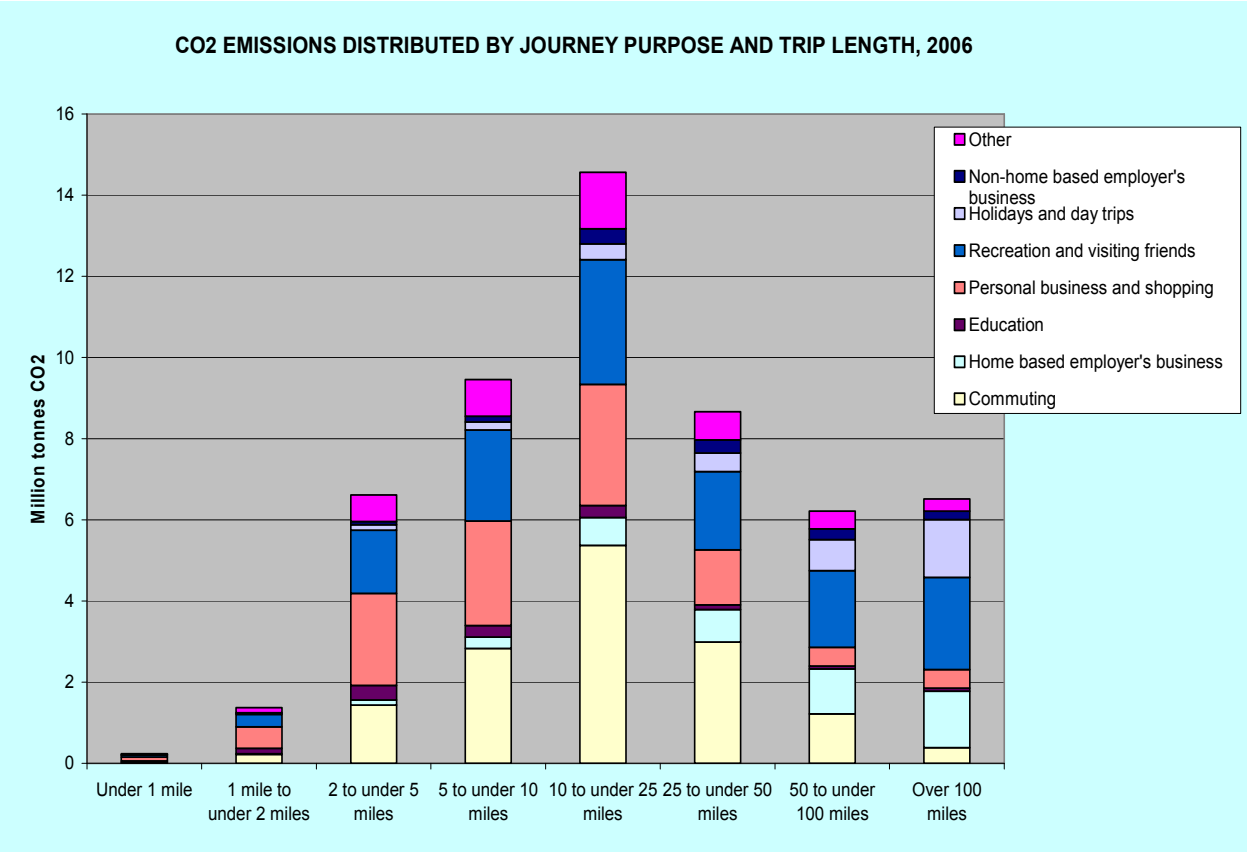
Level of emission reductions: mode switch and journey length

What is clear from any analysis of the NTS or similar data sets[96] is that long distance journeys differ in purpose from local journeys and require a twin track approach of mode switch and reducing total distance travelled.

In relation to longer distance car travel, the number of journeys may be small, but the contribution to emissions is high. The extremely useful DfT carbon pathways analysis[97] shows how only 7% of car journeys are over 25 miles, but these produce 38% of the emissions.

As journey length increases, journey purposes change, with business use and holidays becoming more important while commuting, shopping and personal business journeys become less so. There are very few 100 mile commutes or shopping trips and this is exactly as would be expected.

Nevertheless, it is perhaps surprising that in the middle distances, for example 10 to 25 miles, there is a significant amount of emissions from shopping and even more so from commuting. The latter is equally important in the 25 to 50 mile category. A chart from the DfT report which sets out this analysis is reproduced below.



As set out in this report and elsewhere, vehicle technology improvements are insufficient to meet emission reduction targets, and are slow in their impact. Behavioural change is important, both for individual purposes and in terms of a comprehensive package which provides low emissions alternatives.

The approach to this is both from individual choice, actively supported through the various travel planning approaches, and a recognition of the different network requirements for the different distances involved. Some of this may not involve the travel planning pathway, for example the improvements in rail comfort, speed and reliability in the last few years have clearly had their effect and will continue to do so. Given a rise in fuel price (either through the oil market or fuel duty) decisions will change, leading to mode switch or the substitution of electronic communication for travel itself.

In this sense, the encouragement of videoconferencing in the context of avoiding international aviation will be just as important for business journeys undertaken by car. The integration with domestic flight fuel duty is important here – it is sometimes cheaper to fly between British cities than drive. Clearly there are productivity gains to be made from using the train and this means that at least part of the travel time can be viewed as a benefit and not a cost. Given good local transport access at the end of a rail journey, this is already a preferred mode in many circumstances.

Each purpose will find its own pathway, some examples of the most important purposes for longer distances are given in the Table below.

Table 12.2
Examples of longer distance travel alternatives to car use
(Walk is used as link mode in all cases)

Journey purpose	***Alternative to car use***
Business (not commute)	• Rail (work on train)+local train/tram/bus/taxi • Videoconferencing
Holiday	• Rail+local bus, cycle or car • Express Coach/local bus, cycle or car
Commute	• Rail+ local bus, cycle or car • Car share • Work at home

By definition, the application of Smarter Choices results in specific measures or combinations of measures in a package which is tuned to the individual circumstances. This is one the aspects which makes its impact on car use easier to assess than its impact on individual modes such as walk, bus, cycle, car sharing or electronic substitutes.

The second important factor is the way in which people adjust their journey patterns so that time spent travelling varies to a very small extent, and faster journey speeds have led to an increase in journey length. Avoiding whole journeys by fulfilling a requirement by other means (such as working from home or videoconferencing) is one option for commuting or business travel. Choosing closer but similar destinations for shopping is an example from private motoring. These new journey choices will differ by purpose, as will choice of mode.

Chapter 3 showed how any time savings from faster journey times over the last 20 years have been absorbed by longer distances. In fact, the concept of a relatively constant "travel time budget" has itself been used for several decades. One issue here is the income distribution of those who benefit from time savings, and within the aggregate budget there will be major differences[98].

Nevertheless, it is clear that, in a world with so much choice of destination for similar purposes, it is entirely logical that people will vary their choices according to factors such as time. Thus any analysis of the impact of policy will have to consider a transition from longer to shorter journey bands in combination with mode transfer. An example of this would be the earlier discussion on the strategic importance of walking in Chapter 6.

Summary

Given the increases in levels of traffic and the inability of any capacity expansion to deal with the most popular stretches of road and times of day, what is the vision for longer distance travel by car?

This analysis suggest that there could be improvements well before 2020 in the reliability of such journeys and decreases in the most severe congestion events through the roll out of ATM. In this sense driving quality will improve. However, part of this will involve an adjustment in the perception of how long it takes to drive a particular journey – speeding is currently built in to many people's estimates. Thus perception may become more realistic.

Any decrease in HGV flows (see the following chapters on freight) will be of great benefit to drivers, who prefer their removal to most other transport measures including road widening[99].

The use of speed controls and increases in fuel price would do much to slow down traffic growth, although not the total number of journeys. People may rationalise their journeys and make new choices. In combination with improved travel planning, both at the personal level and at destinations, traffic could be stabilised and reduced. This offers a package which achieves some, though not all, of the objectives of national congestion charging. It would be combined with the local travel package, including land use policy, which has been described in the earlier section of this report.

In terms of climate change, such a package would be better tuned to emissions reductions than congestion charging. The challenge is to assess where the two might differ.

Policy proposals

ATM is a positive and early measure which would assist motorists but offers the potential to assist in the reduction of emissions directly (through improved traffic flow) and indirectly (through more realistic journey time choices).

National speed limits should be enforced to a far higher level than at present and this should be co-ordinated with the roll out of ATM.

The use of variable speed limits should be included in a new debate about further reducing national limits on motorways and trunk roads and setting target average speeds.

Road maintenance requirements need to be reassessed in the light of HGV controls but not reduced.

The need for road building generally and the particular costs and benefits are in a complete state of flux and capital expenditure needs to be slowed down significantly up to 2020.

The drivers' package suggested in the local transport section would also benefit longer distance car users.

13 Longer distance travel: public transport

Overview

The dominant public transport mode for longer distance travel is rail, although the role of longer distance coach travel has been difficult to assess since 1991, when the DfT stopped collecting statistics. Major changes occurred with deregulation and denationalisation (of the National Express Bus Company) in the 1980s.

What is the role of long distance coach?

It appears that intercity coach travel on scheduled services has increased since 1990, using the National Express network historical figures[100] and their own latest passenger figures[101]. These appear far lower than earlier Government statistics both because of a lack of data from other operators and because national statistics include different categories of travel. These include airport feeders, commuter services, private hire and excursions. DfT estimate that about 14% of non-local bus and coach services are scheduled intercity services[102].

The remaining national source is the National Travel Survey (NTS). The NTS definition "non-local bus" is a broad one and in general terms shows that use of this mode is much more likely than domestic aviation, but that it has declined in the last decade. This is subject to large sampling errors[103].

However, choice of mode clearly changes with distance. Combining NTS data from 1992 to 1999, a major overview of public transport calculated the pattern of long distance mode split. The latest NTS figures have also been extracted and are shown below.

Table 13.1
Percentage mode share by distance
1992-99

Distance kms	Car	Bus & coach	Rail	Air
80-120	86	4	8	
121-240	84	6	8	
241-402	80	7	11	1
403-563	69	12	13	4
>563	46	10	20	23

Source: Public Transport, White, P, 2002, Table 9.1, based on NTS

2004-06

Distance kms	Car	Bus & coach	Rail	Air
80-120	85	3	11	
121-240	85	4	9	
241-402	80	6	12	1
403-563	72	8	14	5
>563	42	5	12	39

Source: NTS 2006

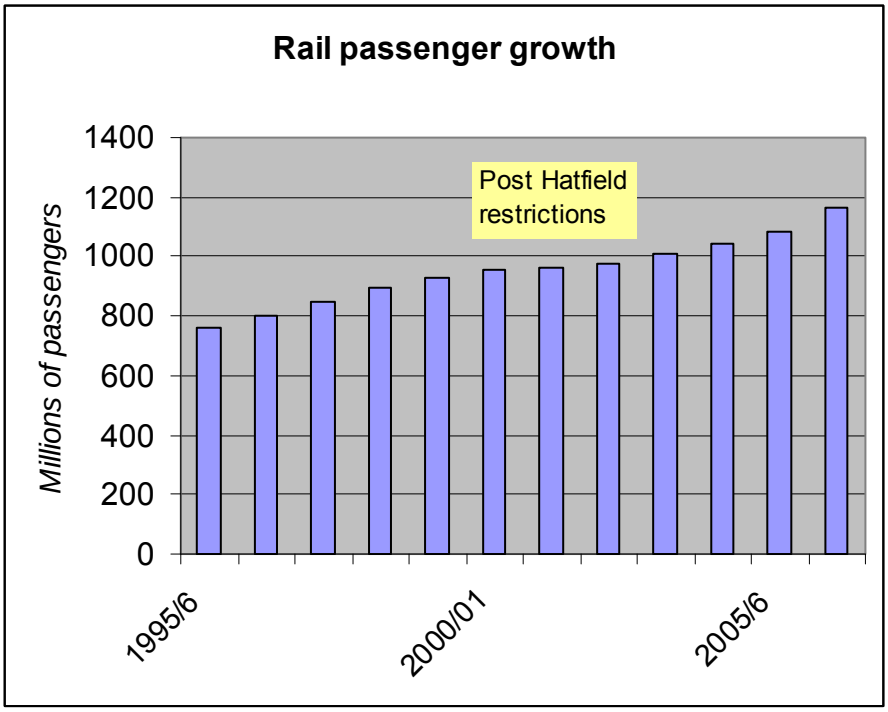
In terms of mode competition, this shows the growth of domestic air, a weakening of coach travel and an improvement in rail except for the longest journeys. Rail use is continuing to grow strongly and it should be noted that recent CAA data[104] shows a 2.5% decline in domestic flights between 2007/8 and 2006/7.

Overall the unclear picture for long distance road public transport is a major omission, especially when the amount of data which is available for rail or domestic air is considered. In terms of CO2 emissions for this report, the impact of an increased long distance mode share for coach travel is likely to be positive in terms of emissions. It is hard to be more accurate than this given the lack of data. It should be noted that long distance services do not receive fuel duty rebate.

Rail travel growth

Rail use has, however, much more comprehensive data and this shows strong growth in recent years, with a temporary pause caused by the restrictions following the Hatfield rail crash. The NTS reveals that rail has been a major source of travel growth in the UK[105] in terms of miles per person, both in the last decade (45% growth) and in the last five years (13%). Figures from the rail operators show similar strong growth in passenger numbers as shown in Figure X.

Figure 13.1



Source: TSGB 2007

These figures are for rail travel as whole, and the Office of the Rail Regulator gives some breakdown, looking at the different operators[106]. This is set out below.

The analysis is not quite what it appears because operators in each category have a range of journey distances. However, both the regional and long distance operators have seen very significant growth.

Table 13.2
Billion passenger kilometres by operator type

	Long distance	London & SE	Regional
2002-03	12.9	19.8	6.9
2003-04	13.3	20.1	7.5
2004-05	13.4	20.5	7.9
2005-06	14.2	20.7	8.3
2006-07	15.6	22.2	8.5
2007-08	16.5	23.5	8.9
Change	+28%	+19%	+29%

This growth is despite a significant increase in long distance fares, with first class rising 52% and unregulated standard fares 48% (cash terms 2002 to 2008). All fares in cash terms and with RPI adjustment are shown in Table X below.

Table 13.3
Fares increase for long distance operators 2002 to 2008

	First	Standard	Regulated Standard	All
Cash	+52%	+48%	+26%	+42%
Real (RPI)	+25%	+22%	+4%	+17%

Source: ORR 2008

Other sectors have shown significantly lower fares increases, with the equivalent real price figures for all tickets at 4% for regional operators and 4.5% for London and South East.

In summary, there has been significant growth in all sectors, but higher for operators outside London and the South East. For regional operators the strong growth has been in a period of relatively stable fares. For long distance operators the equally strong growth has been in the context of fares rising in cash and real terms, particularly where these are unregulated.

