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Putting the brakes on climate change

A policy report on road transport and climate change

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Motoring Towards Sustainability programme

This report is part of ippr's Motoring Towards Sustainability programme which is examining the role of the car in progressive and environmentally sustainable transport policy. *Putting the Brakes on Climate Change* is the third publication from the Motoring Towards Sustainability programme. In 2002 ippr published the *Streets Ahead* report which analysed the relationship between deprivation and child pedestrian casualties in Britain. In June 2003 ippr published the *Tomorrow's Low Carbon Cars* report which examined how government can help to drive innovation and long term investment in low carbon car technologies and fuels. This report can be downloaded from the ippr web-site at www.ippr.org In 2004 ippr will be publishing a further report on the role that road user charging could play in helping to reduce traffic congestion.

The Motoring Towards Sustainability programme is made possible through the generous support of BMW, Direct Line, Macquarie Bank, RSPB and Shell. The analysis and recommendations in this report are entirely the authors and do not necessarily represent the views of the programme's supporters.

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Executive Summary

More affordable cars, rising incomes and a land use policy that has favoured out of town shopping centres and greenfield housing developments, have all led to a growing dependency on the car as a means of transport. Road vehicles currently account for 22 per cent of all UK carbon dioxide (CO_2) emissions, the main greenhouse gas responsible for the human contribution to climate change. To date, the CO_2 emissions from increases in road traffic have been largely offset by improvements in vehicle efficiency. But in future further fuel efficiency improvements are unlikely to keep pace with traffic growth.

Our research suggests that **road transport's share of total UK CO_2 emissions could rise to 29 per cent by 2020 overtaking the domestic, industry and service sectors. Transport is likely to be the only sector with rising emissions in the period to 2020, the large majority of which comes from road transport.** If the Government's policies in other sectors prove successful, the increase in CO_2 emissions from road transport will not be so great as to reverse the downward trend predicted for total UK emissions. But **rising road transport CO_2 emissions could, if not addressed, endanger the prospects of meeting the Government's 2010 target to cut CO_2 emissions by 20 per cent compared to 1990 levels.**

After 2020, the continued increase in emissions from road transport could start to raise total UK CO_2 emissions again and begin to erode the carbon savings anticipated from greater energy efficiency and renewable electricity use. Urgent action is therefore needed to reduce the growth in CO_2 emissions from road transport.

Policy Recommendations

According to the Government's official forecast, traffic will grow by between 20-25 per cent by 2010 which is higher than the growth experienced over the 1990s. The Government's high traffic forecast is based on the premise that car fuel costs will fall by 30 per cent by the end of the decade due to a combination of improvements in fuel efficiency as well as a reduction in real fuel prices[1].

Congestion Charging

With traffic set to increase by 20-25 per cent by 2010, a policy supporting unrestrained car use would be unsustainable. Our current system of motoring taxation means that motorists do not pay for the external costs their journey

1. The 30 per cent fall in car fuel costs is measured against the average fuel price in 2000.

imposes on others such as congestion and pollution. Fuel taxes and Vehicle Excise Duty tend to disadvantage low income households in rural areas where there is less congestion and pollution. Congestion charging would be fairer as motorists who drive on the most congested roads at peak times would pay more than motorists who use roads that are less busy at off peak times. Congestion charging should be one of the key policy measures taken forward in the Government's review of the Ten Year Plan for Transport in 2004.

ippr commissioned Imperial College to undertake some research on the effects that a national congestion charging scheme could have if it were introduced on roads throughout England in 2010. Given that fuel costs are expected to continue to fall, the results suggest that it does not appear to make sense to introduce congestion charging on a revenue neutral basis with offsetting fuel duty reductions. **A revenue neutral charge could actually increase traffic levels and CO_2 emissions by making the average costs of rural motoring even cheaper.**

Summary of the impacts that a congestion charge plus a carbon tax could have in England in 2010

	Revenue neutral charge	Revenue raising charge
% change in total traffic	+ 6.7%	- 6.7%
% change in bus patronage	+ 8.6%	+ 11.4%
% change in carbon	+ 5.0%	- 8.2%

By 2010, the average money cost per kilometre (km) would be expected to be just under 10 pence in a rural area and nearly 12 pence in a large urban area (under business as usual conditions, without congestion charging). **Under a revenue neutral charge in 2010, the average money cost per km could be about 7 pence for a rural motorist and about 18 pence for an urban motorist.** As a consequence rural areas would experience a significant increase in traffic.

The average money cost per kilometre for rural versus urban motorists in 2010*

	Average cost (pence per kilometre)	
	Rural areas	**Large urban areas (population 250,000)**
Business as usual (without congestion charging)	9.5 p	11.7p
Revenue neutral charge	6.9p	17.8p
Revenue raising charge	10.4p	20.4p

* The money cost (including fuel and operating costs) is based on a weighted average cost across all times of the day

The Government should start to develop options for introducing congestion charging on a revenue raising basis whereby charges are added on top of fuel duty costs. **A revenue raising charge introduced in 2010, could reduce road traffic in England by nearly 7 per cent, reduce CO_2 emissions by just over 8 per cent and increase bus patronage by just over 11 per cent.**

Under a revenue raising charge in 2010, the average money cost per km could be just over 10 pence for a rural motorist and about 20 pence for an urban motorist. Rural motorists might only pay, on average, 1 penny more per km than what they would expect to pay for their road use in 2010 without congestion charging. This implies that whilst a revenue raising charge would help to avoid the growth in rural traffic seen under a revenue neutral scheme, it would not dramatically increase the average costs of motoring in rural areas where there are often few public transport alternatives to the car.

Since 1997, spending on transport has been squeezed and it is only in 2002-03 that transport spending, as a proportion of Gross Domestic Product (GDP), has risen to the levels before this Labour Government came into power. Years of under-investment have left much of the public transport network in crisis and there are no quick fixes to improving the quality of bus and rail services. Yet in the next Spending Review 2004-2006, there are likely to be few additional resources for transport as health, child poverty and education will be the priority spending areas. Transport is likely to continue to have to fight for spending if Labour secures a third term in office as many of the Government's social and health policy priorities will require long term, sustained investment.

If a revenue raising charge were to be introduced in 2010, or soon after, it would not only help to reduce traffic and CO_2 emissions but also provide a much needed source of revenue. Our modelling results show that **a revenue raising charge introduced across England in 2010 could potentially raise an additional £16 billion per year.** This is just an illustration of what a revenue raising charge could be expected to raise.

If motorists are to pay more for their road use then a significant proportion of the money raised should be used to pay for better roads and public transport improvements. The Government spent about £13 billion on transport in 2002-03 and even with further investment in roads and public transport, it is highly unlikely that it will need to spend an additional £16 billion per year (in 2010 prices). Introducing a revenue raising congestion charge is likely to be politically challenging and the Government will need to identify ways of making it more publicly acceptable. **To help make a revenue raising charge more acceptable to motorists the Government should abolish Vehicle Excise Duty (which raised £4.5 billion in 2002-03).**

Voluntary Agreements for Improving the Fuel Efficiency of Vehicles

The European vehicle industry looks on track to deliver its voluntary agreement with the European Commission to reduce average CO_2 emissions from new cars to 140 grams per km (g/km) by 2008 – a 25 per cent improvement in fuel economy compared to 1995 levels. The voluntary agreement, along with CO_2 based reforms to Company Car Taxation, is expected to achieve savings of around 4 million tonnes of carbon (DTI, 2003). The voluntary agreement demonstrates that soft intervention, and indeed the threat of regulation, can play an important role in encouraging car manufacturers to invest in more fuel efficient technologies and lighter weight vehicle designs.

There is a political expectation that a target of 120 g/km of CO_2 could be reached for the average new car fleet by early in the next decade. The Government should encourage the European Commission to extend the current voluntary agreement as soon as possible and adopt a more ambitious target for the new car fleet average in 2020 of 100g/km of CO_2 or less. The Government should examine what further fiscal measures are needed for stimulating greater consumer demand for very fuel efficient car technologies such as hybrid-electric cars that combine an electric motor and battery with the power and performance of a conventional engine.

The Government should press for early agreement of legislation requiring the measurement and reporting of fuel consumption and CO_2 emissions from Light Goods Vehicles (LGVs). **The Government should encourage the European Commission to begin negotiations with the European vehicle industry to develop a new voluntary agreement for significantly reducing average CO_2 emissions from the new LGV fleet.** The Government should work with other European Union member states to develop consensus on the need for appropriate voluntary measures for reducing average CO_2 emissions from Heavy Goods Vehicles (HGVs).

Encouraging Innovation and Investment in Low Carbon Vehicles

In the longer term radically new transport fuels will be needed if we are to achieve deep cuts in carbon on the scale needed to meet the Government's aspiration of a 60 per cent reduction in CO_2 emissions by 2050. **Future fuels like hydrogen and biofuels, from woody biomass sources, hold out the promise of replacing fossil fuels in transport in the decades to come.**

The Government should:

- Send a long term price signal of its commitment to low carbon transport by developing differential rates of fuel duty that distinguish and reward climate friendly fuels.
- Target additional spending on the development and commercialisation of vehicle technologies and fuels that show the most promise of becoming mass market alternatives and not just niche options. Priority should be given to hybrid-electric technologies, hydrogen and biofuels from woody biomass sources.
- Seek to collaborate with other countries in developing innovative biofuel and hydrogen partnerships to spread research and development (R&D) costs, pool resources and share results.

Past and Current Traffic Levels

Over the last few decades, the amount of road travel has risen steadily and broadly in line with increasing incomes (Gross Domestic Product has risen by on average 2.5 per cent per year). In the early to mid 1980s there was a period of dramatic growth followed by much slower growth on account of the recession towards the end of the decade. During the 1980s, total traffic grew by an explosive 51 per cent in spite of the recession. The 1990s however saw a much more modest growth in road traffic of 14 per cent (DfT, 2003a). Over the last decade, road travel has increased in particular for commuting and leisure. The average distance people travel to work has increased by 17 per cent to 8.5 miles per day in 1999/2001. Leisure travel has risen by 11 per cent to around 6.8 miles per day in 1999/2001 (DfT, 2003b).

