Fuel taxes and beyond

UK transport and climate change

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Part 1. Transport and Climate Change: Strategies for Change

INTRODUCTION

The starting point for this report is climate change, and strategies to tackle it. Transport is one of the fastest growing sources of emissions – especially carbon dioxide (CO_2) – contributing to climate change. Scientific advice, notably from the Intergovernmental Panel on Climate Change (IPCC, Houghton et al, 1990) and, more recently, from the Royal Commission on Environmental Pollution (RCEP 2000), is that, to stabilise atmospheric concentrations of carbon dioxide, emissions need to be cut to 40 per cent of their 1990 level by 2050. This report assumes that the transport sector will need to contribute a proportionate cut, and explains how this might best be done. Its focus is surface transport, since the issues and implications of aviation emissions are very different and will need to be addressed through different policy levers.

EXPLORING THE ISSUE

In discussions on reducing environmental impacts from passenger transport there can be a polarisation of views. Attention is often focused on one part of the system generating total emissions. For example, emphasis is often placed on reducing emissions by improving vehicle design or promoting alternative fuels. However, such improvements may fail to make much difference in practice as increases in the amount of travel, and changes in drivers' and car buyers' behaviour compensate for the vehicle improvements.[1] Against this, there is the view that the main response should be behavioural change, with a dramatic cut in car and air travel. But individuals and politicians balk at the political and economic implications of this, seeing it as 'turning the clock back' to a level of mobility considerably less than that enjoyed by people today.

A useful way to explore this issue is to break down the components of environmental impacts and identify key factors. An approach suggested by Paul and Anne Ehrlich (1990), and developed by Ekins et al (1992), identifies environmental impacts as a product of *Population* multiplied by *Consumption* and *Technology*. Using this approach, and assuming that, in the next 50 years or so, both global population and consumption are set to roughly double, then simply to stop environmental impacts getting worse, the *Technology* component has to achieve a 'Factor 4' efficiency improvement.[2]

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[1] A classic example of such systems and rebound effects is the fuel economy regulations in the USA. These have improved car fuel economy by over a third since the mid 1970s, but growing vehicle use has more than compensated for this, part of which is due to lower running costs arising from better fuel economy. Overall, though energy efficiency has improved, the total amount of fuel consumed has risen.

[2] If current environmental impacts are taken as an index of 1.0, then the baseline position on the Ehrlich/Ekins formula is PxCxT=1. If population and consumption double, then, assuming the technology does not change, the formula becomes 2x2x1=4. So to stop things getting worse, technology has to become 0.25 – a 'Factor 4' efficiency improvement.

For transport, this approach can be adapted to disaggregate total travel into key emission-generating factors. A number of key life-cycle studies have established that the fuel consumed in driving vehicles represents some 90 per cent of total life-cycle energy consumption (eg Teufel et al, 1993, Hughes, 1993), so this is the issue upon which to concentrate. The Ehrlich/Ekins model can be developed as follows to calculate the environmental impacts from motorised travel. In the first instance a 20-year timescale is taken. For this, the baseline index would be:

Population	1x
Car journeys per person	1x
Journey length	1x
Vehicle occupation	1x
Emissions per vehicle km	1
Total emissions =	**1**

BUSINESS AS USUAL

This simple index model approach can be used to explore possible futures and alternative policy scenarios. For simplicity, this paper concentrates on the key global issue of CO_2 emissions from personal transport, and looks ahead 20 years.

Concentrating upon the UK situation, what might such a CO_2 index be by the year 2020? With UK population roughly stable, this can be left out for the moment, but other key factors are shown in Table 1.

Table 1: Key travel trends, based on a continuation of past trends
Index in 20 years

Car journeys average about 600 per person per year (currently rising by 14 per year): 1.5
Journey length averages 13.6 km (rising @ 0.14 km per year): 1.2
Occupancy averages 1.6 (declining by 0.3 per cent per year): 1.1
Fuel use averages 9.1 litres per 100 km (31 mpg) across the car fleet (presently improving by only 0.2 per cent per year – but assume it is accelerated, so 8 litres per 100 km is achieved): 0.88

Sources: Noble and Potter (1998) and DETR, Transport Statistics Great Britain.