Current policy for rail

While longer distance coach operations and vehicles have been left to the market, and infrastructure investment has been limited to facilities, the issue of national rail investment is a major focus of analysis.

Government published a White Paper in June 2007[107], and this recognised the need for capacity increases, for example the London – Birmingham – Manchester corridor (West Coast Main Line). A wide range of improvements have been put in hand, including tilting trains, longer trains and platforms, local track improvements to remove bottlenecks, and modern signalling. Some of the anticipated improvements are significant, as shown below.

Table 13.4
Journey time savings from London after route improvements
Via West Coast Main Line from December 2008

	Birmingham New Street	Manchester	Liverpool	Glasgow
Before	1hr 43	2hr 41	2hr 53	5hr 06
After	1hr 23	1 hr 58	2hr 07	4hr 09

Source: Network Rail, News Release September 8, 2008

The strategy contained the Government's High Level Output Specification (HLOS). This set out the outputs the Government wished to purchase from the railway, particularly relating to the period 2009 to 2014, known as Control Period 4 (CP4). This was accompanied by details of the funding that Government proposed to set aside for the railway (known as the Statement of Funds Available or SOFA).

The strategy and HLOS did not envisage the need for any major new high speed lines or electrification saying that,

"On inter-urban routes, current evidence suggests that maglevs and dedicated freight-lines are not appropriate solutions – both are too inflexible, and maglevs are too expensive to provide value for money. At present the balance of advantage would appear to favour new services running at conventional speeds and operating on an existing disused alignment. But this is not a decision that need or should be taken now. Further assessment of the options will be undertaken to inform the next HLOS." (page 12).

This now appears to be under review already, with Network Rail announcing in June 2008 that it,
"will be conducting a strategic review into the case for building new rail lines across the network of Great Britain. The review will look at five of Network Rail's strategic routes, north and west of London: Chiltern, East Coast, West Coast, Great Western and Midland Main Lines."

It goes on to say that, "an initial report will be completed in summer 2009."[108]

This is mainly due to the fact that, despite the capacity improvements outlined in the 2007 strategy, by 2024 the forecast is that capacity limitations will start to cause problems for passenger services on major routes. This is not confined to London based corridors.

New capacity has been the subject of proposals[109] by the Greengauge 21 Group which considered five corridors:
• Corridor 1: London – Birmingham – Manchester
• Corridor 2: London – Cambridge – Northeast
• Corridor 3: London – Bristol/Cardiff
• Corridor 4: Trans-Pennine
• Corridor 5: Anglo-Scottish.

These are similar, but not identical, to those included in the new Network Rail study. Much of the pressure for new lines is related to the long time scales needed for planning and approval. Studies undertaken for the now defunct Strategic Rail Authority (SRA) showed reasonable benefit to cost ratios[110]. This was, however, in the context of high capital costs, from £9billion to £31billion.

Reopening rail lines and services

While the issue of new lines has been the focus of much attention, the reopening of rail links, or their expansion, where alignments are still available, should not be ignored, especially in the period up to 2020. Some of these may be more suitable for light rail operation (of all kinds) but the cost benefit analysis will change significantly in the context of carbon pricing and oil price increases. For example, the Buxton Matlock reopening, which would not become viable until after 2020 in the original assessment[111] would have its benefits significantly increased if the climate change impact and the impact of increased fuel costs (either through oil price or higher duty) were included. The most likely effect would be to bring forward significantly the date on which its operating costs were covered by fares income (one of the key criteria in the original study). Network Rail are now considering this option in their medium term plans[112].

Services can also be introduced if capacity can be made available. An example is the direct service between Norwich and Cambridge, introduced in 2002[113]. This paralleled the A11 and surveys undertaken after two years operation showed 44% of users had transferred from car. There are now 16 trains a day (each way) and 700,000 users a year.

Reopenings are by definition at a detailed level of policy implementation. However, any longer distance policy must include schemes in this sector of rail improvement, both in their own right and in terms of feeding into the wider network. Some of these will be of local significance rather than provide new long distance opportunities. There needs to be a centrally co-ordinated reappraisal of reopening opportunities. Environmental impacts need to be taken into account and in some places there will be problems where tracks have established alternative uses, particularly cycleways.

Assessing the value of new high speed lines

Given that there has been considerable detailed work already, and that a completely new study is to be completed next year, this chapter does not draw specific conclusions on whether high speed rail (HSR) projects should proceed. In addition, new research for the Conservative party has suggested that a high speed line between London and Manchester, allowing faster times to Leeds, would be better value than a third runway at Heathrow. This is now party policy.

In general terms, it is possible to identify areas where problems in the planning of high speed lines need to be addressed. The first is in assessing the financial costs and benefits, the second is assessing any emissions savings.

Assessing benefits
The first is in relation to benefits. There is already considerable argument over the real value of time savings in relation to road schemes. For rail, such savings need to take into account the positive value of some of the time spent on a train journey. However, this is not a simple calculation.

Making work easier on the train has been, and probably still is, one of the best investments possible in terms of creating extra work time. This makes rail attractive for business users, but also means that reducing their time spent on a train may be valued lower in a cost benefit analysis using the same approach as that for road schemes and thus inhibit investment in rail. On the other hand, in a direct comparison of a rail and road journey cost, the productive time on the train should make the rail option more attractive. Unfortunately there are other reasons that this does not always find its way into decision making, as is discussed in more detail in Chapter 16.

In addition, working time on the train may have value, but is only a part of the journey time. It may well not be as valuable as time at an office with full workplace resources available. This is particularly influential when considering the value of faster train journeys, because it will be diminished if saving travel time was considered of no value. This is an important issue for appraisal, both for existing route improvements and for the proper assessment of new lines. As elsewhere in transport appraisal, the technical methods used should not be allowed to produce undesirable outcomes.

The "agglomeration" benefits attributed to higher speed rail (or any other longer distance mode) also require examination. Connecting cities is an unconventional way of looking at agglomeration, which is more usually associated with increasing the density of urban business districts. A new term is required, and any effect must be separately identified and justified.

Emission savings
The second relates to carbon savings. Here the high speed options need to be treated fairly in relation to load factors. For example, the White Paper compares CO2 emissions using the following:

Table 13.5
Long distance load factors

Urban bus	Intercity coach	Intercity rail	Other rail	Domestic air	Cars
20%	60%	40%	30%	70%	30%

Source : DfT Update to Figure 11.1 in Delivering a Sustainable Railway

Issues as to whether higher load factors for HSR would be possible, for example Eurostar is closer to aviation with an average in 2007 of 60%[114]. This is even higher, 65-70% for London to Paris and Brussels. Eurostar themselves publish emissions figures for their trains which are far lower than the White Paper, and figures from their table are shown below[115]. These are based on actual load factors and the specific energy suppliers used.

Table 13.6
Eurostar claimed emissions

London-Paris (return)	Kg CO2 per passenger trip
Short-haul air (average) Heathrow	122
Eurostar	10.9
London-Brussels (return)	
Short-haul air (average) Heathrow	160
Short-haul air (average) Gatwick	222
Eurostar	18.3

Source: Eurostar

These figures would, however, vary considerably according to what source of electricity is used for the calculation. For example, the Eurostar figures would treble if the average power generation CO2 emissions were used rather the nuclear power suppliers which they currently use. This would still mean significant savings. In the Network Rail or any other assessments, some assumptions must be made about future emissions from electricity suppliers and these must be made explicit.

Overall in relation to carbon, this means that high speed rail should offer worthwhile savings in relation to air travel and car use, even when car occupancy is more than one. However, it would not offer savings if passengers were switched from slower trains. Thus the calculations depend on whether the growth on high speed lines would have occurred anyway, but taken place by car or air, or whether it is generated and requires additional trains to be run. If the generated traffic simply increases load factors, the savings will still be valid.

This illustrates the need for clarity in the analysis and the impact that simple assumptions can have on the results.

Comparing options
In terms of longer distance transport it will be essential to consider how one piece of infrastructure can substitute for another. For example, if rail can provide an attractive alternative to domestic air travel, runway capacity would not have to be increased. The aviation chapter showed how almost a third of all landings and take offs are on domestic flights. This would be even higher if close European city destinations are taken into account. The issue here is that building new runway capacity and new rail capacity are unlikely to be value for money if pursued at the same time, since they are inherently competing for the same business.

Supplementary environmental issues
There are a range of environmental issues other than climate change in relation to new rail lines compared to expanding existing alignments which must be considered. Noise and visual intrusion are clearly important in this regard. Such factors can make the cross modal comparisons challenging, for example a runway has very intense pollution and noise impacts while rail has less intense effects which occur throughout a route. As road vehicles become less polluting in terms of

engine emissions the particulates from tyre and brake wear will remain and thus rise in importance.

Improving public transport emissions

Rail

There still remain opportunities for greatly improving rail emissions through lighter trains (electrification assists in this regard), regenerative braking and improvements in electricity supply or on-board propulsion. Rail is a very small proportion of transport emissions but these would rise slightly over 1990 levels. DfT estimate the gross increase at 6%, although emissions per passenger kilometre would fall by 50%[116].

It should be noted that the DfT calculation does not include any significant increase in electrification of the network or new technology for self-propulsion. Diesel remains at 47% of the total passenger rail emissions. Freight is assumed to stay 100% diesel hauled. Currently, about 39% of the network is electrified[117]. Electrification is best implemented by a rolling programme with an established team approach.

Apart from electrification, a major issue for transport policy becomes how much generated traffic there is within the future increases in rail travel and how many passengers have been attracted from the less efficient long distance modes. Expanding capacity rather than speed and pricing other modes on the basis of emissions is the most likely package to maximise the benefits in terms of climate change.

Bus and coach

Efficiency is already an issue for coach operators who do not have the financial cushion of fuel duty rebates (BSOG). These vehicles also have higher technical specifications. Hydraulic (retarder) braking is already in common use and has improved efficiency to a modest extent. However, overall improvements for all buses and coaches need to be encouraged through purchasing policy. Major operators who participate in trials of new technology (such as the EU CUTE project) have helped to test some of the more radical options in a real operating environment.

To make progress, incentives for efficient vehicle purchase need to be offered in addition to fuel duty through the VED system. At the moment, buses and coaches receive a discount if they reduce their air pollution and obtain a Reduced Pollution Certificate (RPC)[118]. Carbon dioxide is not included in this scheme. While keeping the total VED take constant, CO2 emissions should be included so that hybrid coaches pay less than at present, while those which are polluting and less efficient pay more.

High load factor coaches are also an effective way of providing alternatives, particularly, but not solely, where rail is not available. For a range of specialised services such as excursions and holidays, as well as longer distance travel generally, bus and coach can offer low carbon and low cost alternatives. Without

more comprehensive and reliable information it is difficult to be more precise. Thus a key recommendation is to establish a proper national data base.

Interaction with private car mode

Both overall use and any emission benefits depend crucially on how far any gains by public transport displace car journeys, either those that take place today or those predicted in future. There is no data available to predict precisely the combined impact of rising fuel cost, more realistic taxation of domestic air travel, slower car speeds on motorways, rail improvements including shorter journey times and improved quality (both in terms of better rolling stock and reliability). There is sufficient evidence that it would create powerful change in the long distance travel market.

Policy proposals

DfT should commission a more comprehensive data set for longer distance road public transport.

Vehicle technology improvements for longer distance road vehicles should be sought in parallel with local bus design.

Reopening rail connections should be reconsidered in the light of new BERR oil price forecasts and DEFRA carbon prices.

Network Rail should consider both a speed priority option and a capacity priority option in its latest study on new rail capacity. The analysis should be explicit about assumptions on

- load factors,
- level of electrification, and
- sources of electricity supply

and how these change the costs and benefits.

The study should look at all options including new freight only sections.

A rolling programme of further electrification of the rail network should be assessed as a matter of urgency in view of the uncertainty over self-propulsion methods and the DfT prediction of rising emissions from rail.

High speed lines should be considered but detailed issues about how many high speed limited stop paths are needed and how best to provide them (with and without new lines) should be included.

No study of future rail capacity should prevent or delay implementation of capacity or other improvements to existing lines, including further electrification.

14 International maritime freight

Marine contribution to climate change

Domestic coastal shipping produces about 3% of carbon from UK transport sources[119]. This does not include international shipping.

Globally, international shipping may produce between 1.8% and 3.5% of greenhouse gases but the picture is complicated by the use of a particularly impure form of fuel oil. This produces so much sulphur dioxide that this reflects sunlight in the wake of the ships, producing localised ocean cooling. This is a relatively small effect, but is sufficient to balance out the warming produced by CO2 and NOx emissions from the ships' engines. However, while average warming effects are negligible, climate change effects are still strong, because the cooling is very local and the warming is global[120]. Shipping overall is growing steadily, in line with increases in global trade.

The temperature variation problem will decrease in future because low sulphur fuels are being introduced through international agreement[121] and the cooling effect will thus be reduced. However, the warming effect will remain and shipping will become a positive net contributor to global warming overall. The low sulphur policy is on grounds of damage to the environment, which is also caused by the use of the low grade fuel oil. This is so viscous that it has to be pre-heated before it is burned and produces particulates as well as NOx and CO2. Attempts are also being made to reduce NOx emissions.

Sensitivity of maritime freight to oil price

As the cost of fuel changes, the cost of international freight movements will rise or fall in price. This will in turn affect where in the world goods are produced in relation to where they are purchased and used. Fuel is not the only cost but is significant and rising.

In fact, the sensitivity of maritime shipping costs to fuel costs has increased rapidly in recent decades for several reasons.

Changes in the nature of deep sea shipping

The first is that ships now spend less time in port, due to containerisation and faster, mechanised loading and unloading. This has increased the importance of at-sea costs which include a larger fuel element.

Secondly, ships have been designed to travel faster and this has increased the tonnes carried per ship per year, making better use of their high initial investment. Financing trade becomes cheaper, because goods are in transit for less time. However, this has meant a fuel penalty. This was accepted because the cost of fuel was low compared to the capital cost of the ship and crew costs.

Finally, the removal or reduction of many import tariffs through world trade agreements has meant that imported goods have become cheaper, but that the

cost of transporting them long distances has become a higher proportion of the final price.

Impact of the oil price rise: short term

Understanding the fuel cost element

There are three main elements in the cost of shipping – hiring the vessel, the fuel price, and the port charges. In recent times the charter rates and the port charges showed wide variation with the fuel relatively cheap and stable. For example, discharging oil in a European port could cost between $0.66 and $1.84 per tonne[122]. Ports will set prices to attract traffic.

The cost of chartering a ship depends a great deal on the demands of global trade relative to available fleet capacity. In relation to the latter, building new ships clearly takes some time. To illustrate this pricing issue, hiring the largest dry cargo ocean vessel (Capesize) was about $30,000 a day in 2004 and about $80,000 a day at the start of 2008. The market is very volatile[123], but at the time of writing (June 2008) this has risen to between $140,000[124] and $200,000 a day[125]. Capesize ships are used in particular for raw materials such as coal and iron ore.