More affordable cars, rising incomes and a land use planning policy that has favoured out of town shopping centres and greenfield housing developments, have all led to a growing dependency on the car as a means of transport. Last year car sales reached a record 2.5 million, which was 11 per cent higher than in 2000 (SMMT, 2002), and car ownership levels are set to increase in the foreseeable future. The growth in car travel and the fall in bus patronage have been accompanied by stable motoring costs and rising bus fares. Since the mid 1980s, the average number of trips per person made by car has increased by 24 per cent from 517 to 639 per year. The distance travelled by car has also increased by 61 per cent since 1980, up from 388 to 624 billion passenger kilometres (DfT, 2003a).

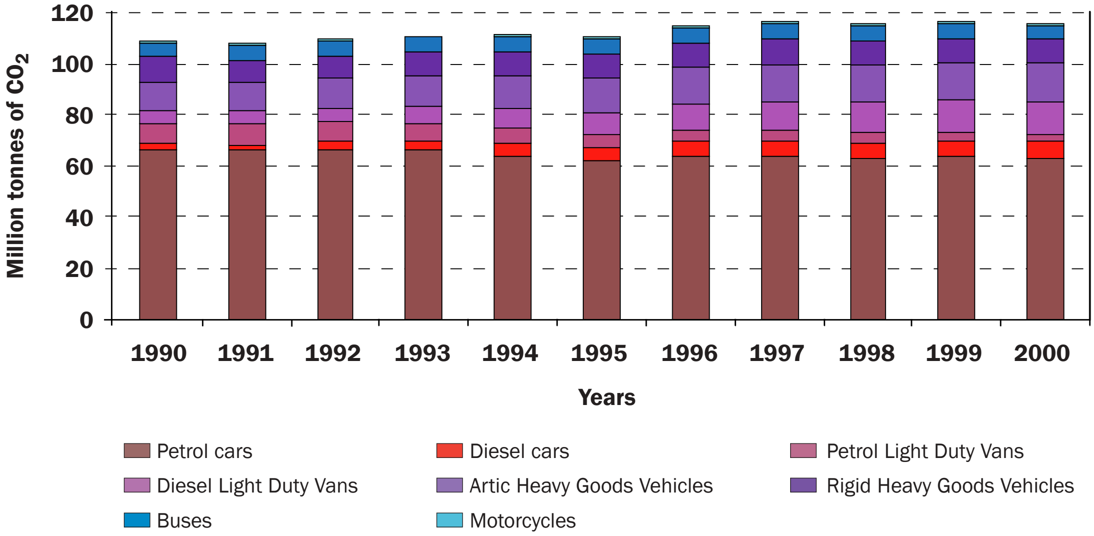
UK Transport CO_2 Emissions 1990-2000

Road transport has many impacts on the environment including air and noise pollution as well as indirect effects on land use such as habitat loss. Perhaps one of the greatest challenges for policy makers, business and individuals will be to mitigate the contribution that road transport makes to climate change.

Carbon dioxide (CO_2) is the main greenhouse gas responsible for the human contribution to climate change. The Government has a commitment under the 1997 Kyoto Protocol to cut greenhouse gas emissions by 12.5 per cent below 1990 levels over the period of 2008-2012. In addition, the Government's Climate Change Programme has set a goal to cut CO_2 emissions by 20 per cent below 1990 levels by 2010. In the recent Energy White Paper (2003) the Government recognised that more radical action will be needed over the longer term and aspired to putting the economy on a path to reducing UK CO_2 emissions by 60 per cent by 2050.

Road vehicles account for 22 per cent of all UK CO_2 emissions, the majority of which comes from passenger cars. Figure 1 shows that CO_2 emissions from road transport have in fact levelled off in recent years. To date, the CO_2 emissions from increases in road traffic have been largely offset by improvements in vehicle efficiency. The average new car today produces 178 grams per kilometre (g/km) of CO_2, a seven per cent reduction on 1997 levels (SMMT, 2002).

Figure 1: UK CO2 emissions by vehicle type 1990-2000

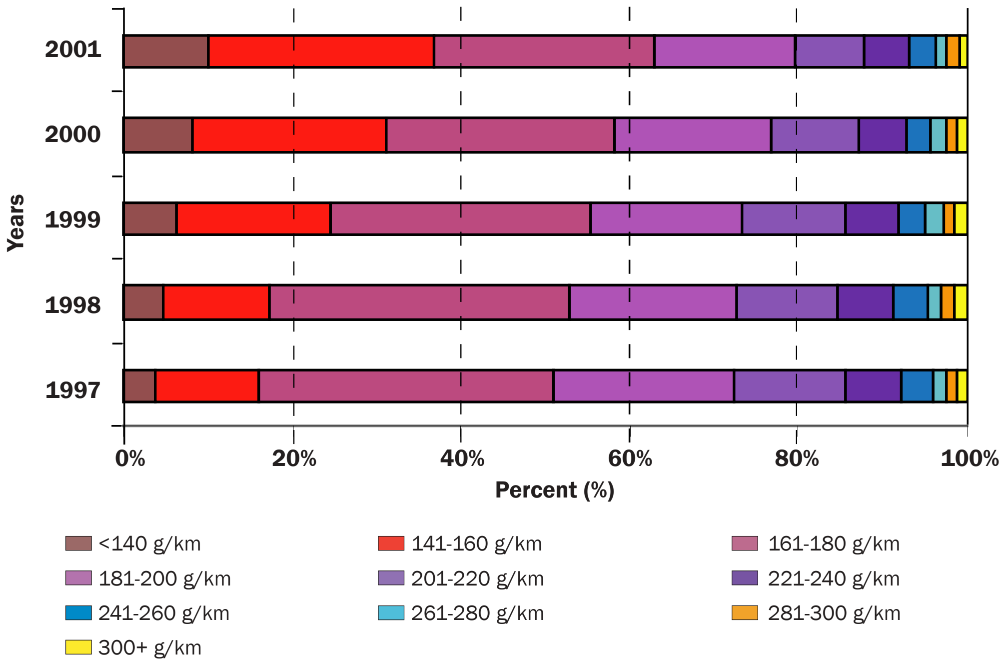


(Source: AEA Technology, 2001 Greenhouse Gas Inventory)

The European car industry has made a voluntary agreement to reduce CO_2 emissions from the new car fleet to an average of 140 g/km by 2008. This is expected to deliver approximately a 25 per cent reduction in the fuel consumption of new cars compared to 1995 levels. Without the voluntary agreement, road passenger CO_2 emissions across the European Union (EU) would have been expected to rise by 31 per cent between 1990 and 2010. Full implementation of the agreement is likely to reduce this increase to 11 per cent (EEA, 2002).

The voluntary agreement only refers to average EU emissions from news cars and there are no targets set at national level for individual member states. In fact a recent assessment of the effectiveness of the Community Strategy to reduce CO_2 emissions from cars suggested that the UK has performed relatively poorly in the early stages of the agreement (EC, 2002 – see figure 4). Despite this, figure 2 suggests that the UK is quite likely to meet the voluntary agreement, although this will require a further acceleration in the rate of improvement in the latter years of the agreement.

Figure 2: Distribution of CO_2 emissions for new cars 1997-2001



(Source: SMMT, 2002)

In future, the trajectory of road transport CO_2 emissions will depend on whether or not fuel efficiency improvements can continue to keep pace with traffic growth. This is a central question in assessing road transport's contribution to the UK's greenhouse gas emissions which we shall explore further in this report.

The National Transport Model

The Government has recently developed a new National Traffic Model (NTM) which supports policy making by testing the impacts of various transport scenarios. The NTM is composed of a series of sub-models that produce forecasts for road traffic, road congestion and pollution from surface modes of transport which includes road and rail for both passenger and freight journeys. At the heart of the NTM is a 'demand model' that analyses the options faced by travellers in different circumstances including how far they travel, what area types they travel to and which modes of travel they use to get there. The NTM will play a central role in helping to develop the future spending and policy priorities for the Government's review of the Ten Year Plan for Transport due to be published in 2004.

The NTM was used last year to produce updated forecasts for the Government's progress report on its Ten Year Plan for Transport which was first published in 2000. This progress report published new traffic and CO_2 emission forecasts for 2010 (for England only) which are shown in table 1 below.

Table 1: Summary of key National Transport Model assumptions (England only)

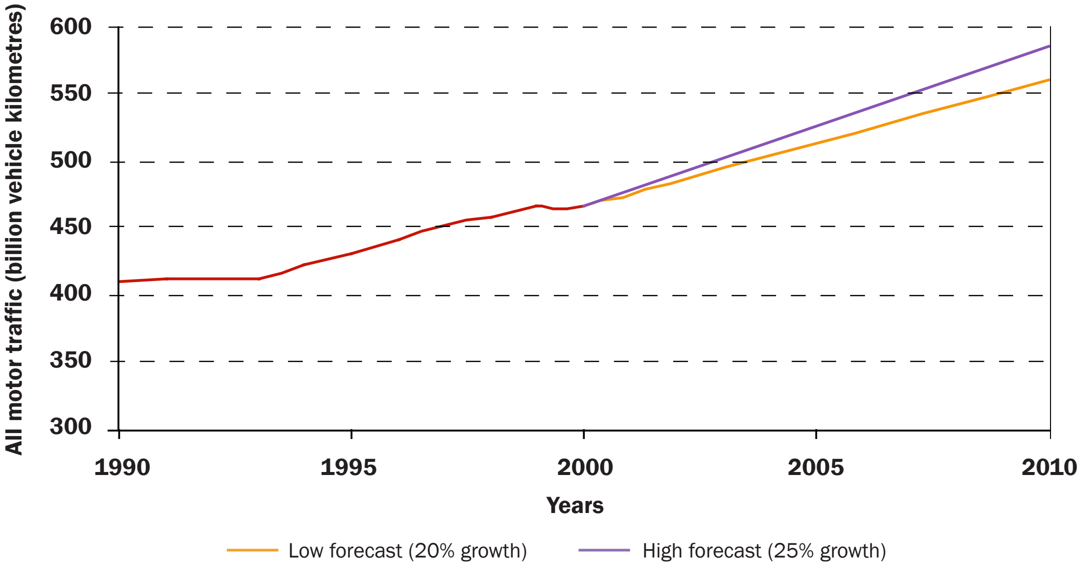
	Low forecast	High forecast
Total road traffic growth 2000-2010	+20%	+25%
Total road traffic CO_2 emissions in 2010 (measured in millions of tonnes of carbon -MtC)	29.3 MtC	30.2 MtC
Change in CO_2 emissions from 2000-2010 (%)	-2.7%	+0.3%
Gross Domestic Product (GDP) growth 2000-2010	28%	32%
GDP sensitivity around the Treasury's central forecast for 2010	-2%	+2%

(Source: DfT, 2003c)

Traffic Growth Assumption

For 2010, the NTM forecasts that traffic in England will grow in the range of 20 to 25 per cent, which is around 6 to 11 per cent higher than the growth in traffic experienced over the 1990s. This traffic growth assumption includes the effects of the Government's provisions in the Ten Year Plan for Transport for road capacity improvements.