The improvements in fuel economy in this table look modest, given the claims from the motor industry of large past and future fuel efficiency gains, and need a little more explanation. It is true that the fuel efficiency of like-for-like vehicles has improved considerably, and shows prospects of continuing to do so. In practice, however, car users take the savings from these efficiency gains and use them to trade up to bigger and less fuel-efficient vehicles, as well as driving further. This means that the fuel efficiency of the UK car fleet as a whole has barely changed in the last twenty years. In Britain, this has been exacerbated in the past by the company car taxation system, which tended to reward larger engine vehicles more than smaller engine ones, though this system is now changing. The increase in fuel efficiency assumed in this table, which would bring the UK to the current level of fuel economy achieved in the Netherlands, could therefore be optimistic, in view of past trends. As we note below, the UK is

lagging behind other European countries in cutting CO_2 emissions from cars, and the government's ten year plan for transport (DETR 2000b) assumes that fuel efficiencies will reduce real motoring costs by one fifth.

Such a future would result in the formula becoming:

Population	1.0x
Car journeys per person	1.5x
Journey length	1.2x
Vehicle occupation	1.1x
Emissions per vehicle km	0.88
Total emissions =	**1.7**

So, if we go on as we are, the model suggests that CO_2 emissions will increase to 1.7 times their current level – a growth of 70 per cent.

This, of course, is only at the level of the UK. Such an isolationist approach to a global issue is not acceptable. Car ownership and traffic levels per capita in the developing world are growing much faster. There are around 550 million vehicles in the world, of which 400 million are cars (Mackenzie and Walsh, 1990). These are heavily concentrated in the industrialised nations (15 per cent of the world's population in OECD countries accounts for more than 80 per cent of car registrations). On average, there are fewer than 100 cars for every 1,000 people in the world, with four times this level in the UK (370) and over six times this (650) in the USA. Car ownership is forecast to rise sharply in non-OECD countries, particularly in Eastern Europe and Asian economies. If historic rates of growth are maintained, the global vehicle population could exceed one billion in as little as 20 years' time, with the number of car journeys expected to rise even faster.

As shown below, a global Business As Usual (BAU) run of this simple model suggests a quadrupling of CO_2 emissions from personal transport within 20 years. Population growth could well be less, but these calculations assume UK figures for journey lengthening, a relatively small decline in vehicle occupancy, and an improvement in fuel economy at the UK rate. All of these factors would probably be poorer in developing nations, so if anything, this underestimates the likely rise in CO_2 emissions.

Population	1.5x
Car journeys per person	2.3x
Journey length	1.2x
Vehicle occupation	1.1x
Emissions per vehicle km	0.88
Total emissions =	**4.0**

If CO_2 reduction policies were to rely on efficiency measures alone, the index for CO_2 emissions per vehicle kilometre would have to be drastically cut. For the UK, to stop CO_2 emissions from personal transport worsening would require the emissions index to be cut to 0.5. It is enlightening to express this figure in terms of average car fuel economy. To achieve this index figure would represent a doubling of average car fuel economy from 9.1 litres per 100 km

to 4.55 litres per 100 km (60 mpg). At the global level, the emissions index would need to be 0.22 to hold transport's CO_2 emissions at current levels, requiring a 4.5 factor improvement in fuel economy. This would require, within 20 years, the world's car fleet averaging about 150 mpg (2 litres per 100 km).

REDUCING TRANSPORT'S ENVIRONMENTAL IMPACTS

The thought of achieving a global average car fuel economy of 150 mpg within 20 years suggests that the sums are starting to look beyond the realms of political (and possibly technical) viability. However, this is without even attempting to reduce CO_2 emissions from personal transport! The RCEP report (RCEP 2000) suggests that a 60 per cent cut on 1990 levels is needed by 2050 to mitigate the effects of climate change. For this report, we have assumed that a 40 per cent cut will be required by 2020, and that the transport sector will be required to contribute its proportionate share to this.

Taking the 20-year target, and assuming that personal transport needs to make a proportional contribution, what sort of efficiency improvements might achieve a 40 per cent drop? Returning to the UK focus, transport's CO_2 emissions have already risen by 15 per cent since 1990, thus the target for the index needs to be not 0.6 but 0.52. Again, if we were to rely on efficiency measures alone, the index for emissions per vehicle kilometre would need to be drastically reduced.