Across the longer distance sectors, because short term bulk capacity is fixed, the ship charter market is very sensitive to fluctuations in demand.

There is thus variation in the proportion of shipping costs represented by fuel arising from the volatility in charter rates and the choice of port before any variation in oil price is taken into account.

However, the recent oil price rise has had a significant effect on the cost of shipping and this can be illustrated by reworking some published figures for a trip between South America and Northern Europe. The payload is 80,000 tonnes and in 2004/5 was taking about 24 days. There are some lesser scale weather effects which can effect fuel consumption, but these are not relevant in this comparative analysis. The analysis is shown in Table 14.1 below. The next table shows the effect of slowing down the ship by 5% (adding 1.2 days) to save fuel.

Table 14.1
Key elements of total cost

	Bunker fuel $300 tonne	Bunker fuel $650 tonne
Charter cost	$720,000	$720,000
Interest on cargo value	$168,000	$168,000
Fuel	$432,000	$936,000
Harbour fees	$53,000	$53,000
Total	***$1,373,000***	***$1,877,000***

Source: CE Delft 2005, Bunkerworld, MTRU calculations

Table 14.2
Viability of speed reduction to save fuel

	Bunker fuel $300 tonne, low speed	Bunker fuel $650 tonne, low speed
Charter cost	$756,000	$756,000
Interest on cargo value	$176,000	$176,000
Fuel	$393,000	$852,000
Harbour fees	$53,000	$53,000
Total	***$1,378,000***	***$1,837,000***
Difference from normal speed	**+ $5,000**	**-$40,000**

Source: CE Delft 2005, Bunkerworld, MTRU calculations

It can be seen from the above that one approach to the fuel consumption problem is to slow ships down, and if necessary add extra ships to maintain total capacity on a route. This has already been adopted by some long distance carriers[126]. The same source reports that a reduction from 24 knots to 20.5 knots average speed would save $50m a year for a ship capable of carrying 8,500 twenty foot containers between China and Northern Europe. This is about 100,000 tonnes of bunker fuel, about 85,000 tonnes of carbon. This would, however, add two to three days to the journey.

Such long distance operators consider around 20 knots an optimum speed for fuel consumption in the present fleet and one which is at the limit of acceptability in terms of transit times. Slower speed, combined with shippers accepting profit reductions, has meant that rates have been held back to some extent. However, carbon emissions have already been reduced per tonne carried. This is of course countered by growth in international trade and it remains to be seen how far this will slow down, stabilise or reduce in terms of the distance that goods travel around the world.

However, such economies are not limited to long distance freight. Closer to the UK, an Irish Ferry operator has added 16 minutes to its fast ferry service between Wales and Eire, currently 99 minutes[127]. Stena Line said,

"It's amazing how much we can save just by slowing the craft down."

Impact of the oil price rise: longer term

Overall this sensitivity to oil price means that international trade will become significantly more expensive in the longer term. In the past low labour costs and tariff reductions have created cheap imports and been accompanied by major relocation of manufacturing industries, and some agriculture, to places distant from their markets. If the oil price continues to rise, overall prices will rise but there is likely to be a switch from distant production to production nearer home.

The overall economic impact will be that cost increases will be limited by the differential in production costs. Thus it may be more expensive to produce some

goods in Europe for European consumption than in the Far East, but less than the cost of cheap production plus expensive transport.

To illustrate this with a real world example, China has been expanding its steel exports to the US rapidly in the last decade. A recent analysis[128] showed that in December 2007, steel imports from China to the US were 30% higher than a year before. In December 2008 they were the same as the year before and are currently falling. Meanwhile US steel production has started growing. An analysis of shipping plus manufacturing costs shows that the additional shipping costs have now made US steel cheaper than the imported product.

In general terms, the higher the value of the product the less impact the increased transport cost will have on final price. The higher the cost differential (usually wages) between the consuming country and the producing country, the more likely it is that the current pattern will continue, although higher prices would normally mean less consumer demand.

Overall, the rise in oil price could have a similar short term effect to a carbon tax which reflects both transport and production costs, as briefly outlined in Phase One of this project. The balance between the strength of implementation of such a policy, and allowing the impact of oil price rises to change patterns of production and consumption on their own, depends on the price of oil. In a real sense, the excessive cheapness of transport has distorted markets and the removal of this needs time to work through. The preferred approach is to set up the carbon content policy while adjusting short term rates in the light of actual oil prices. This allows for adjustment in terms of product choice and changes in sources.

Maritime propulsion and bunker fuels

While the oil price rise may act like a carbon charge in the short term, there is another issue which needs to be considered in relation to international shipping. There are two key issues: short term improvements to fuels and short to long term improvements to ship and propulsion design.

Bunker crude or bio-crude?

The first is that existing maritime engines burn a particularly viscous and impure form of diesel. This has to be pre-heated to allow efficient working and free flow of fuel. The pollution occurs away from centres of population and is only now being seen as a major problem. The heavily used Baltic area ports have already taken steps to clean up bunker fuel by creating the SOx Emissions Control Area (SECA) which limits ships to using fuel with less than 1.5% SOx. The International Maritime Organisation has proposed this as a standard for all shipping by 2010.

One obvious option for ships which use bunker oil is to switch to unrefined plant oils. For use in normal diesels such as those in cars, a simple oil such as rape seed needs to be altered chemically to become bio-diesel. Given the nature of the maritime engines, such simpler bio-fuels can be used directly with minor modification. In the short term, the supply of bunker fuels could be switched to bio-crude – unrefined plant oils. At the end of last year, plant oils were about 25%

more expensive than bunker crude[129]. This balance is changing due to oil price rises and at the same time some companies are choosing low sulphur fuel on environmental grounds. This is more expensive than current bunker fuels and is not always available.

Given the current debate over how far bio-fuels have fed the rise in food prices, expanding its use could be counter productive. However, in policy terms the use of simpler biofuels in ships would achieve better CO2 replacement rates than biofuels in cars or trucks because it avoids the energy needed for refining. The EU should review its biofuel policy to prioritise bunker stocks for shipping and if necessary reduce its commitment for the bio-content in road transport fuel.

It should be noted that the current price of oil, and the need to reduce SOx in bunker fuel to meet new international standards, will make plant oil increasingly comparable in price to fossil fuel oils.

A final improvement would be to avoid fuel burning while ships are in port – new and specialist electric supply points are needed at quayside.

There are two other obvious areas where the efficiency of maritime transport can be improved: how efficiently the ship travels through the water and the efficiency of the method of propulsion.

Hydrodynamics

The first concerns the hydrodynamics of the hull and its interaction with the design and speed of the propeller. How smoothly the hull passes through the water depends on several factors, the simplest of which is keeping it clean. Coatings which reduce drag can be used and beyond this there are more radical redesigns including several hull elements. However, the flow of water, particularly around the propulsion area, has to be considered as an integral part of hull design.

There are already several designs for pentamarans[130] including a zero emissions concept ship[131]. The basic approach is to reduce water resistance by creating a long slim central hull and to make it stable by using two sets of outriding “fins”. This can also remove the need for ballast, ensuring more cargo can be carried and reducing marine pollution. The concept ship, entitled E/S Orcelle, also proposes the use of wind, solar, and wave power, combined with fuel cell storage and electrically powered propeller pods[132].

Pentamarans can produce faster ships (around 40 knots) suitable for ferries or coastal shipping which can compete with road transport times. Of greater interest here is the large market for long distance cargo vessels which travel at slower speeds (15 to 20 knots).

Improved propulsion

As with land based transport, there is considerable scope for improving marine diesel performance, although the techniques are very different. Capturing waste heat for propulsion is an obvious means of improvement, but very few ship builders

have done this so far because oil was so cheap that the capital cost was not worthwhile. Energy efficiency standards for ships are already a focus of research for the International Maritime Organisation (IMO) and could be phased in using existing technology in the short to medium term.

This should be linked to the longer term research into new propulsion methods, including wind assistance, conversion of wind and solar energy to electric power and hydrogen. Wind assistance, in the form of kite-like sails is already a reality on the MS Beluga SkySails, which runs between Germany and Venezuela[133]. These can be retrofitted and are currently being evaluated. An average in use fuel saving of at least 10% should be possible even with the first generation design. In ideal conditions it can reduce consumption by 50% and monitoring the performance of MS Beluga will lead to improved second generation designs.

Commercial applications are high risk, and ship building has a high capital cost. It is proposed that part of the current transport capital budget should be reallocated to fund or support the building of prototype vessels in the UK, in collaboration with maritime centres for research and development. The DfT has already undertaken some desktop research work in this field[134].

Summary and implications for UK policy

From the above analysis, the operational changes to improve performance can be summarised in the following Table.

Table 14.3
Example operational changes and timescales

Short term (to 2012)	**Medium term (to 2020)**	**Long term (2020 on)**
Slower cruising speeds	Slower cruising speeds	Optimum design speeds
Improved hull maintenance	Improved hull maintenance	Improved hull maintenance
	Improved conventional engines	New types of propulsion (at lower power)
	New hull designs (smaller vessels)	New hull designs (all vessels)
Use of bio crude to replace bunker crude	Use of bio crude to replace bunker crude	
Wind assistance (1st generation)	Wind assistance (2nd generation)	Wind assistance (2nd generation)
		Advanced wind power
	Solar power	Solar power
		Wave power

In addition to using less and cleaner fuels, the price of oil is likely to reduce the viability of certain global trades, especially where trade is based on developing country production costs being low compared to consumer country production costs. In the very long term the implications of global development and

equalisation are that many of these trades will relocate back to consumer countries in any case, since the differentials in production costs would be removed.

There are several elements to a marine policy framework which will bring about the improvements set out above.

Summary of marine policy framework

The carbon cost of sea transport should be included in any carbon tax on the sale of goods.

The easiest method of applying this would be a flat rate addition to port charges based on emissions per charter, preferably at EU level.

Any carbon harbour tax must take account of the fluctuations and current high price of oil and be phased in.

The EU should drop its support for refined biofuel in road vehicles and prioritise the replacement of bunker crude with bio crude as a short to medium term measure.

A review of port facilities to identify where new power supply infrastructure is needed should be undertaken.

Following this review a programme of port power supply improvement should be undertaken, based on local generation using renewable sources.

The Government should initiate a major research and development project on marine propulsion and hull design including wind assistance.

The marine project will need sufficient capital funding to build a sizeable demonstration vessel.

15 Inland freight transport

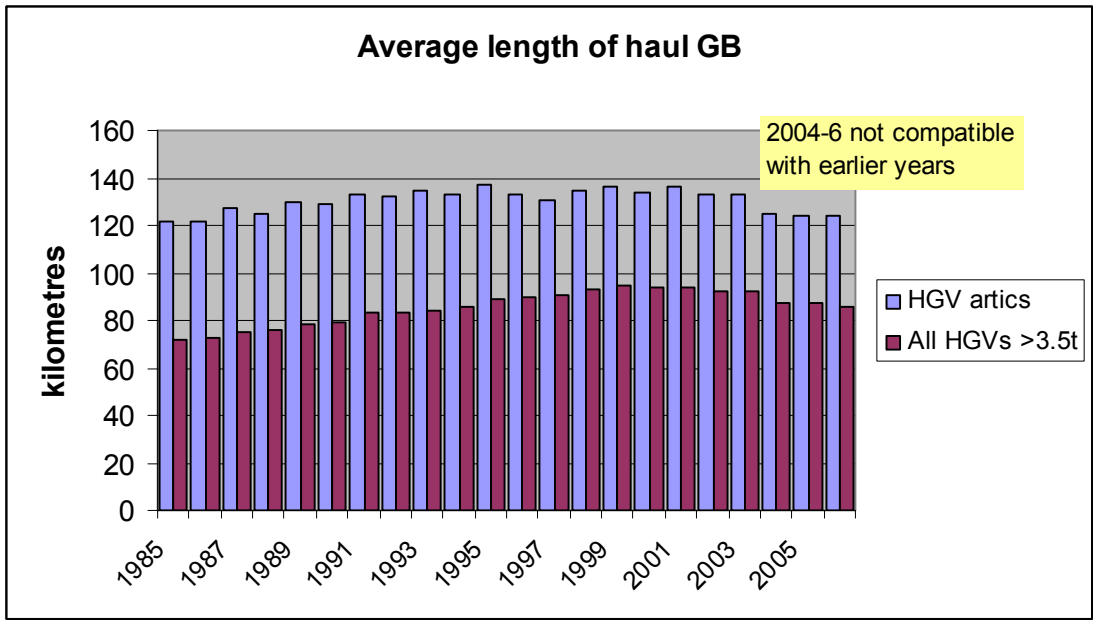
Before considering the role of freight transport in achieving the required reductions in emissions it is important to distinguish the key patterns in the distribution of goods.

The first is that transport to a point of consumption, either at individual homes or businesses, is at the end of a series of transport movements (the supply chain) which have very different characteristics. Even at the final destination, different patterns of shopping, for example, can have an influence on the broader patterns of where businesses store goods and the nature of retail outlets. The use of cars to carry an amount of goods which could not be carried on foot, cycle or public transport has meant changes to the size of retail outlets, the places that goods are stored relative to those outlets, and the size of vehicles used to supply the larger outlets. Both the packaging and the nature of some the goods (particularly food) have been strongly influenced by the evolution of this new pattern.

Thus, in general terms, a parallel to the way in which many facilities have become fewer and larger has occurred in goods transport. Major distribution centres have been set up, serving very large catchment areas which have taken advantage of the expanded road network, particularly motorways. Overall this led to a steady rise in the average distances travelled by goods themselves, leading to studies, for example, of the phenomenon of excessive "food miles"[135]. Low cost road transport has enabled other costs to be reduced, including the closure of local and regional depots in favour of national centres. In retailing an example would be holding lower stocks in expensive town centre shop sites and relying on goods supplied "just in time"[136] instead.

However, there is some limit to this process, and recent figures have shown that average haul lengths have in fact stabilised since the mid 1990s. This is shown in Figure 15.1 below.