Figure 3: Total road traffic in Great Britain 1990-2010



(Source: DfT, 2003a and DfT, 2003c)

The NTM's 20 to 25 per cent growth forecast is presumably an aggregate figure that covers all road traffic. It distinguishes between urban and inter-urban journeys although no published data is available on the growth rates for different vehicle types. This is a high growth rate compared to other traffic studies. For example, the RAC Foundation's Motoring Towards 2050 study projected a growth rate of 33 per cent between 2000 and 2031 once the impact of congestion was taken into account (RAC Foundation, 2002).

Fuel Efficiency Assumptions

Despite a 20-25 per cent growth in traffic, the NTM envisages that the level of road transport CO_2 emissions will be stable or even fall slightly by 2010. In essence this is a prediction that the impact of traffic growth will be balanced or exceeded by improvements in the average fuel efficiency of the road vehicle fleet. One of the key elements in the forecast for future road transport CO_2 emissions therefore concerns the Government's assumptions about future vehicle fuel efficiency. For cars it is assumed that there will be a 20 per cent improvement in fuel efficiency for the fleet average between 2000 and 2010. It is assumed that the fuel efficiency for light goods vehicles (LGVs) and articulated heavy goods vehicles (HGVs) will improve by 15 per cent in the period from 2000 to 2010. It is also assumed that the fuel efficiency for rigid HGVs will improve by 12.5 per cent in the period from 2000 to 2010.

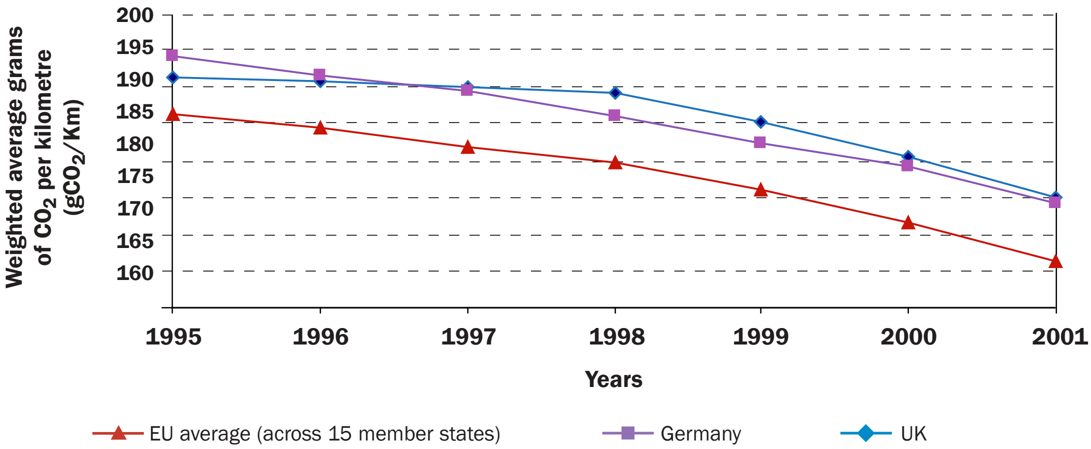
The NTM is still under development and testing access is currently restricted to the Department for Transport (DfT). At the time of writing our understanding of the model has been restricted to the information published in a recent Government publication 'Modelling and Forecasting using the National Transport Model' (DfT, 2003c) which describes the structure of the model and some of the underlying assumptions behind its forecasts. As discussed below, we believe that the assumption for the fuel efficiency improvement of cars may be a little too optimistic and have significant reservations about the fuel efficiency projections for LGVs and HGVs.

Uncertainties about the assumption for cars: fuel efficiency improvement of 20 per cent by 2010

- We appear to be on track to meet the European voluntary agreement to reduce CO_2 emissions from the new car fleet to an average of 140 g/km by 2008. But this target only refers to new cars entering the fleet, whereas the overall composition of the car fleet and the rate of replacement of old cars determine the fleet average. By 2010, for example, there will still be some millions of cars on the road that were built in the 1990s, and there was little sign of improving fuel efficiency until the end of the 1990s (DfT, 2003a). As a result, the fleet average does not yet fully reflect recent improvements.
- The rate of progress towards the voluntary agreement will inevitably have a cumulative effect on fleet average emissions over time. But the fact that the UK made a slow start in the early years of the agreement suggests that this trickle down process may take longer than some other European countries. Figure 4 shows that Germany has been much faster in moving towards the target compared to the UK. This is despite Germany having higher average CO_2 emissions for newly registered passenger cars before the agreement came into effect. In recent years, the UK has begun to catch up with Germany in part due to the effects of Company Car Tax[2] which from April 2002 was graduated according to CO_2 emission levels. Both the UK and Germany however remain well above the European average for CO_2 emissions from new cars (across the 15 member states).

2. Company-purchased cars account for around half of the new car market in the UK and the tax reforms appear to have significantly increased the popularity of company cars with lower CO2 emissions.

Figure 4: **Weighted average CO_2 emissions for newly registered cars from 1995 to 2001**



(Source: European Commission, 2000, 2001 and 2002*).

* Voluntary commitments have been made by the European, (European Automobile Manufacturers Association – ACEA) Japanese (Japan Automobile Manufacturers Association – JAMA) and Korean (Korea Automobile Manufacturers Association – KAMA) vehicle manufacturers to improve the fuel efficiency of the new car fleet. All these commitments are to reduce average CO_2 emissions from new passenger cars to 140 g/km. ACEA has a target date of 2008, while JAMA and KAMA have until 2009. The graph above shows the weighted average CO_2 emissions for new cars sold in the EU based on the emissions data from ACEA, JAMA and KAMA combined.

- Improvements in fuel efficiency are expressed in terms of 'test cycle' results, whereas it is well known that real on-road emissions differ significantly from these because the test cycle poorly reflects real driving conditions. It is impossible to predict how the relationship between test cycle and real world emissions will alter as vehicle technologies develop. But the predicted increase in congestion is one of several reasons to suppose that they may diverge further and that anticipated improvements in average emissions may therefore not fully materialise.

All of these above points suggest that the DfT's assumption of at least a 20 per cent improvement in average car fuel efficiency may be over-optimistic.

Uncertainties about the assumptions for goods vehicles: fuel efficiency improvement of 15 per cent for LGVs and articulated HGVs and 12.5 per cent for rigid HGVs by 2010

- As with cars, the assumed improvements in efficiency are for the whole of the LGV fleet. Smaller light commercial vehicles have a similar turnover to passenger cars which have a life expectancy of at least 12 years. Unlike cars there is currently no standard measure for quantifying the CO_2 emissions from LGVs. Data on the CO_2 performance of LGVs is therefore patchy and not directly comparable. The most recent data we could find came from DfT estimates for the CO_2 emissions from new small and large vans in 2003. Even though the DfT's data-set is based on fairly limited data, coming from specific vehicle manufacturers, it shows that there are wide variations in the CO_2 emissions for new LGVs and that emission levels vary just as much between different models of small and large van. Small vans appear to have CO_2 emissions broadly on a par with those for a car, while the larger class of van can be 30 to 40 per cent higher. The DfT's data-set revealed no clear trend in the CO_2 emissions from LGVs over time.

Table 2: Examples of CO_2 Emissions for Light Goods Vehicles (measured in grams per kilometre of CO_2)*

Small Vans		Engine cc	Fuel	Euro Standard (regulated air pollutants)	CO_2 emissions (g/km)
CITROEN Berlingo Multispace	Berlingo Multispace 1.9D	1868	Diesel	III	**181**
PEUGEOT New Partner Combi	2.0 HDi (90 bhp)	1997	Diesel	III	**152**
VOLKSWAGEN C.V.Caddy Kombi	1.9 TDI (90 PS)	1896	Diesel	III	**154**
FIAT Doblò Range	1.9 JTD	1910	Diesel	III	**176**
Large Vans					
FORD New Transit Tourneo	2.0 Turbo Diesel (100PS) 4.54 FDR	1998	Diesel	III	**209**
VOLKSWAGEN C.V.Caravelle	2.5 TDI (102 PS)	2461	Diesel	III	**213**
VOLKSWAGEN C.V.Multi-Van	2.5 TDI (102 PS)	2461	Diesel	III	**240**
VOLKSWAGEN C.V.LT Kombi	2.5 (83 PS) Axle Ratio 4.111	2461	Diesel	III	**257**
VOLKSWAGEN C.V.LT 4.6 Kombi	2.8 (158 PS) TDI Axle Ratio 3.727	2799	Diesel	III	**289**

(Source: Estimates by the DfT, based on information supplied by vehicle manufacturers for new LGVs in 2003)