Population	1x
Car journeys per person	1.5x
Journey length	1.2x
Vehicle occupation	1.1x
Emissions per vehicle km.	0.26
Total emissions =	**0.52**

So, if fossil fuels were used, and every other trend left unaffected, then fuel economy would need to improve about fourfold, to an average of 113 mpg (2.4 litres per 100 km). Allowing for a proportion of poorer fuel economy vehicles, much of the car fleet would need to achieve 130 – 150 mpg. This, of course, is referring to Britain alone. The necessary improvement in fuel economy becomes even greater once a global perspective is taken. This would involve something like the following index figures[3]:

Population	1.5x
Car journeys per person	2.3x
Journey length	1.2x
Vehicle occupation	1.1x
Emissions per vehicle km	0.11
Total emissions =	**0.52**

[3] The journey length and vehicle occupation figures are as for the UK because global estimates are not available. It seems likely these factors would be greater than for the UK and so the rise in these factors is probably underestimated.

For a 20-year timescale, a continued use of fossil fuels for personal transport or as feedstock to 'alternative' fuels like electricity or hydrogen seems likely. Using conventional fossil fuels, in 20 years the global average fuel consumption needs to be just over a tenth of that today – 0.9 litres per 100 km (over 300 mpg). Taking a longer perspective with further population and car use growth, this would need to drop even more. We are thus into the realms of at least a Factor 10 efficiency improvement and probably a Factor 20 or more improvement needed to hit the full RCEP target for 2050.

Even if, over a 20-year timespan, such figures look utterly unrealistic, might renewable energy and alternative fuels (such as fuel cells) allow such a target to be reached? Alternative fuels can cut CO_2 emissions, depending on the primary fuel used and the efficiency of the production process. Even if the use of renewable fuels is assumed, there remains a major issue of efficiency improvement. For example, if within 20 years, half the global car fleet somehow managed to use renewable fuels with no net CO_2 emissions (a wildly optimistic assumption!), the rest would still have to manage 2.2 litres per 100 km (130 mpg) in order to hit the IPCC sustainability target. We discuss prospects for alternative fuels in more detail below.

If the scenario date were pushed back, such technical improvements might appear possible, but equally, the further growth in car use and population would require even more efficiency improvements. It is clear that even if, by 2050, all internal combustion-engined vehicles were replaced by hydrogen fuel cell vehicles, the production of this hydrogen would have to use something like 50 times less fossil fuel than is currently consumed by the world's car fleet. **The inevitable conclusion is that improvements to vehicle technology cannot represent a viable approach to reducing transport's CO_2 emissions to a sustainable level, for either a 20-year or longer timescale.**

TRAVEL MODE AND VOLUME OF TRAVEL

A much-advocated alternative approach to cutting transport's environmental impacts is to promote a modal shift from the car to less energy-intensive modes of transport. To evaluate this option requires a return to a UK focus, as it is difficult to obtain and use global figures for key factors such as modal share and journey length.

To explore the effect of modal shift requires the formula model to be split into the three main components of motorised travel: car, bus and train. This is not to say that non-motorised travel (walk and cycle) is unimportant, but they do not generate CO_2. Shifting car journeys to walk and cycle can be accommodated in the model by altering the 'journeys per person' figure for the motorised modes.

The Baseline Index is now as follows. This allows for energy use per passenger kilometre by train and bus being, on average, about half that of cars (Potter, 2000).

	Car	Bus	Rail
Journeys per person	1.0x	1.0x	1.0x
Journey length	1.0x	1.0x	1.0x
Vehicle occupation	1.0x	1.0x	1.0x
Emissions per vehicle kilometre	1.1x	0.5x	0.6x
Modal share	0.88	0.10	0.02
Total emissions	= 0.88	= 0.10	= 0.02
			TOTAL = 1.0

A Modal Shift Scenario could be based around the targets suggested by the UK's Royal Commission on Environmental Pollution (RCEP, 1994). In 20 years, this involves cutting the car's share from 88 per cent of motorised trips to 65 per cent, with bus increasing to 25 per cent and rail to 10 per cent. Improvements to fuel economy could be at the BAU historic rate, as are the changes in car occupancy, although the shift to public transport is likely to raise average occupancy levels of buses and trains.