Figure 15.1



Source: TSGB 1996 and 2007

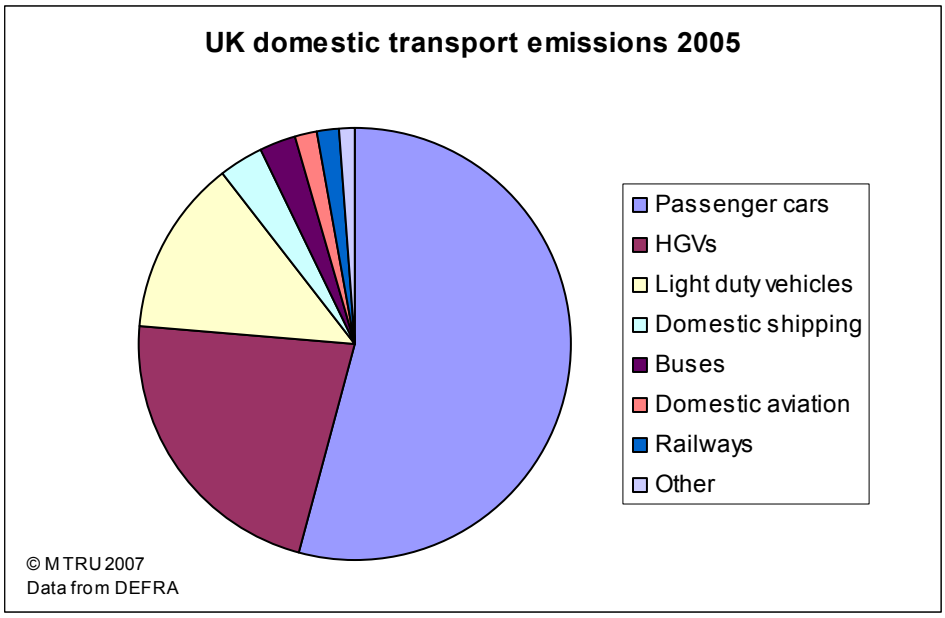
Regrettably, several changes in data collection mean that no comparable time series figures are available for rail.

Contribution of road freight to greenhouse emissions

While there is general agreement as to the importance of road freight emissions, there are several different figures for the precise amount. Even in the DfT's "Pathways" document, there appear to be significant differences in estimates for the lighter vehicles, possibly due to differences in definitions. A change in the way statistics were collected starting in 2004 also means that comparisons with earlier time periods are also difficult, particularly for average length of haul (see chart above) and for fuel consumption. There are also issues over whether emissions from producing petrol and diesel are included as a separate category, or allocated to where the fuel is used. This would cause a significant rise in the case of transport as a whole. The precise impact on road freight's contribution is hard to estimate precisely.

The chart below uses DEFRA data and is compatible with the latest DfT figures.

Figure 15.2



What is clear is that road freight emissions are about a third of domestic transport as a whole, with HGV emissions between 20 and 25%. It is also clear that they have grown significantly in the last decade, by at least 12%, although some sources have this much higher[137]. DfT expects emissions from HGVs to grow by about 10% by 2020 and from all goods vehicles by about 15%[138]. This includes some limited improvements to HGV and LGV fuel efficiency (see below).

It is also true that figures which look at all HGVs over 3.5 tonnes tend to conceal the real trends in what most people consider to be heavy lorry use (for example articulated vehicles with more than 3 axles). At the opposite end of the spectrum, any move from using the lightest HGVs (3.5 to 7.5 tonnes) into using the far less regulated large van sector must be recognised in a meaningful analysis. For

example, the DfT's 2004 national survey of company owned vans [139] showed that 32% of the distance they travelled was used to carry goods, the same as driving between home and work.

Potential for technological improvement

LGVs

For lighter vehicles, up to 3.5 and possibly up to 7.5 tonnes, maximum vehicle weight, there are parallel initiatives to those for cars and buses, particularly the hybrid approach. In fact, these lighter goods vehicles do not have the demand for higher speed and the introduction of more efficient engines and speed limiters (already used for many HGVs) should achieve savings which equal, or exceed, those from cars. This is an area where there is simply insufficient data to make further proposals for these smaller delivery vehicles. The impact of the Internet and changes in driver licensing and vehicle licensing lie behind a sharp rise in traffic from LGVs, but much more data is needed. This should be gathered as soon as possible. This process should not hold back initiatives to improve LGV fuel efficiency, both through the general fuel duty increase and the first year duty (essentially a sales charge on the least efficient vehicles). Since January 2008, LGV emission figures have been available to Government, but not made public. These should be used to produce a VED and 1st year charge package equivalent to that for cars.

HGVs

As large diesel engines have had their air pollution reduced, mainly through the Euro Directives (I to VI), this has sometimes involved a slight increase in CO2 emissions, or at least a lack of progress. The heavy duty diesels often used are less amenable to other options. Driving techniques, maintenance and aerodynamics do, however, provide options for some improvement. DfT believes that this programme (SAFED[140]) could achieve a 10% saving by 2014, stable thereafter[141].

Changes to the supply chain and distribution patterns

The technological improvements available for all road freight vehicles in the medium term are limited and result in an increase over 1990 levels of about 32%. Allowing for SAFED, this would fall to a 19% increase by 2020. This is partly due to the rise in LGVs. HGVs alone would rise by 14% over their 1990 level (again allowing for SAFED).

Clearly this requires further examination of the overall efficiency of the road freight industry. This falls naturally into three areas:

- Efficiency of vehicle use (how far vehicles run empty or part loaded)
- Choice of distribution depot for storage and supplier for raw materials
- Choice of mode.

These will be considered in the sections which follow. Overall this chapter focuses on the heaviest goods vehicles and gives an overview of the strengths and

weaknesses of different approaches. It is the heavy articulated HGVs which have been subject to the most significant changes in weight and size limits. These are also the vehicles most associated with environmental damage and road infrastructure costs, and the ones in direct competition with other bulk freight modes such as rail and coastal shipping. LGVs will need, however, to be addressed through technological improvements and, following further research, identifying their role in the distribution chain and any subsequent opportunities for carbon reduction.

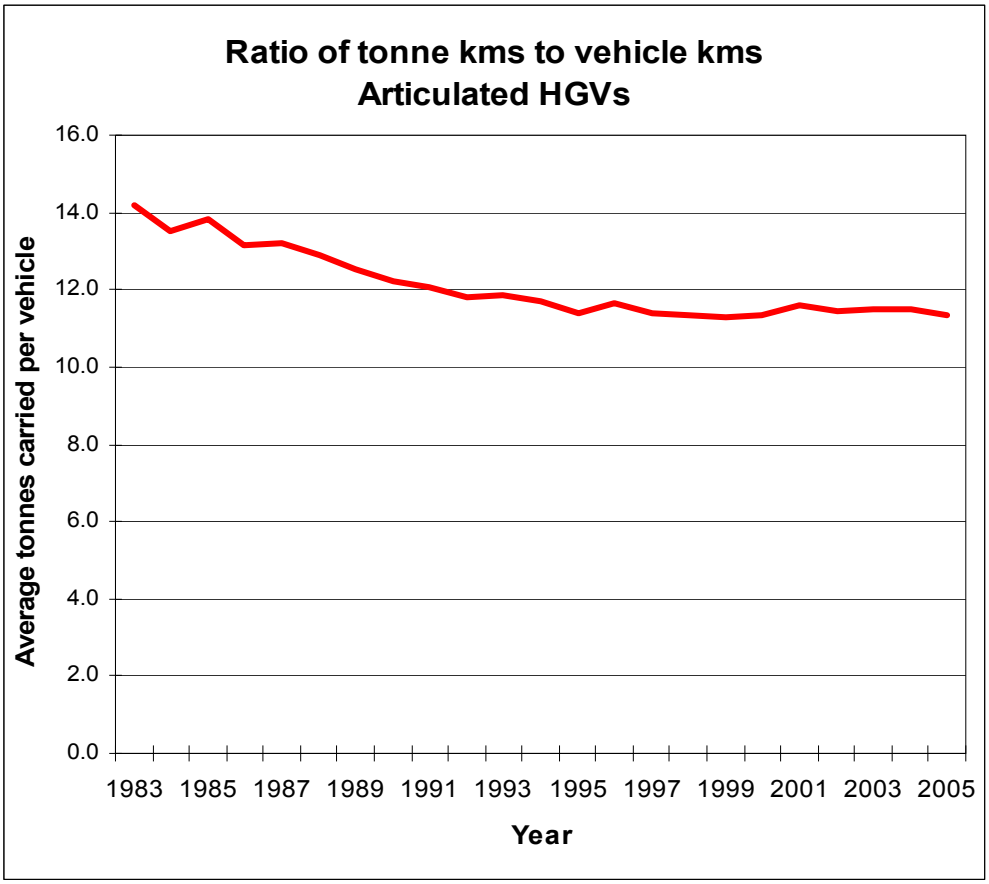
Efficiency and load factors

Average payload

The first measure considered is how much freight (in terms of tonnes) the average artic carries. This is simply calculated from CSRGT[142] by dividing the survey tonne kilometres by the survey vehicle kilometres. The exercise was undertaken for the type of vehicles which are involved in the majority of goods movement, measured as tonne kilometres: artics with a gross permitted weight of 33 tonnes or more.

In fact the average payload has fallen considerably since 1983. Since 1995 there has been relative stability, although weight limits have increased twice, allowing an extra 6.5 to 7 tonnes payload on 6 axles. This is shown in Figure 15.3 below.

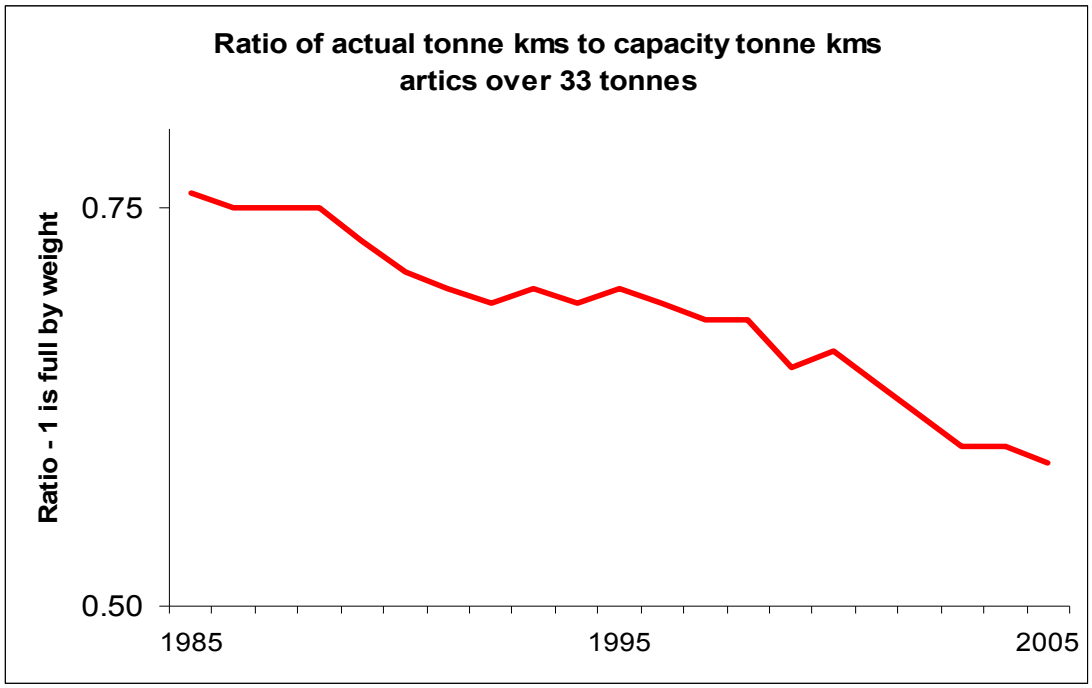
Figure 15.3



Source: CSRGT 1990, 1995 and 2005

There is also evidence that the capacity of the fleet has grown faster than the amount of freight transport actually carried or the weight of goods transported. This is referred to as the "average lading factor" shown in Figure 15.4.

Figure 15.4



Source: CSRGT 1995 and 2005

The above are very surprising results because, if industry predictions of improving efficiency were correct, significant long term increases should have resulted. It may seem common sense that when articulated lorries become larger and heavier, as they have done consistently for several decades, they should carry heavier payloads.

Before discussing why this has not happened, the reason for expecting increases can be explored in more detail as follows.

Considering the 1999 increase, the case was put that there were many loads which could not be carried because they would cause the permitted weight to be exceeded. In its consultation document [143] the DfT assumed this figure as 50%. This should lead to a reduction of 6,500 artics needed and 490 million vehicle miles travelled on 1995 levels. When weight limits are raised, many of the weight constrained loads can be carried, although perhaps not up to the maximum weight. Assuming that half the payload increase can be used, this would mean an increase in average payload of 1.25 tonnes. Even after allowing for the fact that not all artics are at the maximum weight, there should still be some significant change. It should be noted that the average payload calculated from CSRGT should increase independently of any general rise or fall in the amount of goods carried.

This analysis is based on weight increases, but there is considerable interest in the road freight sector over low density goods which may fill a vehicle before its maximum weight is reached. This is often referred to as volume constraint or

"cubing out". This effect has been discussed at least as far back as the 1980s. Direct and robust evidence on the extent of this problem and how it has changed over time is not available, but there are two important indicators as to its extent.

Can "cubing out" explain falling payloads

The first is that there are vehicle options which would allow a far greater volume for the same gross weight. The first of these is draw bar trailers, which can carry up to 44 tonnes. These can be 18 metres long and are articulated in the middle of the vehicle rather than just behind the driver's cab. Demand for such vehicles has been extremely low throughout the period studied here. They are not suitable for container traffic, but otherwise can utilise swap bodies offering similar flexibility to the trailers used by traditional artics. In addition, lighter artics on 4 axles could be used to give a much higher volume to weight ratio. They would be cheaper to operate and produce less CO2. However, this category of vehicle has in fact declined in number very significantly, from 42 thousand in 1990 to 16 thousand in 2005 [144].

There is one other factor which complicates the issue – the use of "double decking". This addresses the problem of goods on pallets not reaching the full height of the load area. This means that goods are constrained by the floor area rather than volume. Creating a second floor in the trailer allows better utilisation. However, if this were widespread, the average payload should have risen rather than fallen.

The second reason for believing that volume constraint is not the only answer to the falling payloads is the increase in dimensions in 1990. This was very significant at about 8 to 10%. If volume was a problem this would have had a major impact and should have allowed average payloads to rise, at least in the short term. This simply did not happen. The most significant rise in payload (still small) occurred after the 2% increase in width in 1996 and lasted one year.