- For light vans based on the same technology as cars, some crossover effect from the fuel economy improvements of cars can be expected. But this may be confounded by important differences in gear ratios, average engine sizes, demand for ancillary equipment, and differing patterns of use. All of these factors are likely to dilute the crossover benefits in vans from the agreement on cars.
- A recent report by the Advisory Committee on Business and the Environment (ACBE) observed that easier regulations for commercial vehicles under 3.5 tonnes have led to a switch from smaller HGVs to large panels vans which have become the vehicle of choice for urban deliveries (ACBE, 2002). This trend towards larger LGVs carrying heavier loads is likely to increase van fuel consumption, adversely impacting on average CO_2 emissions across the LGV fleet as a whole.
- In the coming years, much of the improvement in new car CO_2 emissions is expected to come directly from the switch to diesel which is inherently more fuel efficient and therefore emits less carbon. In 2002, diesel represented 23.5 per cent of new car registrations in the UK (SMMT, 2002). CO_2 related taxation measures (such as company car tax and Vehicle Excise Duty – VED) and pressures to achieve the European voluntary car agreement, suggest that diesel will continue to compete with petrol for at least an equal share of the car fuels market. For light vans, however, the ‘dieselisation’ process is already virtually complete. In 2002, over 80 per cent of the light van fleet was diesel (DfT, 2003a) and virtually all new vans purchased today run on diesel. As a result, the increased use of diesel is very unlikely to deliver further significant improvements in the overall fuel efficiency of the LGV fleet.
- For heavier vans and HGVs, the picture is also rather unclear due to lack of comprehensive data on CO_2 emissions performance. Analysis undertaken for the DfT suggests that a fuel efficiency improvement in the order of 15 per cent over ten years would be possible (NERA, 1999). It concluded that the improvement would be clearest for heavier goods vehicles, including articulated lorries, and less so for the smaller, rigid vehicles. There is no doubt that fuel is one of the largest cost elements for the haulage industry and competition drives fuel efficiency. But the fact that the data on which these projections are based is not very reliable or representative raises concerns about whether such high fuel efficiency gains could actually be achieved within the HGV sector, especially for the smaller classes of truck.
- More or less all of the growth in HGV traffic is occurring in the largest articulated lorries. As noted above articulated lorries appear to be experiencing some of the greatest efficiency improvements. Improved logistics, such as on board equipment for managing goods handling, have enhanced these efficiency gains. But this has been mirrored by changes in distribution patterns, such as the development of regional distribution centres and ‘just in time’ deliveries, which has increased long distance HGV travel. Articulated

lorries currently account for 13 per cent of all traffic on motorways (DfT, 2003b). As the mileage of articulated lorries have been growing, their average payload has been getting lighter as the types of goods being hauled have shifted from heavy commodities to lighter, high value consumer goods. This has meant that even though the average CO_2 emissions per kilometre travelled by an articulated lorry has been improving there has been a deterioration in the CO_2 emissions per tonne kilometre hauled (ACBE, 2002).
- In contrast to company and private cars, there are less tax incentives for encouraging greater fuel economy within the HGV fleet. The pace of fuel efficiency improvements is therefore likely to be much slower for HGVs.

In summary, there is very limited data on the CO_2 emissions from goods vehicles with no clear trend in the CO_2 emissions performance of either LGVs or HGVs. This casts doubt on the reliability of the evidence base the DfT has used to generate its fuel efficiency forecasts for goods vehicles.

As discussed above logistics, changes to delivery patterns and the types of goods being transported will all affect average CO_2 emissions. It is however not currently possible to account for these considerations in the model for freight within the NTM, and even more so for light duty vans, as these are less sophisticated and well integrated than that for road passenger travel. The NTM's fuel efficiency assumptions for LGVs and HGVs are therefore an awkward compromise, as changes to logistics and distribution patterns should be properly attributed to the traffic model rather than to improvements in unit fuel economy. This adds to our doubts about whether the NTM's fuel efficiency projections for goods vehicles will materialise. This is especially the case given that they are expressed as an improvement not just for new vehicles but over the whole of the LGV and HGV fleets.

Fuel Price Assumptions

The NTM's forecasts for road traffic and CO_2 emissions are based on the premise that the unit fuel costs for passenger cars will fall by 30 per cent in the period to 2010[3]. In other words, the most important aspect of the marginal cost of private motoring will fall by 30 per cent over the decade. This arises from the underlying assumption that there will be a 20 per cent improvement in fuel efficiency for cars, as discussed above, combined with a 12 per cent fall in real fuel prices. This is a substantial change, which would significantly affect the total traffic level and would help to explain a more rapid growth in traffic.

The fall in fuel prices assumes that there will be a fall in the underlying price of oil, which seems plausible. However, it also assumes that **duty levels will remain**

3. The 30 per cent fall in car fuel costs is measured against the average fuel price in 2000. Prices are currently below these levels.

roughly the same in real terms, and will not increase to compensate for either the fall in the underlying price of oil or improvements in fuel efficiency.

Conclusions of Official Government Forecasts

Taken all together, we have a picture of a national traffic forecast dominated by high levels of road traffic growth (higher than those experienced in the 1990s), driven by rising incomes, falling fuel prices and improving fuel economy. Improvements in fuel economy, however, also mitigate the increase in CO_2 emissions which would otherwise result from traffic growth.

There are real uncertainties surrounding both average vehicle fuel efficiency and traffic levels in future years, but the balance between these two elements is critical to predictions of future road transport CO_2 emissions. **In our view, the improvements in fuel efficiency and reduction in CO_2 emissions assumed by the NTM may prove over-optimistic. If this is the case, the growth in road traffic might be slightly reduced, but CO_2 emissions would grow as a result.**

Alternative Forecasts to 2010 and 2020

The Institute for European Environmental Policy (IEEP) was a partner in the production of a major forecast of possible energy futures for the road transport sector last year which was commissioned by the DfT (Eyre, Fergusson and Mills, 2003). This involved IEEP developing a transport and energy forecasting model. Since it has not been possible to use the official NTM model, and because of the lack of an official traffic or CO_2 emissions forecast for 2020, IEEP's model has been used instead for this report. The results have been calibrated to match the 2000 baseline in the official forecasts.

The IEEP model is in essence a physical model of the UK road transport sector coupled to a model of the relevant elements of the energy supply system. It is a 'bottom up' model that derives a detailed vehicle stock profile from a combination of transport demand (traffic) and vehicle technology development scenarios. From this basis end user fuel demands in each modelling year are calculated, and then translated into primary energy demands and corresponding CO_2 emissions. The model is structured to have separate scenario data for each year modelled in the following categories:

- Traffic demand by class – including car, bus, LGV, HGV and public service vehicles.
- Vehicle technology developments – the percentage of cleaner vehicles, such as hybrid-electric or fuel cell vehicles, as well as expected improvements in fuel efficiency.
- Energy supply characteristics – such as the electricity generation and road fuel mix.

A diagrammatic representation of the model can be seen in appendix 1. The key outputs of the model are energy demand by vehicle class and fuel type and carbon emissions for each year. The model is in most major respects similar to the NTM model, but it uses different inputs and procedures in some areas and the data used are more aggregated.

Our Modelling Assumptions

The NTM's 20-25 per cent growth forecast corresponds well with the high growth scenario developed by the Department of Trade and Industry (DTI) Technology Foresight Programme (2001). This was recently updated by AEA Technology and Imperial College in the low carbon futures modelling work (2002) for the DTI in the lead up to the 2003 Energy White Paper. We have therefore used this scenario to reflect the DfT's assumptions.

For 2020, we have assumed almost exactly the same growth rate in car traffic between 2010 and 2020 as between 2000 and 2010. ACBE used the same assumption in a paper it recently produced on road transport and climate change (ACBE, 2002). However, we have used a slightly higher growth rate in the period from 2010 to 2020 for goods vehicles, assuming 29 and 22 per cent growth for LGVs and HGVs respectively over the decade.

To calculate fleet average CO_2 emissions in any given year, it is necessary to estimate the expected fuel economy of new vehicles entering all segments of the vehicle fleet. It is also important to track the rate at which older vehicles are scrapped each year, and the numbers of new vehicles which enter the fleet to replace them. These are complex and uncertain calculations. Our basic approach builds on the assumptions of the Government's Powering Future Vehicles Strategy (2002) which aims to support the transition to low carbon road transport and sets 2012 targets for the introduction of low carbon vehicles. We assume that:

- The Government's low carbon car target, requiring 10 per cent of new car sales to have exhaust emissions of 100 g/km of CO_2 or less by 2012, will be achieved. We assume that these low carbon cars will be powered by petrol and diesel hybrid-electic engines. We assume that post 2012 there will be continuous progress in the introduction of low carbon cars and that diesel hybrid-electric cars will dominate.
- 3 per cent of new cars are hydrogen powered by 2020.
- Liquefied Petroleum Gas (LPG) conversions reach the equivalent of 1 per cent of new car and van sales in 2010 and 1.5% by 2020.
- By 2012, one in ten new buses are powered by compressed natural gas (CNG)
- The Government's low carbon bus target, requiring the deployment of 600 low carbon buses by 2012, will be achieved. We assume that these low carbon buses will be powered by diesel hybrid-electric engines.
- Rates of take up of hybrid-electric engines for LGVs will be broadly the same as the diesel car market.
- There will be limited penetration of hybrid-electric engines into captive truck fleets from 2020.
- There will be a steady increase in use of Compressed Natural Gas (CNG) in HGVs.

Combining these assumptions with the other considerations discussed above and our calculations on stock turnover, we arrive at estimates for fleet average fuel efficiencies for 2010 which are shown in table 3. Our estimates are less optimistic than those of the NTM, particularly when it comes to goods vehicles.

Table 3. Our estimates for improvements in the fleet average fuel efficiency for cars, public service vehicles and goods vehicles by 2010

Estimates for fleet average fuel efficiency (2000-2010)	Our assumptions	NTM assumptions
Cars	**18.8%**	20%
Public Service Vehicles	**3.0%**	N/A
LGVs and articulated HGVs	**7.8%**	15%
Rigid HGVs	**1.7%**	12.5%

Total CO_2 Emissions by Sector

Table 4 and figure 5 combines our forecasts for road transport emissions with those for other sectors taken from the background work of the Interdepartmental Analysts Group for the Government's Energy White Paper published in February 2003. The forecasts incorporate the effects of the Climate Change Programme policy measures published in 2000.