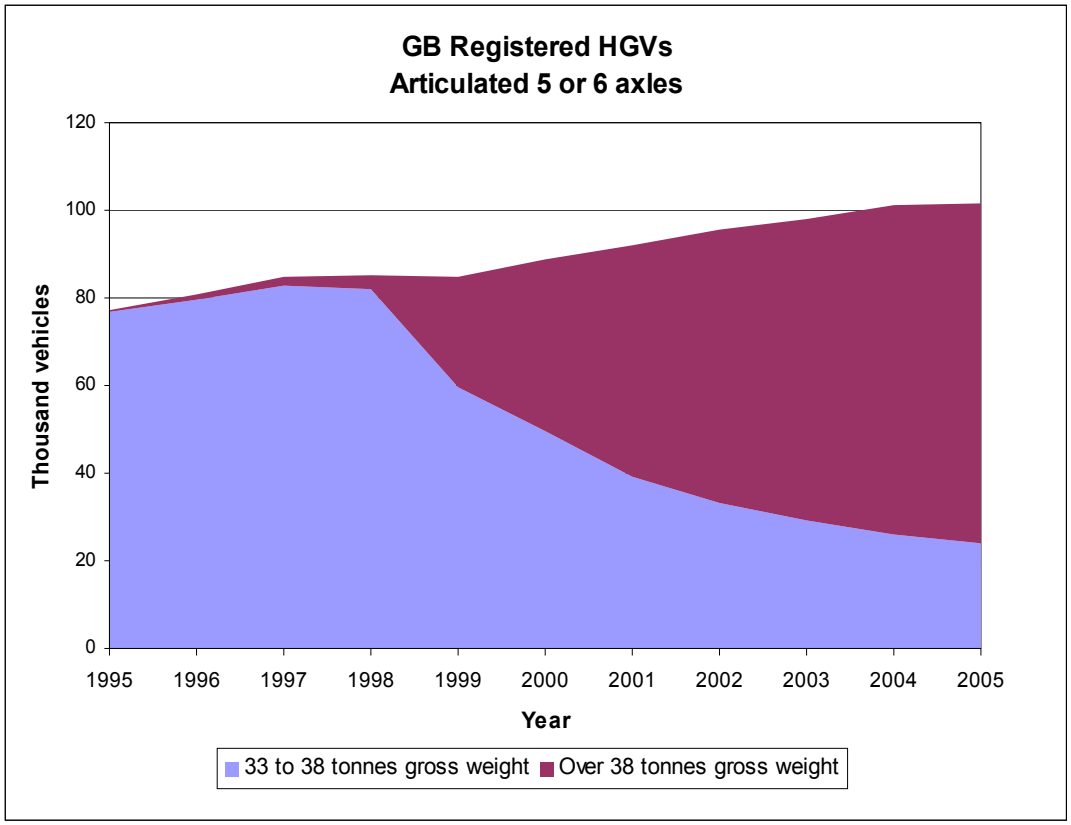
A limited question has been asked on how far vehicles are full in CSRGT from 1998. Unfortunately the data from CSRGT in this area is variable and there are issues about multiple deliveries reducing average payloads. This is in itself strongly related to having vehicles which are over capacity.

Can a fall in payloads be caused by over capacity?

There is however, an alternative explanation as to why average payload should fall.

The great majority of road freight in artics (73.6%) is carried by public hauliers , and they will tend to purchase the heaviest vehicles, so that they can carry the heaviest load they are ever asked to. However, most loads are determined by businesses who produce goods in a similar way for their customers before and after changes to the size and weight of HGVs. The actual pattern of deliveries doesn't change very much (although low transport costs may lead to fewer depots, resulting in longer distances). Evidence showing the bunching of vehicle ownership in the heaviest category is shown in Figure 15.5.

Figure 15.5



*Source: Transport Statistics Great Britain (**TSGB**)*

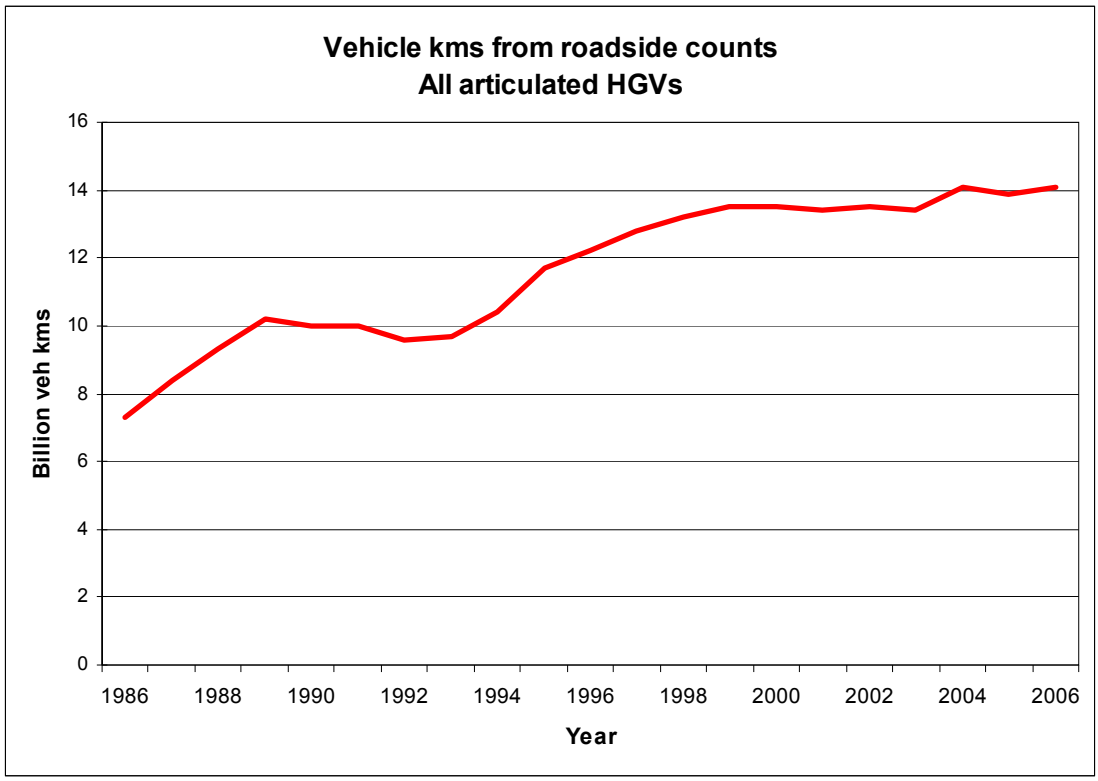
Thus hauliers have to carry similar loads but in heavier vehicles. These will also use more fuel than smaller vehicles. The lack of impact on average payloads is entirely consistent with this explanation. This also explains the lack of any impact on the overall level of vehicle traffic, which is the next area considered here.

Articulated HGV traffic

According to the national traffic surveys, traffic from all articulated vehicles (registered in GB or elsewhere) has doubled between 1985 and 2005. There was a dip from 1990 to 1993 due to the recession, and a stabilisation after 1999. In 2004 the figures rose significantly, but were relatively stable for the next two years. Provisional figures for 2007 show slight growth.

The summary of this is set out below in Figure 15.6. It should be remembered in this context that increases in weights and dimensions have occurred on a regular basis which were predicted to reduce HGV traffic. In fact, vehicle kilometres appear to rise and fall independently from changes in weight and dimensions. Factors such as GDP, logistical patterns (such as centralisation of depots), fuel price, and the cost of alternatives will all have some influence.

Figure 15.6



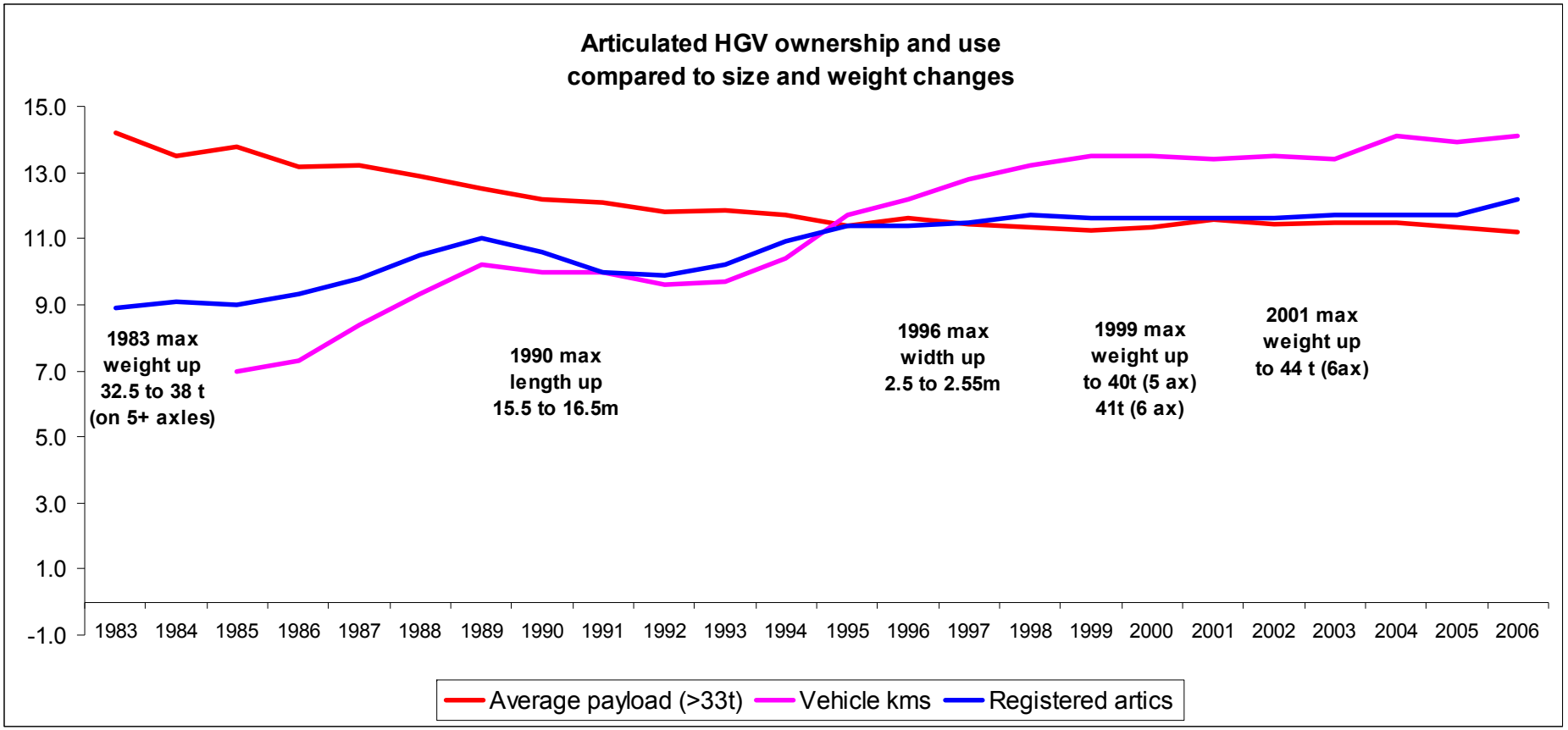
Source: TSGB, 1996 and 2006 editions

Conclusions on efficiency

Despite some statistical limitations, there appears to be no direct evidence that efficiency has been improving, despite a series of increases in the size and weight of HGVs. The precise reasons for this need further research, but the hypothesis that hauliers always "buy the biggest" is borne out in the registration statistics, and helps to explain the lack of any discernible efficiency improvements. This is not to say that some individual operations, focussing on a continuous stream of bulk goods from one place to one other place, have not benefited from heavier and larger lorries. Nevertheless, the overall picture is one of increasing size and weight which is then underutilised.

A chart showing some key indicators and the most significant changes to HGV limits is shown as Figure 15.7.

Figure 15.7


Articulated HGV ownership and use
compared to size and weight changes
15.0
13.0
11.0
9.0
7.0
5.0
3.0
1.0
-1.0
1983 max weight up 32.5 to 38 t (on 5+ axles)
1990 max length up 15.5 to 16.5m
1996 max width up 2.5 to 2.55m
1999 max weight up to 40t (5 ax) 41t (6 ax)
2001 max weight up to 44 t (6ax)
1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006
Average payload (>33t)
Vehicle kms
Registered artics

Calculating the emissions from goods vehicles

Figures have been published for emissions and how they change in preparation for an assessment against 1990 levels (the common base for progress on greenhouse gas targets). Targeted reductions for the UK as a whole have now been included in the draft Climate Change Bill [145].

It is now widely agreed that earlier Office of National Statistics (ONS) data for HGV emissions, while prepared in line with international guidelines, was incomplete. This is because it omitted the significant number of HGVs operated by businesses for their own purposes (called "own account"). Instead it analysed data from hauliers who are open to all customers ("public haulage"). In the international guidelines, emissions from own account operation are included in the totals for the individual industries they serve. The sector "road transport industry" is based on public haulage.

It is sometimes claimed that the latter increased faster than own account operation and thus the increases were exaggerated. In fact, this effect has largely reversed so that the balance of vehicle kilometres (the best measure for emissions) between the two types of operation in 2005 was very close to that in 1990, in fact slightly lower for artics. This is shown in Table 15.1 below.

Table 15.1
Percent of vehicle kilometres by public hauliers

	Public haulage Percent of total	
	All HGV	**All Artics**
1990	**55.7%**	**75.8%**
1995	**58.4%**	**76.9%**
2005	**55.8%**	**73.6%**

Source: CSRGT 1990. 1995, 2005

ONS have already published revisions to their original figures to allow for omissions and corrections and DEFRA has used these in its latest sustainable indicators reports. They are lower than the original ONS, but there has been some criticism that even these estimates of increasing emissions are still too high. One approach is to use the average fuel consumption figures from CSRGT and apply these to traffic survey data from TSGB. One problem with this is the change in survey structure for 2004. There is clearly a step change improvement in 2004 which is unlike earlier years. There is also the issue of CSRGT under reporting distances. This means that mixing CSRGT with TSGB will create some uncertainty even for 1990 to 2003, and does not appear to be advisable from 2004 onwards. This point is illustrated by comparing industry averages with the CSRGT results for 2003-5 in Table 15.2 below. In 2004, small rigid vehicles seem to become much less fuel efficient, then recover the following year, while artics and larger rigid HGVs become more efficient. This is despite a move to heavier articulated vehicles, which consume more fuel (see Table 15.3).

Table 15.2
Average fuel consumption from CSRGT and RHA

	3.5 - 7.5t rigid	All Rigid	All Artics
2003	**12.4**	**7.8**	**7.5**
2004	**10.9**	**8.3**	**7.9**
2005	**13.2**	**8.3**	**8.1**
RHA	**18 - 27**		**7.2 – 9.0**

Source: CSRGT 2005, RHA

It is also true that figures which look at all HGVs over 3.5 tonnes tend to conceal the real trends in what most people consider to be heavy lorry use (for example articulated vehicles with more than 3 axles). At the opposite end of the spectrum, any move from using the lightest HGVs (3.5 to 7.5 tonnes) into using the far less regulated large van sector must be recognised in a meaningful analysis.

The reason for the move out of the 3.5 to 7.5 tonne range is that these are subject to stricter regulation and require operator licences. This is also the break point for much EU regulation for vehicle standards and working practices. This may help to explain the lack of growth in the 3.5 to 7.5 sector and the strong increase in the light goods sector. Despite a survey in 2003 there is still little information comparable to the annual CSRGT. This creates problems for analysts at the lighter end of the HGV sector.

This chapter is focussing on the heaviest articulated vehicles, which produce most emissions and where most change in size and weight has occurred. As mentioned above, there seem to be problems here, due to the change in CSRGT survey structure in 2004. Disaggregated data may address this problem, but industry estimates of fuel consumption for "typical" vehicles in different weight categories can also be obtained. The RHA estimates for the heaviest artics are set out in Table 15.3 below.

Table 15.3
Average fuel consumption by vehicle weight

Weight	Axles	Configuration	MPG
44t	**6**	**3 tractor + 3 trailer**	**7.2**
41t	**6**	**3 tractor + 3 trailer**	**7.5**
40t	**5**	**2 tractor + 3 trailer**	**7.8**
38t	**5**	**2 tractor + 3 trailer**	**8**
32/33	**4**	**2 tractor + 2 trailer**	**9**

Source RHA

The above table shows a significant increase in fuel consumed as maximum permitted weight increases, as would be expected given the requirements for extra axles, larger engines, and more powerful brakes.

Mode split and traffic generation

In relation to HGV traffic and thus to emissions there is another important factor. The overall quantity of traffic will be influenced by any change in cost. For example, cost decreases can cause:

- mode transfer: attracting goods travelling within the UK which would otherwise use rail or water;
- different choice of port: loading imported or exported goods at a port which decreases travel by sea but increases travel by road (this includes the use of RO-RO);
- the creation of extra HGV traffic through longer journeys, for example through more centralised distribution systems and business using more distant suppliers;
- extra HGV tonnes and tonne kilometres by handling goods more frequently (for example each time they pass through a depot they add to the national tonnes figure).

The overall effect, or the different individual responses, can be expressed as an elasticity. Thus an overall value of 0.9 for HGV vehicle kilometres would mean that if costs fell by 10%, there would be an increase of 9% in HGV traffic. This could be composed of all three elements listed above. It is also true that short run elasticities are low, while in the long term more substantial change takes place.

In the UK, the traditional value has been 0.1, although it is not clear whether this only refers to the third bullet above, and whether it represents a low, short term elasticity. The DfT's most recent publication on elasticities[146] notes the variability of freight, but also points to an average value, across a wide range of studies, of 1.07. This includes all the factors influencing HGV use. Recent European studies back values below 1 but approaching it and suggest that vehicle kilometres are more sensitive than tonnes[147][148].

While further research is needed, the use of 0.1 in the UK does not appear to be reasonable as an overall long term elasticity. It may represent an immediate reaction to cost changes, where choice of suppliers, depot or mode are very limited. As contracts are renewed, or logistics systems reviewed, a wide range of options open up. Especially when freight transfers from rail and water are included, it should be very much higher.

It should be noted that when vehicle weights were last increased (2001), transfer from rail was felt to be so serious that a halving of rail track access charges (**TAC**s) for freight operators was introduced in the same year [149]. While this was a sensible precaution, it does make it very difficult to assess the sensitivity of mode choice to the cost of road freight. These access charges are currently being reviewed [150]. One issue should be how much further they could be reduced to avoid the climate change costs of HGV use.

Rail emissions

The question of transfer to rail (or shipping) raises the issue of how much CO2 rail freight produces. It is important to recognise that problems with the estimates of

CO2 emissions are not confined to road freight. The current UK greenhouse gas inventory is based on fuel use assumptions which do not appear to have undergone major revision since the early 1990s. They probably do not reflect current locomotive efficiency, particularly diesels. Changes in working practices to reduce fuel used (such as idling) have also contributed.

A wide range of European studies suggest lower emissions, around 30 gms of CO2 per tonne kilometre rather than the current UK 49gms. The latest report from CfIT [151] supports an even lower figure of around 20 gms. Using these more recent emission levels would lead to reductions in the UK inventory figure of between 30% and 70%. Overall this means that rail carries about 8% of all freight traffic, producing about 1% of CO2 emissions.

One problem is the widespread use of average CO2 per tonne kilometre. This is a one step removed measure and it would be preferable to use the actual amount of fuel used. Train kilometres could be also misleading since there are wide differences in fuel consumed according to number of wagons, weight of goods and type of locomotive. If the tonne kilometre average is still to be the basis, further direct research is needed, although EWS has supplied some data to CfIT for their report. While further research is needed, the uncertainty is not whether rail is more efficient than road, but by how much. The commonly used approximation that rail is 10 times more efficient than road appears reasonable.

One relevant question here is how far rail and water can be expected to capture goods traffic and whether this would make a significant difference. There remain uncertainties over handling levels and emissions from handling. However, a significant increase in rail and water, and a change in port usage [152] [153], could reduce road vehicle kilometres by 15%, roughly where they were in 1995. This could reduce overall freight CO2 emissions by about 12%.

Measures to reduce the amount of HGV traffic per unit of GDP (reducing transport intensity in road freight) could contribute a further 8% reduction in CO2 and improvements in HGV fuel efficiency of 10% could contribute a further 8% reduction. Both figures are compared to emissions today (2005). The basis for these indicative conclusions are shown below in Table 5.

Clearly they need to be further refined, but are in line with Government targets for rail freight (80% increase on 2000 levels by 2010 [154]).

Rail capacity

A recent study, based on the GB Freight Model used for national policy, identified where rail freight increases would occur[155]. The most extreme shortfalls from this report are shown below.

The report identifies a range of other capacity bottlenecks but the overall programme cost has not been calculated.

Table 15.4
Rail freight capacity bottlenecks 2030
Additional trains required per day

>200	West Coast Main Line (WCML): London to Crewe London, Tilbury and Southend and North London Lines
>100	WCML Crewe to Glasgow East Coast Main Line (ECML): London to Doncaster Channel Tunnel to London
>50	Southampton to West Midlands

Source: Rail Freight Group and Freight Transport Association

Overall, the freight users who commissioned the report make the point that providing such capacity by 2030 requires planning to begin now. One difficulty is that this will need to take place in the context of the predicted passenger increases. Overall, the need for rail capacity increases, to accommodate both freight and passenger growth, is the clearest priority for infrastructure investment in UK transport policy.

Other external costs of road freight

Apart from congestion costs there are two basic types of cost which are outside the normal expenditure of transport operators. The first type is a measurable market price – for example the cost of repairing roads or cost of policing and dealing with accidents. The second contains a group of costs for which there is no market price but there is a value. Examples are health, environmental quality and safety (the value of avoiding accidents).

In the case of HGVs, the first group is generally included as the cost of using the road network. There are arguments that the second group are often not really appropriate for valuation in the same way as the lost of laying tarmac. However, Governments in the UK and elsewhere have put considerable effort into calculating these costs so that they can be included in a cost benefit analysis. These figures are becoming increasingly common, but must be used with extreme caution.

The reason for this is that there is usually a double uncertainty in preparing any valuations. The first is measuring the impact itself. The second is finding a money value, usually approached by surveys which try to find people's willingness to pay. This means that there is considerable variation in the values obtained and that they are linked to people's ability to pay and thus there are significant social equity issues.

This is reflected in recent studies, as shown in the Table below.

Table 15.5
Comparison of external costs in 4 recent studies
Cost per vehicle kilometre, all HGVs

	SLM 2003	McKinnon 2007	INFRAS 2004	CE Delft 2007
Social and Environmental externalities	27.9p	14.6p	47.4p	0 – 90p
Marginal congestion costs	Ave 27.3p From 3.9p (Motorway low congestion) to 84.2p (conurbation)	Ave 9.7p From 4.2p (rural any time) to 72.9p (urban any time)	From 4.2p (uncongested M-way) to £12.11 (congested urban)	From 23.3p (off peak) to 38.9 (urban peak)

The SLM values[156] are currently used by the Department for Transport to assess the value of reducing HGV traffic. They were originated by the Strategic Rail Authority's consultants, who reviewed a range of studies, and then scrutinised by the DfT. The second source above is the most recent UK study of HGV costs [157], and the third is one of the more recent EU reports, which tried to assess the externalities of all freight modes (including rail and air)[158]. The fourth is a recent overview of European studies including the UK[159].

The detailed definitions of the external costs are also slightly different, for example McKinnon uses a recent DEFRA value for air pollution which is based on the health impacts involving hospitalisation and premature death only. INFRAS has upstream and downstream effects (such as oil refining) which are included in a less accurate fashion in the SLM study. PM10s from tyres and brakes are included in INFRAS (as the new Euro standard engines are introduced this is at least as important as exhaust PM10s).

Nor are the valuations consistently in one direction, as the comparison between the current SLM values and McKinnon study shows. In fact, the congestion costs differ little by type of road, but the averages are calculated differently.

Table 15.6
Comparison of Sensitive Lorry Miles average values and Mackinnon (converted to miles)

	SLM	**Mckinnon**
Accidents	2.9	7.4
Noise	3.8	0.8
Pollution	6.3	2.7
Climate Change	2.5	3.1
Infrastructure	12.5	9.0
Congestion	43.9	15.7
Unquantified	16.9	0

It should be noted that the unquantified amount is meant to represent a group of known impacts, which did not have a current WTP study. The SLM report lists them as:

- driver frustration/stress (comparable to journey ambience in Government Guidance on appraisal)
- fear of accidents
- restrictions on cycling and walking
- upstream and downstream effects
- community severance
- visual intrusion

This is not exhaustive, for example other impacts from HGVs include:

- loss of unique habitats
- damage to underground structures (including gas and water mains, electricity and telecommunications)
- low frequency noise (vibration) associated with the largest vehicles

Variations in total costs

These variations in costs per kilometre can generate very different total costs for HGVs in the UK. Again using the three examples above, the traffic (vehicle kilometres) from HGVs can be used to show the difference in total costs.

Table 15.7

Comparison of total HGV external costs in the UK (identifying congestion element)
£billion

	SLM 2003 (2005)	McKinnon 2007	INFRAS 2004
Total cost of externalities	10.4	7.05	23.3
Of which environmental cost	N/A	4.23	14.8
Of which congestion cost	N/A	2.82	8.5

Notes:
SLM figures are from National Freight Model run by MDS Transmodal[160] and are in 2005 prices
McKinnon is in 2006 prices
INFRAS figures have wider range of externalities and price carbon above UK Government figure at €140 per tonne CO2
INFRAS prices are €2000 converted to £ at €1.34 per £.

Further variations are due to changes over time, and the introduction of improved HGV engines (Euro standards I to IV) which has reduced emissions. For example, particulates from tyre and brake wear are now as important as those emitted from the latest diesel engines.

Do HGVs meet their external costs?

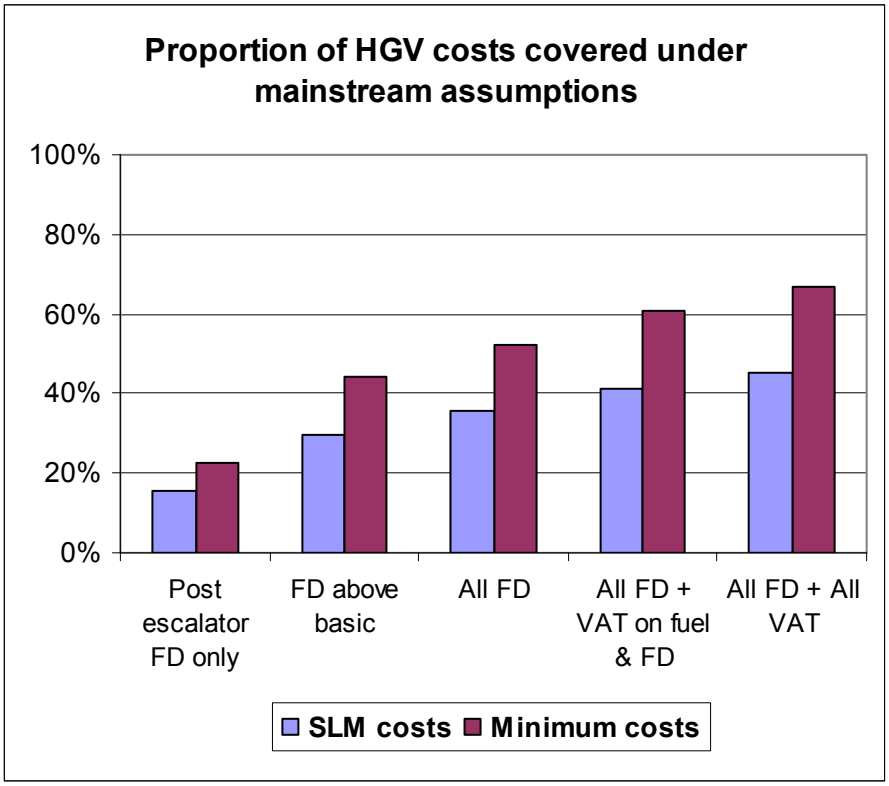
The overall results of this chapter suggest that there are several different ways of looking at the balance sheet for costs and revenues. We thus report the headline results of the two UK studies which represent the low to middle of the costs range, below. The first assumption for revenue represent the most commonly used approach in Europe while the second adds in the VAT on fuel duty which has been counted as part of environmental charges by some UK researchers (see Table 4 above). Other combinations of costs and benefits would at one extreme reduce the amount covered to around 30%, and at the other rise to 67%. Only by excluding congestion altogether do HGVs just about meet their costs overall. Even using this congestion free average figure, the revenue exceeds costs on motorways, but costs still exceed revenue on all other roads.

Table 15.8
Proportion of costs covered by revenue under different assumptions

	SLM costs	Minimum HGV cost
Fuel duty + VED	**36%**	**52%**
Fuel duty + VED + VAT on fuel duty	**41%**	**61%**

Source: MDS Transmodal 2005, McKinnon 2007, MTRU calculation

Figure 15.8
Range of values using UK study assumptions



The need for new fiscal framework

It is clear from the above that HGVs do not meet their external costs in any way comparable to the amounts received from private cars. Any adjustment to take account of this would lead to a reduction in HGV traffic through better utilisation and shorter hauls, and some switch of mode.

The only national figures available for the implications of charging for external costs can be found in the estimate used by the DfT, entitled "Sensitive Lorry Miles". While there are several problems with this index, for example road types are coarse and environmental costs are pre-Stern, it has been used for modelling purposes.

MDS Transmodal, who run the DfT's freight model, estimate SLM external costs which are not covered by current taxation at £6.7billion per year. This represents an average of 22p per kilometre for all HGVs. Since the external costs are strongly weighted towards the heaviest end, this would be significantly greater for articulated HGVs.

From this and the other data presented earlier, it is clear that HGVs do not pay taxes in relation to their external costs in any way comparable to the amounts received from private cars. Any adjustment to take account of this would lead to a reduction in HGV traffic through better utilisation and shorter hauls, and some switch of mode.