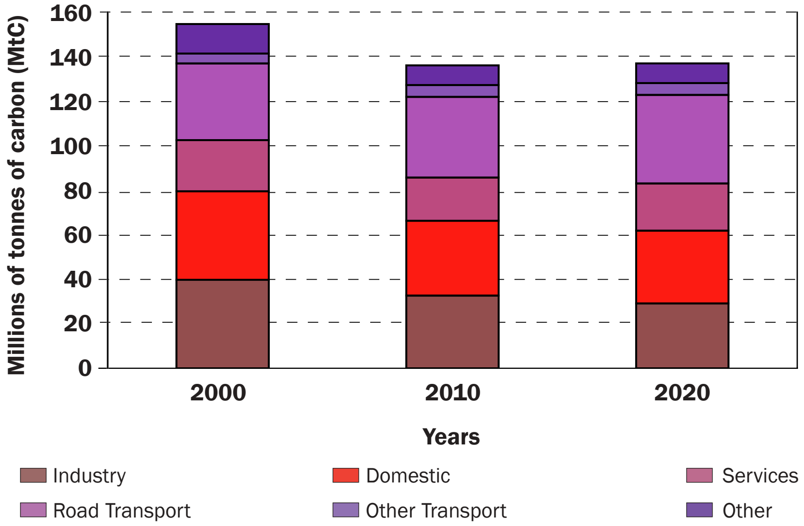
Table 4: Projected UK CO_2 emissions by sector (measured in million of tonnes of carbon – MtC)

	Climate Change Programme baseline	DfT NTM baseline			% change 2000 -2020
	1990	**2000**	**2010**	**2020**	
Industry	49.8	40.1	32.7	29.1	-27.4%
Domestic	42.6	39.8	33.6	33.1	-16.8%
Services	23.3	22.8	19.1	21.3	-6.6%
Road transport	**33.3**	**34.5**	**37.0**	**39.6**	**+14.8%**
Other transport*	4.3	4.4	4.8	5.1	+15.9%
Other	14.7	13.0	9.2	8.9	-31.5%
Total	168	154.6	136.4	137.1	-11.3%
Road transport as % of total	**19.2%**	**22.3%**	**27.1%**	**28.9%**	
Transport as % of total	22.4%	25.2%	30.6%	32.6%	

* Other transport modes include road mobile machinery, rail, shipping and domestic aviation. International aviation does not fall within national greenhouse gas inventories, under the rules of the United Nations Framework Convention on Climate Change (UNFCCC), and so it is not included in the UK Climate Change Programme or the above table.

Total CO_2 Emissions by Sector

Figure 5: Projected UK CO_2 emissions by sector (in millions of tonnes of carbon)



In 2000, road transport accounted for around 22 per cent of total UK CO_2 emissions. On the basis of the assumptions used, **by 2020 road transport CO_2 emissions could be expected to continue to increase by around 15 per cent while total CO_2 emissions are forecast to fall by around 11 per cent. Transport is the only sector with rising emissions, the majority of which comes from road transport.**

The Energy White Paper sets out how a reduction of 15-25 millions of tonnes of carbon (MtC) could be achieved by 2020. The majority of the savings come from the ambitious aspirations the Government has set for improving energy efficiency within the domestic sector and renewable electricity use. The headline aspiration is that the Government hopes to increase the share of renewables in electricity production to 20 per cent by 2020. Virtually all of this renewable electricity is likely to be generated from onshore and offshore wind farms as wind turbines are currently one of the most cost effective low carbon energy technologies.

Total CO_2 Emissions by Sector

Table 5. The Energy White Paper savings of 15-25 million tonnes of carbon (MtC) by 2020

	Estimated reductions in millions of tonnes of carbon – MtC
Energy efficiency in households	4-6
Energy efficiency in industry, commerce and the public sector	4-6
Road transport: extension of the European voluntary agreement for improving the fuel efficiency of the new car fleet post 2008; and the use of biofuels	2-4
Increasing renewables	3-5
EU emissions trading scheme	2-4

(Source: DTI , 2003)

The Energy White Paper projects a reduction of 2-4 MtC from transport – all of which comes from road transport. This arises from the introduction of 5 per cent of biofuels into petrol and diesel (as blends) which could save around 1 MtC by 2020. It also assumes that the current voluntary agreement with European car manufacturers will be extended to require the new car fleet to achieve an average of 100-115 g/km in 2020 (DTI, Energy White Paper Annex 4, 2003).

The other (non-transport) policies in the Energy White Paper are expected to save between 13-21 MtC by 2020. So even though CO_2 emissions from road transport are likely to rise, less is being done under the Energy White Paper to curb road transport emissions. **Our forecasts suggest that road transport's share of total UK CO_2 emissions could rise from just over 22 per cent to 29 per cent by 2020.**

Road Transport CO_2 Emissions by Vehicle Type

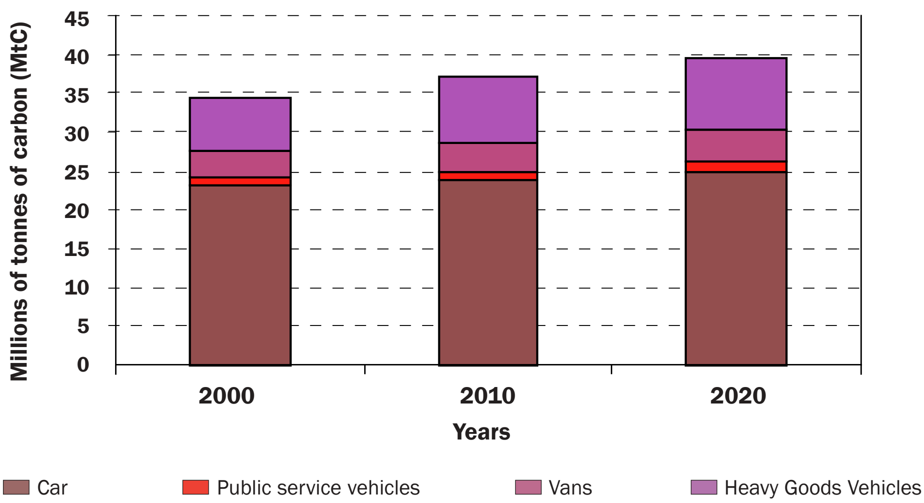
In our analysis we have also examined the relative contributions of different vehicle types to road transport CO_2 emissions. Table 6 and figure 6 show that road transport CO_2 emissions from both vans and HGVs are predicted to rise, both in absolute terms and as a share of the total. This is on account of relatively high expectations for traffic growth, and relatively modest improvements in fuel economy by comparison to cars. **The proportion of total road transport CO_2 emissions from goods vehicles could be expected to rise from about 30 per cent to 34 per cent by 2020.**

Table 6: Projected UK CO_2 emissions by vehicle type (measured in million of tonnes of carbon – MtC)*

	2000	% of total road transport	2010	% of total road transport	2020	% of total road transport
Car	23.3	**67.5%**	23.8	**64.3%**	25.0	**63.1%**
Public service vehicles	1.0	**2.9%**	1.1	**3.0%**	1.1	**2.8%**
Vans	3.2	**9.3%**	3.9	**10.5%**	4.2	**10.6%**
Heavy Goods Vehicles	7.0	**20.3%**	8.2	**22.2%**	9.3	**23.5%**
Total road transport	34.5	**100%**	37.0	**100%**	39.6	**100%**

* Percentages rounded to the nearest decimal place

Figure 6: Projected UK CO_2 emissions by sector (in millions of tonnes of carbon)



Implications for the UK's Climate Change Targets

If the Government's policies in other sectors prove successful, the increase in CO_2 emissions from road transport will not be so great as to reverse the downward trend predicted for total UK emissions in the period to 2010. According to the estimates of the Interdepartmental Analysts Group, the UK should still meet its 2010 target to cut CO_2 emissions by 20 per cent compared to 1990 levels with a small margin to spare. Our higher CO_2 forecasts for road transport suggest that we would miss the target by 1.2 per cent. Of course none of the estimates for any sector can be taken as entirely accurate predictions. Yet our analysis suggests the possibility that **rising road transport CO_2 emissions could, if not addressed, endanger the prospects of meeting the Government's 2010 target.**

However, even if all the Energy White Paper policies are implemented, our forecasts suggest that the continued increase in emissions from road transport could start to raise total UK CO_2 emissions again after 2020. Post 2020, there is a risk that road transport could begin to erode the projected carbon savings expected from the Energy White Paper commitments to improve energy efficiency and increase renewable electricity use. Continuing to let road transport off the hook could prove to be the spanner in the works in staying on track to achieve a 60 per cent cut in CO_2 emissions by 2050.

Summary of Key Findings

Road transport's share of total UK CO_2 emissions could rise from just over 22 per cent to 29 per cent by 2020.

Transport is the only sector with rising emissions in the period to 2020, the majority of which comes from road transport. By 2020, road transport CO_2 emissions could increase by around 15 per cent while total emissions are forecast to fall by around 11 per cent.

If the Government's policies in other sectors prove successful, the increase in CO_2 emissions from road transport will not be so great as to reverse the downward trend predicted for total UK emissions in the period to 2010. But after 2020, the continued increase in emissions from road transport could start to raise total UK CO_2 emissions again. Post 2020, there is a risk that road transport could begin to erode the projected carbon savings expected from the Energy White Paper commitments to improve energy efficiency and renewable electricity use.

Mitigating Road Transport's Contribution to Climate Change

Mitigating road transport's contribution to climate change will require a combination of both voluntary and market based policy measures. Congestion charging, further voluntary agreements for improving the fuel efficiency of vehicles and low carbon vehicle fuels and technologies could all play an important role in reducing the CO_2 emissions from road transport. These policy options are discussed in more detail below.

Making CO_2 Emissions from Road Transport a Policy Priority

Every government department has Public Service Agreements (PSAs) which are agreed with HM Treasury and are symbolic of the Government's policy and spending priorities. For example, the DfT has PSAs for reducing traffic casualties and congestion on trunks roads and in large urban areas. As part of the Spending Review process each department has to measure and report on the status of its PSAs. In the lead up to a Spending Review there will be the usual horse-trading between Ministers and their departments for extra spending. If a department is performing poorly on a particular PSA commitment or target then it is likely to have a stronger case for arguing for additional support.

Critically, the DfT does not have a PSA for reducing (or reducing the growth in) CO_2 emissions from road transport. This implies that reducing CO_2 emissions from road transport is not one of the Government's key policy objectives and will struggle to become a future spending priority. Our modelling results have shown that CO_2 emissions from road transport are threatening a significant increase, while they are falling in all other sectors of the economy, so this is clearly a gap in government policy.

Policy Recommendation

A reduction (or reduced growth) in CO_2 emissions from road transport should be introduced as a new PSA for the DfT.

Using Price Signals to Reduce Traffic Growth

As discussed earlier the Government's high road traffic forecast is driven by rising incomes as well as the assumption that car fuel costs will fall by 30 per cent in the period to 2010 – in part due to an anticipated 12 per cent fall in real fuel prices. Under these assumptions, our CO_2 modelling results suggest that road transport could potentially account for 29 per cent of total UK emissions in 2020.

Fuel Taxation

In the early years of this Labour Government, the fuel duty escalator was employed as a price signal for helping to reduce traffic and in particular CO_2 emissions. There is a widespread misconception amongst politicians that traffic cannot be reduced in absolute terms while the economy is growing. But analysis by Professor Stephen Glaister at Imperial College, London (2001) shows that the fuel duty escalator did just that. Between January 1998 and July 2000 the fuel price rose by 23 per cent above inflation. Assuming a longer term traffic price elasticity of -0.3, Imperial College's analysis showed that this would be expected to reduce traffic by about 7 per cent over the two and half years or an average of 2.8 per cent per year. This is of the same order as the increase that would be expected as a result of economic growth (Glaister, 2001). The seemingly straightforward policy of increasing fuel tax, effectively meant that the Government managed to halt traffic growth over a period of about two years, and counteracted falls in the underlying price of oil. Increases in duties between 1996 and 1999 are estimated to have produced significant annual carbon savings of between 1 and 2.5 MtC (DETR, 2000).

The fuel protests of the autumn of 2000 led to the abandonment of the fuel duty escalator demonstrating that price signals are just as much affected by politics as they are by sound economics. The political sensitivity of not increasing fuel taxation is still present in the Government's NTM forecasts that commit to keeping fuel duty levels roughly the same in real terms in the period to 2010, thereby allowing pump prices to fall and demand to grow. The negative publicity from the fuel protests means that it is highly unlikely that any government will use fuel duty as a price mechanism for reducing traffic and CO_2 emissions for the foreseeable future.

Congestion Charging

There are other price signals that can affect travel behaviour. ippr has long argued for road user charging. Patricia Hewitt advocated congestion charging for London in a 1989 ippr pamphlet which stated that "it is the absence of road pricing, not its introduction, which is unfair." For years, successive governments have considered road user charging but dismissed the idea as too politically risky. Even though congestion is often cited as a top local concern, there is a gap between people's recognition of the problem and their willingness to pay for road use. Following the introduction of the London congestion charging scheme in February 2003, the case for congestion charging appears to be regaining momentum nationally.

Our current system of motoring taxation means that motorists do not pay for the external costs their journey imposes on others such as congestion and pollution. Fuel taxes and Vehicle Excise Duty tend to disadvantage low income households in rural areas where there is less congestion and pollution. Congestion charging would be fairer as motorists who drive on the most congested roads at peak times would pay more than motorists who use roads that are less busy at off peak times.

Earlier in 2003, the Prime Minister signalled his support for congestion charging in an article for the Policy Network. The Government recently announced that it would be conducting a feasibility study on road user charging which will explore how charging schemes could be designed as well as their impact on reducing traffic pollution.

Congestion Charge Modelling Results

Table 7 shows the impact that a national congestion charge scheme could have on CO_2 emissions and traffic in England by 2010. It is taken from some congestion charge research that ippr commissioned Stephen Glaister and Dan Graham of Imperial College to undertake based on the model they developed for The Independent Transport Commission (Glaister and Graham, 2003). It uses the same assumptions as the Government's NTM model for the fuel efficiency of vehicle fleets, fuel price and traffic growth in the period to 2010. The full results from this congestion charge research will be published in a further ippr report on road user charging in 2004.

Opinion poll surveys suggest that motorists are more willing to accept charging if it does not lead to an overall increase in their motoring costs. A politically attractive option would therefore be to design a congestion charging scheme so that it is revenue neutral, offsetting the costs by reducing existing motoring taxes such as fuel duty. Table 7, however, illustrates that whilst a revenue neutral charge would help to redistribute traffic and ease pressure on congestion hot spots in busy town or city areas, it would not necessarily lead to an overall decrease in traffic levels or CO_2 emissions.

Given that the Government expects car fuel costs to fall by 30 per cent by 2010, it does not appear make sense to introduce congestion charging on a revenue neutral basis. The combination of declining fuel costs and rising personal incomes means that **a revenue neutral charge could actually worsen overall traffic levels and CO_2 emissions. Our modelling results suggest that a revenue neutral charge could *increase* road traffic in England by nearly 7 per cent and *increase* CO_2 emissions by 5 per cent in the year 2010.**

Table 7: Impact of a congestion charge plus carbon tax in 2000 and 2010*

	2000	2010	2010
Charge type	Revenue neutral	Revenue neutral	Revenue raising
Change in total traffic (Billion vehicle kilometres per year)	+ 14.7	+ 36.3	- 36.6
% change in total traffic	+ 3.4%	+ 6.7%	- 6.7%
Change in bus patronage (Billion passenger kilometres per year)	+ 0.7	+ 1.6	+ 2.1
% change in bus patronage	+ 4.2%	+ 8.6%	+ 11.4%
Change in CO_2 emissions (Million tonnes of carbon per year)	+ 0.7	+ 1.7	- 2.8
% change in carbon	+ 2.6%	+ 5.0%	- 8.2%
Total revenue increase (£ billion)	N/A	N/A	16.6 (in 2010 prices)
% change in total revenue	N/A	N/A	57.1%

* Notes with table 7:
1. The congestion charge modelling is based on the same assumptions as the Government's National Transport Model (NTM) for 2010. It assumes a 20-25 per cent growth in traffic, a 12 per cent fall in real fuel prices and that the duty level will remain the same in real terms. It also uses the NTM's assumptions for fleet vehicle efficiencies.
2. A revenue neutral charge offsets fuel duty costs. Under business as usual conditions, total fuel revenue is about £23 billion in 2000 and £29 billion in 2010.
3. A revenue raising charge is added on top of fuel duty costs.
4. The traffic price elasticity is 0.30 which assumes that for every 10 per cent increase in price there is a 3 per cent reduction in traffic.
5. The costs of carbon in 2000 were assumed to be £70 per tonne rising to £80 per tonne in 2010.

Table 8 shows the average money cost per km for rural versus urban motorists (including fuel and operating costs). The cost has been weighted across all types of road and for all times of the day. It shows that the effect of a revenue neutral charge would be to make the costs of rural motoring cheaper than it is today. **By 2010, the average money cost per km would be expected to be just under 10 pence in a rural area and about 12 pence in a large urban area** (the business as usual case for 2010 in table 8). **Under a revenue neutral charge in 2010, the average money cost per km could be about 7 pence for a rural motorist and about 18 pence for an urban motorist.** The geographical distribution of the results show that roads in rural areas would experience a significant increase in traffic, explaining how a revenue neutral charge, compounded by falling fuel costs, could cause an overall increase in traffic levels.

Table 8: Average money cost per kilometre for rural versus urban motorists (travelling by car)*

		Average cost (pence per kilometre)	
		Rural areas	Large urban areas (population 250,000)
2000	BAU (without congestion charging)	9.5p	11.3p
	Revenue neutral charge	7.9p	15.6p
2010	BAU (without congestion charging)	9.5p	11.7p
	Revenue neutral charge	6.9p	17.8p
	Revenue raising charge	10.4p	20.4p

* Notes with table 8:
1. BAU (Business As Usual) refers to money cost (i.e. fuel cost plus other vehicle operating costs) expressed in terms of pence per kilometre for the years 2000 and 2010
2. The money cost is based on a weighted average cost across all types of road, for all times of the day.
3. The BAU case is affected by both price and traffic level changes. Even though fuel costs are expected to fall by 2010, traffic will grow causing more congestion which explains why there is little difference between the average money costs for the BAU cases in 2000 and 2010.

The London congestion charge has been introduced on a revenue raising basis and charges motorists £5 for entering the central London area. Despite some of the negative coverage in the press, a recent MORI poll found that half of Londoners support the congestion charge scheme and two thirds believe it has been effective in reducing traffic congestion (MORI, 2003). One of the reasons it has been so popular is because London, as a busy capital city, has good public transport networks. Also, Ken Livingstone, the Mayor of London, has committed to additional spending on bus services to ensure that people travelling around central London are provided with an accessible and reliable alternative to the car. In the first year of the scheme, £84 million is being spent on improving London's buses. The results so far from the London charge show the scheme is working well with traffic levels down by 16 per cent. London buses are carrying 14 per cent more passengers in the morning peak travelling time (TfL, 2003).

Table 7 illustrates the positive effective a revenue raising charging scheme could have on reducing traffic and CO_2 emissions. **A revenue raising charge could *reduce* road traffic in England by nearly 7 per cent and *reduce* CO_2 emissions by just over 8 per cent in the year 2010.** In recent years, the growth in car travel has been accompanied by declining bus patronage and rising bus fares. A revenue raising charge would compensate for the anticipated fall in fuel costs and provide car owners with a financial incentive to make some journeys by bus. A revenue raising charge could ***increase* bus patronage by just over 11 per cent.**

Under a revenue raising charge in 2010, the average money cost per km could be just over 10 pence for a rural motorist and about 20 pence for an urban motorist. Rural motorists might only pay, on average, 1 penny more per km than what they would expect to pay for their road use in 2010 without congestion charging. This implies that whilst a revenue raising charge would help to avoid the growth in rural traffic seen under a revenue neutral scheme, it would not significantly increase the average costs of motoring in rural areas where there are often few public transport alternatives to the car.

Table 9 shows that, under a revenue raising charge, the greatest reductions in absolute CO_2 emissions would come from cars and LGVs. Our modelling results suggest that **a revenue raising charge introduced in 2010 could save a total of 2.8 MtC per year.**

Table 9: Change in CO_2 emissions from a revenue raising congestion charge in 2010

Revenue raising charge in 2010	Change in CO_2 emissions (Million tonnes of carbon per year)	% change in carbon
Cars	- 1.6	- 7.5%
LGVs	- 0.4	- 9.3%
Rigid lorries	- 0.3	- 11.1%
Articulated lorries	- 0.5	- 9.4%

Implications for Transport Spending

Since 1997, spending on transport has been squeezed and it is only in 2002-2003 that transport spending, as a proportion of GDP, has risen to the levels before this Labour Government came into power. Years of under-investment have left much of the public transport network in crisis and there are no quick fixes to improving the quality of bus and rail services. Yet in the next Spending Review 2004-2006, there are likely to be few additional resources for transport as health, child poverty and education will be the priority spending areas. Transport is likely to continue to have to fight for spending if Labour secures a third term in office as many of the Government's social and health policy priorities are based on achieving longer term targets that will require sustained investment. For example, one of the Government's headline pledges is to eliminate child poverty by 2020.