Thus policy should be to apply a user charge to top up the amount raised from fuel duty (VAT is reclaimed by most HGV operators). The previous UK proposal for Lorry Road User Charging was complex and similar to the national scheme. However, a simpler scheme could be introduced without national road user charging.

Proposal for a simpler method of HGV pricing for the UK

If there are strong economic and environmental arguments in favour of road freight pricing, at least for the heaviest vehicles, there remain issues in relation to a national scheme for road pricing. The main problem areas are:

- complexity (and hence risk of failure)
- potential non compatibility with a future scheme
- cost of implementation and administration

In fact, a simpler distance/capacity charge could be implemented which would have the advantage of not interfering with a national scheme (it could be replaced by it in due course). New Zealand has a system of charging based on distance licensing – HGVs buy 1,000 km units which are priced according to weight. This is a substitute for taxing diesel and is accompanied by annual fees.

However, the most relevant examples are the current Swiss system and the previous Swedish system (1973-94), which was dropped as part of the negotiations

on Swedish entry into Europe. This uses hub odometers to show distance travelled, and each vehicle category paid a rate per kilometre. Odometer cards were punched when leaving and entering the country, so kilometres run on non-Swedish roads were not charged. This border control was seen as objectionable by EU negotiators. There has since been some reform of this attitude, including revisions to the "Eurovignette" regulations.

Diesel fuel duty was lower than for petrol and when the distance/weight system was dropped in 1993, diesel fuel duty was increased. The Swedish government was always unhappy about this, since it was a weaker approximation to external costs, especially for heavier vehicles. They are now investigating a new electronic system (not too far removed from the original UK LRUC).

Meanwhile Switzerland has already introduced a weight distance scheme for HGVs. In 2001, maximum weights were raised but this was done concurrently with a new and significant user charge[161]. To put this in perspective, the rate per kilometre for a 40 tonne vehicle meeting Euro I exhaust standards is about 40p, reducing to 34p if it meets Euro II. These levels are comparable to those produced using the MDS study in the UK (see above). Administration and enforcement costs are about 7% of income.

In the UK it would be possible to adopt such a system. Foreign vehicles which did not have the necessary hub odometers have several options. They could produce proof of distance travelled, make a declaration and pay (as with the current Swiss distance/weight charge). Alternatively, they could use a New Zealand style permit to travel a certain number of kilometres (they should know where they are going and thus have a reasonable estimate), or they could pay a simple daily charge. This would be based on a reasonable estimate of average distances plus a small premium. There are several options and operator views should be sought.

There are also issues for further work in relation to the latest rise in fuel duty which affects GB registered lorries. This could be considered to be an environmental tax and it would help if this amount was also represented in the charge for non-GB registered vehicles.

Combinations of fixed and distance related environmental taxes are relatively common throughout Europe. The more complex German system, for example, raises over 3million euros a year. However this requires about 20% for administration and enforcement. The overall aim in relation to EU harmonisation is to move closer to equal treatment for all HGVs.

This system would have the merit of being simple, but would not differentiate between road types. In one sense this is an advantage, because it avoids the problems caused when motorways alone are subject to tolls and HGVs take alternative routes through sensitive areas. Charging on motorways alone requires balancing with strict regulations over where HGVs can go, even for access. Britain is particularly weak in this regard.

16 Transport Appraisal

One of the keys in any transport policy is the way that transport spending is allocated between different schemes and policy packages, and between localities.

The New Approach to Transport Appraisal (NATA) was introduced in 1998 as part of the government's integrated transport policy. In May 2007, The Department for Transport (DfT) announced that it was to 'refresh' NATA and published a detailed consultation document. In March 2008 MTRU was commissioned to produce a detailed submission on this subject by the Green Alliance[162]. This chapter summarises the findings and recommendations of that report. The reform of NATA is a continuing process which is now included in the general work being undertaken for *Towards a Sustainable Transport System* (TSTS) referred to at the beginning of this report.

Transport appraisal methods in the UK have evolved over several decades. The DfT refresh process provides an opportunity to consider both the effectiveness of the overall NATA approach and to fully include the government's new transport objectives, recently set out in the TSTS consultation document.

There are two fundamental questions to be asked. The first is whether NATA delivers an appraisal process that accurately represents the true costs and benefits of transport schemes and fully reflects the government's objectives in general, and in particular its climate change targets. The second issue is whether NATA's basic principles, have been followed in practice.

The purpose of appraisal is to provide the most accurate picture of how much it costs to achieve a certain level of progress towards government objectives for transport. It would therefore be expected that schemes which strongly support government policies should perform well, and those that do not should perform less well.

However, the cumulative effect of a series of individual adjustments, often made for good reason, has been that many schemes which seem to be in line with government ambitions for transport do not fare well in the assessment process. In contrast, many schemes which contradict policy, such as those which increase, or at least fail to reduce, greenhouse gas emissions, score very well. This is explored in more detail below.

When reviewing NATA it is essential to understand the attractiveness of producing a single figure which tells the decision maker, across all modes and in all circumstances, which transport schemes are the best value for money. This is still the dream of many theoretical economists. But seeking to achieve this results in large scale, often hidden, mathematical simplifications, and it requires an attempt to put a monetary value on all costs and benefits irrespective of their nature. There have been so many compromises in NATA that the accurate description of the real costs and benefits of a given transport scheme has been seriously compromised and this has had a major impact on which transport schemes have been implemented.

Findings of the NATA submission

The findings of the report can be summarised as follows:

1 In NATA, schemes that go against government objectives often score best

The introduction of changes in the way that NATA accounts for tax revenues (especially fuel duty) has had two major effects. The first is that increased fuel use, with its associated CO_2 emissions, is counted as a massive benefit, as it increases government revenue. The second is that people spending money on public transport (where fares are VAT free) and not on fuel for their cars is seen as a significant disbenefit due to the tax revenue lost. This runs completely contrary to government policy and is described in the report as the 'cost benefit paradox'.

Tax revenues from increasing fuel use are also set against capital costs which magnifies their detrimental impact on key parts of the cost benefit analysis. There are several options proposed for avoiding these effects. The important point is that they are so serious they must be addressed as a matter of urgency.

2 Environmental valuations to date are hugely uncertain and not comparable to each other or to other valuations and should not be relied upon

The desire to value every non-user cost, including landscape, natural habitats, heritage buildings, street traffic noise, community severance, and the cost of a transport related death, has led to a series of survey based studies based on what people might be;

- willing to pay for improvement or
- willing to be paid to put up with unsatisfactory or worsening conditions.

The latter tends to give consistently higher values. The report explores the basis for this cost benefit approach (in particular the Kaldor and Hicks work), and how this rather singular interpretation of work by economists in the 1930s and 40s, has such a grip on UK transport policy.

The huge uncertainties involved in creating valuations from surveys are shown in all the international studies which compare results (examples are also in the chapter on freight). The individual surveys are usually extremely prone to survey bias and have to be subjected to considerable statistical modelling to avoid this and achieve sensible numbers. On the assumption that people and vehicle flows can be predicted accurately, it is possible to make a reasonable estimate of changes in real operating costs and fares based on actual figures. The other valuations are simply not comparable in nature or in their levels of certainty. The bringing together of such values into a single balance sheet hides the real impacts of a proposal behind invented monetary values and creates a false sense of certainty in terms of the appraisal.

3 NATA still does not adequately represent government objectives

The parts of NATA based on earlier road appraisal systems have continued to attract resources and have been expanded. However, the move towards an

appraisal system which defines benefits as achieving agreed government objectives has been poorly executed.

This is particularly relevant to the Assessment Summary Table (AST), which government guidance requires for each scheme or package. It is intended to be the centrepiece in appraising the impact of different decisions in relation to their cost. In reality, these can show internal inconsistency and a brief survey for this report showed wide variations both within and between ASTs. There seems to be little monitoring of ASTs and their content. The AST would also become more important if the reforms suggested in this report are implemented, and in relation to the new government objectives for transport.

4 NATA does not adequately assess switching between transport modes

While an attempt has been made to alter road based assessment methods to cover different forms, or modes, of transport this is extremely weak in relation to walking and cycling.

A simplification was introduced which treats transfers between transport modes, e.g. from driving to using the bus, as if they were newly generated journeys in each individual mode. This created two important problems.

The first is that the value of transferred trips is downgraded and interacts with the way that fuel tax revenue is accounted for. This creates even more bias against non-car modes.

The second is that the people who change mode are not tracked. So the same person who used to drive by car and whose time was assigned a high value due to their assumed contribution to the economy sees the value assigned to their time significantly reduced if they start travelling by bus, cycle or car share. This approach may have had minimal impact when transport modes were considered separately but it is not suitable for a genuinely multi-modal approach that seeks to compare different forms of transport.

5 Alternative transport schemes are poorly developed

Despite clear guidance on this subject, the exploration of alternatives to a preferred scheme, especially those involving demand management such as 'Smarter Choices'[163] and other travel planning initiatives is very weak. Alternatives are not given the same attention as road schemes and are hardly ever modelled, and many alternatives that would involve different land use policies to encourage walking and cycling are actually beyond the scope of conventional modelling. Current practice is not even in line with the Treasury Green Book[164] and this needs reform and rigorous external monitoring.

6 Time-savings are uncertain and in many cases over valued in NATA appraisals

Time-savings in NATA are averages, taking no account of the size or length of the journey. Both of these factors are important and the survey on which UK travel time

values are based showed this quite clearly, as have other studies. According to the best data available (produced for DfT) the value to a driver of saving a few minutes or less on their journey is close to zero[165]. So a more significant time-saving, even if it is on a lower number of journeys, should be valued more than an almost worthless saving of two minutes on a high number of journeys.

NATA currently aggregates time-savings, which means that regardless of their value to individuals, some negligible time-savings for a large number of people, can have a major impact on which schemes score well in appraisal.

One option to deal with this would be to describe the time-savings in terms of size and volume, and put this in the Assessment Summary Table instead of a single money value.

In addition, average time-savings are used without any indication of reliability. This results in some schemes, which predict a large number of small time-savings in non-congested conditions, score very well, while some schemes which achieve larger time-savings in congested conditions will do less well. It is also likely that time-savings are overvalued relative to accident savings.

7 The NATA refresh process is a positive step and should be continued

Some of the serious problems which have arisen might have been avoided by opening up the process of changing and amending NATA and making it more transparent. There are always likely to be complex technical issues, but this should not deter DfT from engaging with external stakeholders. The commitment to do this during the refresh of NATA is very constructive and should be continued after it is complete.

Policy recommendations

The original report contains a great deal of detailed recommendations for improvement and the DfT is responding to these and other submissions through further consultation, discussion and specific draft proposals. The MTRU report's main recommendations are summarised as follows.

The new objectives for sustainable transport will need to be reflected in NATA, for example health. Proposals which seek to achieve a particular objective can be compared by measuring their effectiveness per pound of cost. Complex schemes will need the decision maker to consider strengths and weaknesses against cost.

Appraisal methods mean that NATA often promotes schemes which run counter to government policy. DfT should set up a multi-modal, multi-interest monitoring and advisory group to ensure the widest possible consideration and acceptance of amendments to NATA by professionals and the public. This will help avoid unintended consequences. *(this has been partly implemented).*

In relation to climate change, the concept of achieving a necessary target requires significant change to NATA. NATA could simply apply a pass/fail criterion if schemes do not achieve the target reduction.

The NATA appraisal internet site, webtag, should be continued as a source of guidance but extended significantly to include more good practice, for example to support the next four recommendations.

The Assessment Summary Table (AST) is at the heart of the appraisal system and needs to be completed in a way that is internally consistent and consistent with other appraisals. This needs a new and more comprehensive approach involving training, better guidance, and monitoring. This should include a specifically trained practitioner having overall responsibility for producing the AST.

The development of alternatives to proposed schemes needs to be taken seriously. This needs even greater emphasis in guidance, but also improved monitoring. Schemes should be judged against the best performing alternative, not against an often unrealistic 'do minimum'. Any serious alternative should have its own AST which has a comparable level of detail to the main proposal.

The impacts of schemes should be described properly in the AST, for example it should set out how large individual time-savings are or what the noise context is relative to standards for sleep or conversation. These aspects should not just be averaged and have a monetary value put on them.

Because of conceptual and practical problems, there should not be trading off of very different costs and benefits to produce a single monetary value, these include: personal injuries and death; climate change; time savings; value of a landscape; damage to historic buildings; street conversation; a night's sleep; air pollution nuisance; air pollution damage to health; health benefits of exercise and social inclusion.

For this reason the preferred option is to describe scheme or policy impacts more accurately, without valuation, in the AST.

Forecasting and modelling resources should be prioritised, first ensuring the best possible data (on travel as well as impacts). After this there should be more broad brush testing of properly modelled alternatives. This can be done using the improved travel and other data and much simpler models. Only if absolutely necessary should highly elaborate network based models be developed.

Every appraisal relies on forecasts, at present supplied by the DfT through their TEMPRO programme[166]. At present this does not produce a demand management forecast, without road pricing. This could use benchmark values from existing DfT studies such as Smarter Choices[167].

Walking and cycling need to be properly represented in the appraisal process and appropriate methods of modelling them need to be developed that allow for useful comparison of their benefits with other transport modes.

When polluting behaviour is reduced and tax is lost as a result that should not be seen as a cost and be allowed to reduce scheme benefits. In reverse, gains in tax through increases in polluting behaviour should not be viewed as a benefit and be

allowed to reduce scheme costs. A separate statement on changes in tax revenue should be made. This must distinguish between charges for polluting behaviour and general taxes.

- Fuel duty should be seen as an environmental tax which needs to be minimised by encouraging people to shift to less fuel intensive forms of transport, whereas NATA currently sees it as a source of government income to be maximised
- People shifting to public transport where fares are not subject to VAT and where fuel duty income falls should not be seen as disbenefits of a scheme

Numbers of travellers changing mode should be identified in the appraisal, rather than treated as generated traffic (and thus have their value reduced). Nor should they have their working time values altered when they switch, as at present.

The problems of using different average values (including national equity rates) continue to produce counter intuitive results and undermines the basis of a cost benefit analysis of the traditional type. The issue of the compatibility of national and scheme specific forecasts, and valuations, is complex and needs its own research and consultation project. A move away from derived valuations, rather than extending their use, will be of some help.

17 Policy package outcomes

The assessment of the policy package depends on three elements:

- the total number of journeys by different modes
- the length of those journeys
- the level of emissions which the new pattern of journeys will produce.

This section describes the travel changes expected from the policy package and how this would reduce emissions.

The starting point for transport planners is usually to collect existing travel data, measure the impacts of different policies in real situations, and go on to apply the impacts to the existing data to predict what effect a policy might have. This is done using a computer model of all the existing transport networks, from walking to aviation. In order to do this, elements such as journey time are given money values so that they can be mixed with real cost elements such as fuel. The approach to appraisal was discussed more fully in the previous chapter and this one seeks to apply the principles set out there to the policy proposals in the report. The first step is to discuss the use of transport modelling.