Further area based charging schemes, modelled on the London congestion charge, or motorways tolls, such as the M6 Birmingham Northern Relief Road, could be introduced in the coming years. But, the kind of national, comprehensive congestion charging scheme modelled in our results is unlikely to be something we could implement before the end of this decade. Questions relating to how a national scheme could be administered and enforced would need to be resolved. Global satellite tracking technology could be used for pinpointing a vehicle's location on any road at any time of the day. There have however been concerns that using such technology could be an infringement on peoples' civil liberties. All this suggests that the Government should start developing a congestion charging strategy as early as possible.

If a revenue raising charge were to be introduced in 2010, or soon after, it would not only help to reduce traffic and CO_2 emissions but also provide a much needed source of revenue. Our modelling results show that **a revenue raising charge introduced across England in 2010 could potentially raise an additional £16 billion per year.** This is of course just an illustration of what a revenue raising charge could be expected to raise and not a definitive amount.

If motorists are to pay more for their road use then it is only reasonable to expect that a significant proportion of the money raised should be used to pay for better roads and public transport improvements. The Government spent about £13 billion on transport in 2002-2003 and even with further investments in roads and public transport, it is highly unlikely that it will need to spend an additional £16 billion per year (in 2010 prices).

Introducing a revenue raising congestion charge is likely to be politically challenging and the Government will need to identify ways of making it more publicly acceptable. **To help make a revenue raising charge more acceptable to motorists the Government should abolish Vehicle Excise Duty (which raised £4-5 billion in 2002-2003).**

The Government should also consider other concessions aimed at addressing some of the negative perceptions that the media and wider public generally have about congestion charging. Options could include:

- Exempting key public sector workers, such as NHS staff or teachers.
- Exempting small urban areas or rural areas where charging might negatively impact on small business trade.
- Exempting vehicles powered by cleaner fuels and technologies.

There is a trade off however with the desire to make any charging scheme transparent and easy to administer. For example, the term 'key public sector worker' is quite contentious and there is often disagreement about exactly who is defined as a key worker. The view that charging would have a direct, negative impact on small business trade is also difficult to measure and quantify. The above are therefore just ideas for consideration at this stage and their administration would need careful thought.

The Lorry Road User Charge

The Government has already committed to introducing a lorry road user charge in 2006. Unlike a congestion charge, the amount lorry operators pay will be related to the distance they travel and not to levels of congestion. Over the last twenty years there has been more than a 40 per cent rise in goods traffic. Although lorries account for less than 2 per cent of vehicles they represent 13 per cent of traffic on motorways (DfT, 2003b). The distance-based charge should provide a financial incentive for lorry operators to reduce their mileage and plan shorter delivery trips which should in turn help to reduce fuel consumption and hence CO_2 emissions. But it is unlikely to have a significant impact on reducing HGV traffic and the congestion they create particularly on motorways.

Part of the reason why the road haulage industry accepted the idea of a distance based charge is because the Government pledged that when it is introduced it will be revenue neutral probably offsetting fuel duty costs. Our modelling results reveal that **in 2010 a revenue raising congestion charge could reduce traffic growth from articulated lorries by about 9 per cent and also reduce their CO_2 emissions by about 9 per cent.** (This is compared to a slight increase in lorry traffic and CO_2 emissions seen under a revenue neutral scheme in 2010).

***If* the Government is to eventually develop the lorry road user charge so that it becomes revenue raising then the money raised should be used to pay for improvements within the road haulage industry.** The road haulage industry should also be consulted about the best ways of spending any money raised.

Policy Recommendations

With road traffic forecast to increase by 20-25 per cent, a policy supporting unrestrained car use in unsustainable. Congestion charging should be one of the key policy measures taken forward in the Government's review of the Ten Year Plan for Transport in 2004.

Given that fuel costs are expected to continue to fall in the period to 2010, it does not appear make sense to introduce congestion charging on a revenue neutral basis with offsetting fuel duty reductions. A revenue neutral charge could increase traffic levels and CO_2 emissions by making the average costs of rural motoring even cheaper.

The Government should start to develop options for introducing congestion charging on a revenue raising basis. A revenue raising charge introduced in 2010, could reduce road traffic in England by nearly 7 per cent, reduce CO_2 emissions by just over 8 per cent and potentially raise an additional £16 billion per year (in 2010 prices).

If motorists are to pay more for their road use then a significant proportion of the money raised should be used to pay for better roads and public transport improvements. To help make a revenue raising charge more acceptable to motorists the Government should abolish Vehicle Excise Duty (which raised £4-5 billion in 2002-2003).

If the Government is to eventually develop the lorry road user charge so that it becomes revenue raising then the money raised should be used to pay for improvements within the road haulage industry.

Extending and Developing Voluntary Agreements for Improving the Fuel Efficiency of Vehicles

The European car industry looks on track to deliver its voluntary agreement with the European Commission (EC) to reduce average CO_2 emissions from new cars to 140 g/km by 2008. It is estimated that the voluntary agreement, along with CO_2 based reforms to Company Car Taxation and Vehicle Excise Duty, will achieve savings of around 4 MtC by 2010 (DTI, 2003). The voluntary agreement demonstrates that soft intervention, and indeed the threat of regulation, can play an important role in encouraging car manufacturers to continue investing in more fuel efficient technologies and lighter weight vehicle designs. Our CO_2 forecasts show that even accounting for the long term impacts of the current voluntary agreement, cars will make up just over 60 per cent of total road transport CO_2 emissions by 2020 (see table 6). The EC is rightly therefore looking to extend the agreement beyond 2008 in order to build on the progress and momentum that the current voluntary agreement has achieved.

At the end of 2003, ACEA (the European vehicle manufacturers' association) will be reviewing the potential to reach a new car fleet average of 120 g/km of CO_2 by 2012. This was in fact the original target suggested by the Council of Ministers when the existing 2008 voluntary agreement was developed, but ACEA negotiated it down to 140 g/km. Meanwhile, both the Council of Ministers and the European Parliament are putting pressure on the European car industry to achieve a car fleet average of 120 g/km of CO_2 by 2010 at the latest.

Achieving a target of 120g/km of CO_2 would require a greater proportion of new car sales to be smaller, lighter weight diesel models. It may also require greater take up of very fuel efficient, new car technologies such as hybrid-electric cars that combine an electric motor and battery with the power and performance of a conventional engine. A number of car manufacturers have cautioned that any extension of the voluntary agreement should account for consumer expectations such as whether more motorists are prepared to buy smaller diesel cars or new hybrid-electric cars.

Recent analysis by the Ricardo engineering group (2002) for the DfT suggested that mass market hybrid-electric cars could be developed before 2010. Later in 2003, a major car manufacturer is launching a new petrol hybrid-electric car in the UK. It is expected to produce exhaust CO_2 emissions of just below 100g/km but costs about £3,000 more than the equivalent petrol car. Through tax incentives and purchase grants, the Government is hoping to encourage more car manufacturers to sell a greater range of hybrid-electric cars in the UK.

As mentioned earlier, as part of the Energy White Paper measures, the Government has tentatively suggested a further target in the range of 100-115 g/km of CO_2 for the new car fleet average in 2020. Given that there remains a political expectation that a target of 120 g/km of CO_2 can be reached by early in the next decade then the higher end of this range seems conservative. The Government should encourage the European Community to adopt a more ambitious target for the new car fleet average in 2020 of 100g/km of CO_2 or less.

Whilst there is currently a European voluntary agreement to improve the average fuel efficiency of the new car fleet, no equivalent measures exist for either LGVs or HGVs. As illustrated by our modelling results, goods vehicles are expected to account for a large and growing share of CO_2 emissions in the coming decades. This is therefore a hole in current policies for mitigating road transport CO_2 emissions.

A major stumbling block is that there is no requirement to even measure the CO_2 emissions from vans in the same way there is for cars. There is currently a proposal to extend the current legislation for cars requiring the measurement and reporting of fuel consumption and CO_2 emissions from LGVs. But this is still in the early stages of the complex European legislative machinery and is likely to suffer further delays as a result of the impending elections for a new European Parliament in 2004.

This proposal represents a necessary first step towards better monitoring and evaluation of CO_2 emissions from LGVs. The European Commission is already undertaking preparatory work for developing a voluntary agreement for reducing average CO_2 emissions from the new LGV fleet, but this may take several years to be agreed and even longer to take effect. A recent study for the European Commission by the Netherlands think tank Rand Europe (2003) suggested that, as a conservative estimate, a 10-15 per cent reduction in average CO_2 emissions from new light vans was possible by 2010. In light of the time it is likely to take to develop a full picture of the pattern of LGV CO_2 emissions, agreement of a 2010 target date for reducing the CO_2 emissions from new LGVs seems unlikely. The Rand Europe study does however illustrate that fuel efficiency improvements could deliver significant savings in CO_2 emissions from LGVs and that there is no reason why the Community should not be aiming for a target date in the middle of the next decade.

Extending and Developing Voluntary Agreements for Improving the Fuel Efficiency of Vehicles

As with LGVs, monitoring of the CO_2 emissions performance of new HGVs is very poor and patchy, making it difficult to assess what future fuel efficiency improvements in new HGVs is technically possible and realistic. The situation with HGVs is however even less well advanced, with no significant European level policy proposals under active development for reducing average CO_2 emissions from the new HGV fleet. Measures for improving the fuel efficiency of lorries weighing up to 17 tonnes should be given priority.

Policy Recommendations

Given there remains a political expectation that a target of 120 g/km of CO_2 could be reached for the average new car fleet by early in the next decade, the Government should encourage the European Commission to extend the current voluntary agreement as soon as possible.

Achieving a target of 120g/km of CO_2 by early in the next decade would require a greater proportion of new car sales to be smaller, lighter weight diesel models. It may also require greater take up of very fuel efficient, hybrid-electric cars. The Government should examine what further fiscal measures would be needed for stimulating greater consumer demand for lower carbon cars.

The Government should also encourage the European Community to adopt a more ambitious target for the new car fleet average in 2020 of 100g/km of CO_2 or less.

The Government should press for early agreement of legislation requiring the measurement and reporting of fuel consumption and CO_2 emissions from LGVs. Alongside this, the Government should encourage the European Commission to begin negotiations with ACEA (the European vehicle industry) to develop a new voluntary agreement for significantly reducing average CO_2 emissions from the new LGV fleet.

The Government should work with other EU member states to develop consensus on the need for appropriate voluntary measures for reducing average CO_2 emissions from the new HGV fleet. Priority should be given to encouraging further improvements in the fuel efficiency of articulated lorries.

Encouraging Innovation and Long Term Investment in Future Low Carbon Vehicles

Increasing pressures to improve the fuel efficiency of vehicle fleets, and cars in particular, will inevitably increase interest in new low carbon vehicle technologies capable of achieving even higher carbon savings. In the coming years, hybrid-electric vehicles appear attractive because they are very energy efficient, use conventional fuels and do not need new refuelling infrastructure. In the longer term however radically new transport fuels will be needed if we are to achieve deep cuts in carbon on the scale needed to meet a 60 per cent cut in CO_2 emissions by 2050.

In June 2003 ippr published *Tomorrow's Low Carbon Cars* a policy report from the ippr's Motoring Towards Sustainability programme. The report examined how government could help to drive innovation and long term investment in low carbon vehicle fuels and technologies over future decades. These issues are therefore not discussed in depth in this report and we will instead summarise some of the key findings. The report highlighted the role that hydrogen and biofuels, particularly from woody biomass sources, could play in potentially replacing fossil fuels, modernising our transport infrastructures and technologies and transforming the way we meet our road transport energy demands.

One of the outcomes from the Energy White Paper analysis was that over the next twenty years carbon savings are likely to be more cost effectively achieved within the energy sector than the transport sector. It is of course prudent and efficient use of public money to expect that over the coming decades the energy sector should be the main beneficiary of any further government support and spending on low carbon technologies. It is however misleading to simply compare the costs of mature, market ready energy technologies, like wind turbines, with some of low carbon vehicle technologies that still need a lot more research and development and may still be some way off. The development of biofuels and hydrogen for road transport are also likely to require different kinds of government intervention compared to other low carbon energy technologies, and will also raise questions relating to land-use and energy policy.

Biofuels can be derived from annual crops, such as sugar beet or rape seed oil, or even from agricultural by-products like straw. Some of the major supermarkets and bus operators are showing growing interest in supplying biodiesel, based on a 5 per cent blend of rape seed oil with conventional diesel. Over the longer term, deriving biofuels from high yielding crops, such as willow, has the potential to satisfy a much larger proportion of road transport energy demands. But the technologies for converting woody biomass and wastes into liquid transport fuels are still in their early stages of development. As a result, they are much more expensive than established technologies for converting food crops into liquid fuels. In addition, if land is to be set aside for growing energy crops for transport fuels then it will be important to think through the implications for farming policy and the impacts on biodiversity.

In the case of hydrogen and fuel cell vehicles, there is no doubting that there are many challenges that lie ahead. The technologies for storing hydrogen on board vehicles still need further development. Hydrogen powered vehicles will require a completely new refuelling infrastructure and there is currently great uncertainty about how that infrastructure might be developed and how much it will cost. In addition, constraints on renewable energy supplies also mean that renewable hydrogen is almost certainly decades away from being a mass market option.

In the decades to come however, mitigating climate change could depend on developing policies today that foster technological innovation in the development of future low carbon vehicles – be it either biofuel or hydrogen powered vehicles. The risk is that they will be neglected by government policy in favour of short term decision making and become victims of the politics of the moment. In light of the limited – if any – spending that is likely to be available for low carbon vehicles in the next Spending Review 2004-2006, it does not make sense to spread small additional pots of money too thinly across a wide range of vehicle technology or fuel options. Rather, any additional funding should be targeted towards supporting the research and development (R&D) and commercialisation of hybrid-electric technologies, hydrogen, fuel cells and biofuels from woody biomass.

The *Tomorrow's Low Carbon Cars* report identified a number of ways in which government could help to give industry greater confidence to invest in future low carbon vehicle fuels and technologies, and to view the UK as an attractive market-place for their development. Some of these are highlighted in the recommendations on the next page.

Encouraging Innovation and Long Term Investment in Future Low Carbon Vehicles

Policy Recommendations:

The Government should:

- Send a long term price signal of its commitment to low carbon transport by developing differential rates of fuel duty that distinguish and reward lower carbon forms of fuels.
- Demonstrate ministerial leadership and commitment to the innovation of low carbon vehicle technologies and fuels over the longer term.
- Target what is likely to be limited additional spending on the development and commercialisation of low carbon vehicle technologies and fuels that show the most promise of becoming mass market alternatives and not just niche options. Priority should be given to hybrid-electric technologies, hydrogen, fuel cells and biofuels from woody biomass sources.
- Identify opportunities for international or European wide partnerships for innovative biofuel, hydrogen and fuel cell research projects and demonstrations. The Government should actively seek to collaborate with other countries to spread R&D costs, pool resources and share results.

References

AEA Technology and Imperial College Centre for Energy Policy and Technology (2002) Options for a Low Carbon Future. Report for the Department of Trade and Industry (DTI), Department of Environment, Foods and Rural Affairs (DEFRA) and Performance and Innovation Unit (PIU)

AEA Technology (2001) National Greenhouse Gas Inventory for the UK 1990-2000. Annual Report for submission under the Framework Convention on Climate Change

ACBE (2002) Transport Interim Report. Advisory Committee on Business and the Environment

DETR (2000) The UK Climate Change Programme. Department of Environment, Transport and the Regions, Scottish Executive, National Assembly for Wales and Department for the Environment (Northern Ireland)

DfT (2003a) Transport Statistics Great Britain. Transport Trends 2002. Department for Transport

DfT (2003b) Managing Our Roads. Department for Transport

DfT (2003c) Modelling and Forecasting using the National Transport Model. Department for Transport

DfT, DTI, DEFRA and HM Treasury (2002) Powering Future Vehicles. The Government Strategy. Department for Transport, Department for Trade and Industry, Department for Environment, Food and Rural Affairs and HM Treasury

DfT (2000) Ten Year Plan for Transport. Department for Transport

DTI (2003) Energy White Paper. Our Energy Future – Creating a Low Carbon Economy. Department of Trade and Industry

DTI (2001) Energy for Tomorrow – Powering the 21st Century. Report for the Energy Futures Task Force by the Department of Trade and Industry Technology Foresight Programme

European Commission (2002) Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Third annual report on the effectiveness of the strategy (Reporting year 2001)

References

European Commission (2001) Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Second annual report on the effectiveness of the strategy (Reporting year 2000)

European Commission (2000) Monitoring ACEA's Commitment on CO_2 Emission Reductions from Passenger Cars (1995-1999). Joint report of the European Automobile Manufacturers Association and the Commission Services.

Eyre N, Fergusson M and Mills R (2002) Fuelling Road Transport. Implications for

Energy Policy. Energy Saving Trust (EST), Institute for European Environmental Policy (IEEP) and National Society for Clean Air (NSCA)

Foley J (2002) Tomorrow's Low Carbon Cars. Driving innovation and long term investment in low carbon cars. ippr

Glaister S and Graham D (2003) Transport Pricing and Investment in England. Research commissioned by the Independent Transport Commission

Glaister S (2001) UK Transport Policy 1997-2001. Paper delivered to the Economics Section of the British Association for Science, Glasgow, 4th September 2001

Glaister S (1999) Predict – But Don't Provide? Underinvestment in the transport infrastructure. New Economy, ippr

Hewitt P (1989) A Cleaner, Faster London: Road Pricing, Transport Policy and the Environment. ippr

MORI (2003) Greater London Opinion Survey of Londoners. March 2003

NERA (2001) Lorry Track and Environment Costs. Report for the Department for Transport

RAC Foundation (2002) Motoring Towards 2050. RAC Foundation

Rand Europe et al (2003) Preparation of Measures to Reduce CO_2 Emissions from N1 vehicles. Report for the European Commission, Rand Europe, Netherlands.

Ricardo Engineering Group (2002) Options for a 'Carbon to Hydrogen' Roadmap for Passenger Cars. A report for the Department of Transport

References

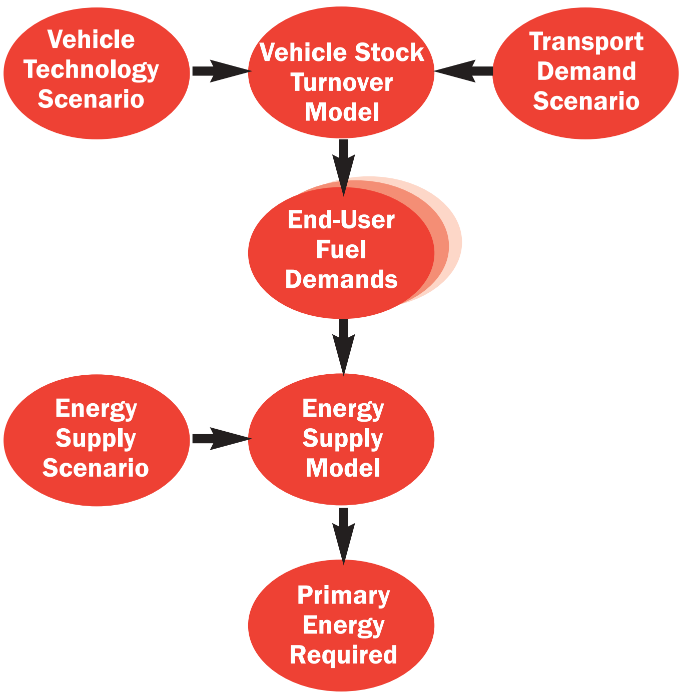
SMMT (2002) Towards Sustainability. The Automotive Sector. Third Annual Report by the Society of Motor Manufacturers and Traders

TfL (2003) Central London Congestion Charge Scheme. Three Months On. Congestion Charging Division, Transport for London

Appendix: Model Used to Forecast Road Transport CO_2 Emissions

The diagrammatic representation of the model we used in this report for forecasting road transport CO_2 emissions (see tables 4 and 6) is shown below. It is structured to have separate scenario data for each year modelled in the following categories:

- Traffic demand by class – including car, bus, LGV, HGV and public service vehicles.
- Vehicle technology developments – the percentage of cleaner vehicles, such as hybrid-electric or fuel cell vehicles, as well as expected improvements in fuel efficiency.
- Energy supply characteristics – such as the electricity generation mix and road fuel options.



The configuration of results from the model is very flexible, but the key outputs are:

- Final energy demand by vehicle class.
- Primary energy demand by fuel type.
- Carbon emissions by fuel type and year.