Understanding what models can do

There are several problems for all transport policies and schemes in relation to non-road transport infrastructure, and behavioural change options for all modes. There is no UK national model which adequately represents all modes at the same time. There are few multi modal models for motorised transport and even fewer which include walking and cycling to any degree. This usually amounts to a sensitivity test treating them as one mode – of very little use in this context.

However, transport models can be asked to do two very different tasks.

Recreating a precise present and a precise future
The first and most frequent use of models is to predict the exact outcome of a new policy, or introducing a new scheme. To do this, they must first replicate the present levels of travel on the computerised networks. Models are, generally speaking, not particularly good at this. They have to undergo significant adjustment to their mathematical structure in order to replicate the present. This includes, for example, having to penalise public transport so that people with a car available hardly ever use it (this is usually called the mode specific constant). This means that policies to attract people out of cars will never be successful in such models.

Overall, the very precision of the figures for future travel patterns 20, 30 and, in current appraisals, 60 years ahead, is misleading in itself. The underlying forecasts of travel behaviour which underpin them are subject to major uncertainty, and depend on relationships that exist today, for example between economic activity and transport, continuing indefinitely without change. Again, this creates particular problem for policies which are designed to change travel behaviour.

Models, and in particular those created with better and more comprehensive data than is often available, can be used effectively for a different purpose.

Scale, capacity and potential
What models can do is to help with questions such as, if travel (defined as all modes) increases when and where will the networks be congested? If traffic decreases, how much carbon will be saved and how will air quality improve? In many cases a good data set alone, or a very simple model, is capable of giving answers which are sufficient for the purpose. Rail modelling, for example, has been very useful in identifying where the network will be under pressure, both in terms of passengers and freight.

Modelling for this report

It was hoped to use data from the National Traffic Model (NTM) or possibly existing NTM model runs to assess the strategic level impact of the package. NTM is based on the National Travel Survey (NTS), plus a variety of freight sources. Overall it has established methods for assessing car based travel trends, but has little provision for behavioural change. Work is in hand by DfT to address this and to integrate its separate passenger rail model. There is also a national freight model which includes rail and road and comparative costs. It deals with issues such as port choice, but is not designed to deal with behavioural changes such as locational choice of supplier or distribution and depot choice.

Runs are available both for passenger and freight and have informed this section of the report. It may still be possible to undertake an NTM freight and passenger run but this would probably need significant adjustments. These have been explored with DfT during 2008, and work is continuing. It should be noted that the Climate Change Committee is also constructing broad brush transport models in connection with calculating the costs of reducing carbon.

While no modelling is yet available, the impact of the policy package on travel has been assessed, using NTS, Transport Statistics GB and other sources. The results are as follows.

Table 17.1
Changes in passenger travel from the policy package

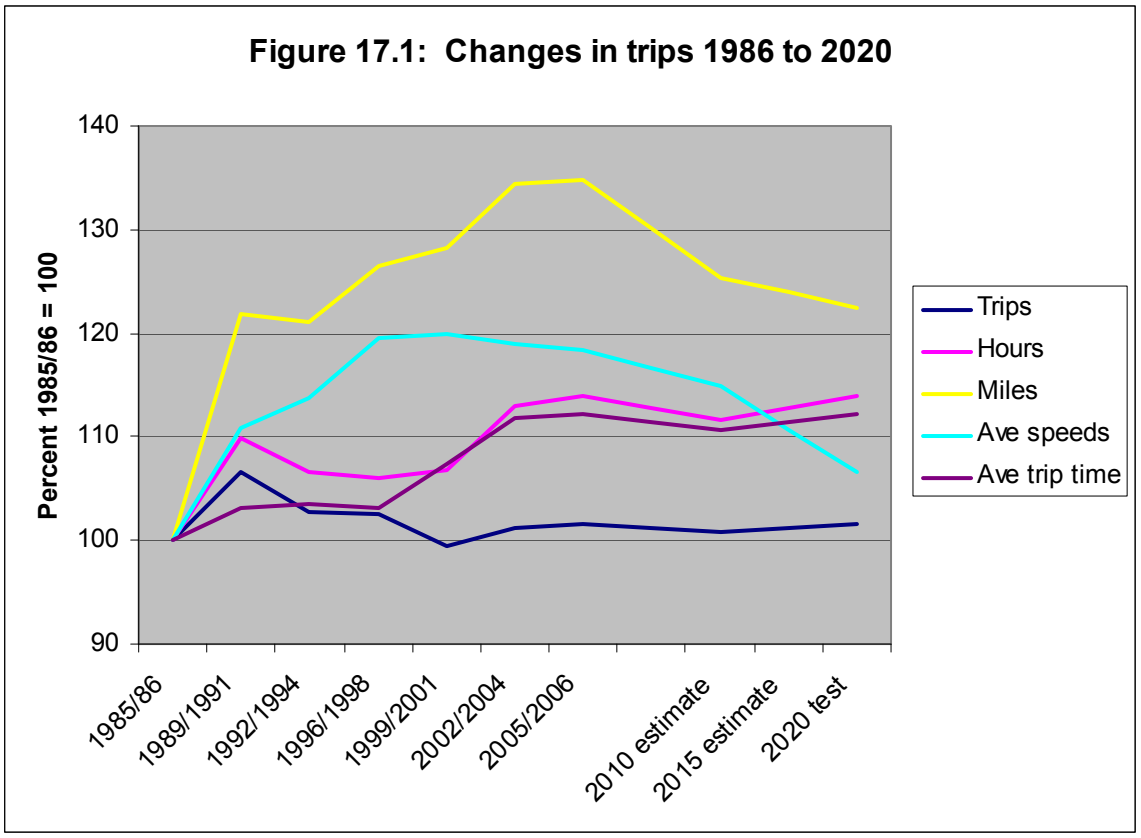
Passenger kilometres
Current

	Bus/ Coach	Car pass	Car driver	M/cyc	Cycle	Transit + BRT	Rail	Air	Total
2006	50.0	267.7	418.3	6	4	0.9	54.5	9.9	
Ave 2003-6	49.0	264.6	413.4	6	5	1.1	51.8	9.7	800.5
% share	*6.1*	*33.1*	*51.6*	*0.7*	*0.6*	*0.1*	*6.5*	*1.2*	
New prediction									
Ave 2019-23	61.3	264.6	351.4	9	15	3.2	80.0	6.8	791.3
% share	*7.7*	*33.4*	*44.4*	*1.1*	*1.9*	*0.4*	*10.1*	*0.9*	
% Change	*125.0*	*100.0*	*85.0*	*150.0*	*300.0*	*300.0*	*154.6*	*70.1*	*98.8*

Source: TSGB, DfT, NTS, MTRU calculations

The results for number of journeys are shown below in Table 17.2, which includes walking. The changes in the nature of these journeys are shown in Figure 17.1.

Figure 17.1: Changes in trips 1986 to 2020



The overall picture here is one of travel patterns which are not unknown in terms of recent years, which capable of being achieved through the policy package, and which are capable of being accommodated on the transport system with the land use, smarter choice, and infrastructure changes which are also proposed.

These results can be translated into emissions using the National Atmospheric Emissions Inventory (NAEI). This is shown in Table 17.2 below.

Table 17.2
Changes in emissions from the policy package

K-Tonnes CEq from National Atmospheric Emissions Inventory

Passenger

		Bus/Coach	Car pass	Car driver	M/cyc	Bicycle	Rail	Air	*Total*		
2006	Ceq	1000.0		18945.1	125.9		592.6	636.9	*21300.5*		***Reduction***
2020		1000.0		12077.5	188.9		792.7	424.2	*14483.2*	*6817.3*	**32.0%**

Freight

		Rail	HGVs	LGVs	Shipping	*Total*		
	Option 1							
2006	Ceq	175.6	7381.5	5418.7	1500.5	*14476.3*		***Reduction***
2020		175.6	5333.1	5418.7	1200.4	*12127.83*	*2348.5*	**16.2%**
	Option 1							
2006	Ceq	175.6	7381.5	5418.7	1500.5	*14476.3*		***Reduction***
2020		175.6	6311.9	4064.025	1200.4	*11751.91*	*2724.4*	**18.8%**

Combined emissions results for 2020 compared to 2006

	Total		
2006	*35776.8*		***Reduction Option 1***
Reduction		*9165.8*	**25.6%**
2006	*35776.8*		***Reduction Option 2***
Reduction		*9541.7*	**26.7%**

Assumptions

Car vehicle efficiency improves by 25%
Car traffic falls by 15%
HGV efficiency improves by 15%
12% of HGV traffic transfers to rail
HGV utilisation (load factors) improve by 10%
Bus/HGV emissions split adjusted to be more realistic
LGV efficiency improves by 10%

Two freight options reflect uncertainty over HGV/LGV emissions split
Bus efficiency improvements match growth in services
Rail passenger emissions in line with traffic growth, thus 52% increase, (DfT calculation is 15% emissions increase)
Rail use in line with DfT up to 2018, then does not slow down (constant 2.5% per annum)
Domestic shipping assumed 20% efficiency improvement
Domestic air assumed 10% efficiency improvement

Table 17.3 Indicative timescale: low carbon transport policy package

Policy proposal	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Limits on parking in new development												
Excess parking charge on space above limit												
Smarter choice fund (all journey types)												
Tax benefit reform to support smarter choices												
Fuel duty increases linked to car efficiency												
City bus planning reforms initiation phase												
City fares simplification in concert with above												
Bus service enhancement following above												
Rapid transit schemes across spectrum												
Aviation duty reform (beyond current proposal)												
Fuel duty + altitude effect applied to domestic aviation												
Additional rail capacity on existing routes												
Rail reopenings and local line support												
Motoring fixed penalty reform												
HGV weight distance charge												
Third sector bus operator support and training												
HGV small operator support and training												
LGVs and vans brought into car efficiency charge scheme												
1st year car & LGV charge escalator												
National travelcard including car club use												
In-vehicle information for speed and fuel use												
Speed limit enforcement included in ATM												
High efficiency ship prototype												
Maritime bio-fuel replacement												
Slow down in road and runway capacity increases												
New walkable streets fund												
Cycling infrastructure investment fund												

Green is implementation period, implementation ends where policy is reviewed/completed

Summary

Overall

- Same number of passenger journeys (consistent with NTS long term data)
- Car occupancy does not reduce as NTM predicts but improves
- Mode switch through Smarter Choices/Land Use package
- Average passenger journey length falls by about 7% (back to NTS 1997 level) but varies by purpose
- As journey length falls, mode switch to walk and cycle
- Longer distance mode switch to rail and coach

Passenger modes

- Cars are 25% more efficient
- 15% less car traffic
- 50% more rail travel
- 25% more local bus travel:
- 498m more passengers in London
- 388m more passengers in PTEs
- 341m elsewhere in England & Wales
- Cycling trebles
- Trams and bus transit use trebles
- 30% increase in walking journeys
- 30% decrease in flights totally within GB

Freight modes

- HGV utilisation is restored to the 1990 level (improves by about 10%)
- Rail freight use doubles
- HGV fuel efficiency improves by 15%
- Haul lengths reduce by 10% through:
    - Localisation of choice of supplier
    - Choice of port/airport for freight shippers which minimises inland transport

18 Policy package Assessment Summary Table

The following table takes the above sample policies and assesses their performance against the new objectives set out in TaSTS. Where there are negative and positive effects, both scores are shown rather than a neutral entry.

Clearly, the policies score very well against the climate change objective, since this is their main motivation. However, the robust nature of, and balance within, the overall package is illustrated by the very small number of negatives and the positive scores in achieving other objectives, particularly health and equity.

The positive scores appear fairly self evident, but the negatives may need a little explanation.

Negatives
Some policies which impose costs on business have positive as well as negative scores in the competitiveness column which reflect the fact that the revenue is recycled and that resource costs (mainly oil) are reduced. This is the case for the aviation entries.

In the case of speed limit enforcement, the negative score represents time lost if a lower speed limit is imposed on grounds of fuel efficiency alone. There should be no negative score from enforcing the existing speed limit, or to be more accurate there is a balancing benefit of obeying the law which must at least equal any time cost. If it did not, illegal behaviour which saved resources would have to be supported in social cost benefit analysis. There is also the important issue of how much other people value the increase in law abiding behaviour – this could be calculated in exactly the same way as the value of time currently in use. This sum may well exceed the value of any time costs but is never referred to. There are other complex issues here, for example a comparison of the cost of preventing road fatalities or serious injuries with the cost of preventing the same from violent crime.

The answer is that the idea of being law abiding is similar to the situation in relation to avoiding climate change – it is an objective which policy seeks to achieve, not an option which is costed and then traded off in a cost benefit table.

The negative scores for walking and cycling under health represent concerns over road safety, although it would be the aim to improve safety as the walking and cycling policies are implemented. It is included to provide a warning as well as being cautious in the assessment table.

The negative score for the national travelcard under health represents the risk of attracting people from walking and cycling.

Key to the Table
Score is positive: + or negative: - or neutral: N
Scale is low, medium, high

18.1 Assessment Summary Table: Low carbon transport policy package

	Economic competition	Reduce GHGs	Safety & Health	Quality of life	Equity
PPG13 mandatory, limits gradually reduced	N	+++	N	N	N
Excess parking charge on space above limit	N	+++	N	N	N
Smarter choice fund (all journey types)	N	+++	++	+	+
Tax benefit reform to support smarter choices	+	+++	N	+	+
Fuel duty escalator	N	+++	+	+	-
City bus planning reforms Phase 1	+	+	+	+	++
City fares simplification in concert with above	+	+	+	+	++
Bus service enhancement following above	+	+	+	+	++
Rapid transit schemes across spectrum	+	++	+	+	+
Aviation duty reform (beyond current proposal)	- - + +	+++	+	+	+
Fuel duty + altitude effect on domestic aviation	+ + -	+++	+	+	+
Additional rail capacity on existing routes	+	++	+	+	N
Rail reopenings and local line support	+	++	+	+	+
Motoring fixed penalty reform	N	N	N	+	+
HGV weight distance charge	+	+++	+	+	N
Third sector bus operator support and training	++	+	N	+	++
HGV small operator support and training	++	N	++	N	++
LGVs and vans brought into car efficiency scheme	+	+++	N	N	N
1st year car & LGV charge escalator	N	+++	N	N	N
National travelcard including car club use	+	++	-	+	+++
In-vehicle information for speed and fuel use	N	+	+	+	+
Speed limit enforcement included in ATM	+ -	++	++	N	++
High efficiency ship prototype	++	++	N	N	N
Maritime bio-fuel replacement	N	+	+	N	N
Slow down in road and runway spending	Awaiting new forecasts	+	+	+	+
New walkable streets fund	+	++	++ -	+++	+++
Cycling infrastructure investment fund	+	++	+++ -	++	+++

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