	Car	Bus	Rail
Journeys per person	1.5x	1.5x	1.5x
Journey length	1.2x	1.2x	1.2x
Vehicle occupation	1.1x	0.8x	0.8x
Emissions per vehicle kilometre	1.1x 0.88	0.5x 0.88	0.6 x 0.88
Modal share	0.65x	0.25x	0.10x
Total emissions	= 1.25	= 0.16	= 0.08
			TOTAL = 1.49

The net result is a near 50 per cent increase in CO_2 emissions! This may be better than the 70 per cent rise in CO_2 without modal shift, but even so, the energy efficiency improvements arising from modal shift are insufficient to counterbalance the rise in other factors in the formula. An important component of this is trip lengthening, which involves not only motorised trips becoming longer, but also the substitution of short trips by foot with longer trips by car. Simply to get the total to equal 1.0 would require car modal share to be cut to 30 per cent, with bus rising to 40 per cent and train 30 per cent. Such a substantial change seems very unlikely in a 20-year timeframe, and in any case, would only hold CO_2 emissions at their current unsustainable level.

A MULTIPLE APPROACH

This simple model demonstrates clearly that the only technically (and certainly politically) practical way that transport's CO_2 emissions can be cut to sustainable levels is to combine changes in *both* vehicle technology and behavioural factors. Importantly, behavioural change cannot just be modal shift between motorised transport, but needs to involve a consideration of trip lengthening and its effect on non-motorised travel.

One variation of the index formula that would hit the 40 per cent reduction target is as follows:

	Car	Bus	Train
Journeys per person	1.3x	1.3x	1.5x
Journey length	1.1x	1.1x	1.2x
Vehicle occupation	1.0x	0.8x	0.8x
Emissions per vehicle kilometre	1.1x 0.4	0.5x 0.4	0.6x 0.4
Modal share	0.65x	0.25x	0.10x
Total emissions	=0.41	=0.06	0.04
			TOTAL = 0.51

This particular combination involves:

- a 30 per cent increase in car and bus journeys (rather than 50 per cent in the BAU scenario);
- halving trip lengthening except for rail (assuming this to pick up some long car trips);
- a 2.75-fold improvement in vehicle car fuel economy;
- a RCEP level of modal shift to bus and train.

The first two factors would involve the number of walk and cycle trips being retained or increased (reversing past trends of decline in walking and cycling), and land use planning policies that reduce the need for motorised travel (through higher densities and less car-based out of town developments).

Overall for the UK, this means an improvement from our current average fuel economy of 9.1 litres per 100 km (31 mpg) to 3.3 litres per 100 km (85 mpg), which is a tough, but probably both technically and politically possible target. This needs to be combined with significant modal shift and a reduction in the rate of trip lengthening to hit the CO_2 reduction target recommended by the mainstream scientific community. The number and length of journeys are crucial factors, and yet are rarely considered in the transport/environment debate. If all parts of the travel generation are not addressed, an unrealistic improvement in individual factors is required and system rebound effects are likely.

It might be argued that (surface) transport should not be required to make such cuts in CO_2 emissions, and that other sectors (domestic energy or industry) should be required to produce greater than their share of emission reductions on the grounds that it is more cost-effective or politically easier to reduce emissions in these sectors. However, this section has shown that, without any intervention, CO_2 emissions from cars are likely to rise and that technological developments will not, on their own, stop this happening.

Part 2. Tax and Transport Policy

The above analysis is purposely generalised, with the intention of highlighting the long-term magnitude of the changes that are needed to address transport's emissions of CO_2. A range of policy measures and agreements with industry will inevitably be involved, but this paper explores in particular the role that taxation policy could, with other measures, play in such a long-term strategic approach to reduce reliance on oil for mobility.

In the UK, the transport sector, particularly road transport, is an important source of taxation revenue. It is also one where the issue of the level of taxation has become an increasingly controversial subject, with demands being made for tax reduction. This danger was epitomised by the September 2000 refinery blockades by road hauliers, and other disruption created by powerful groups intent on winning a fuel tax cut for themselves.

This, in turn, obviously gave rise to concerns that these demands could lead the government to be pushed into counterproductive tax cuts, when more useful and considered measures would have been possible. This section therefore outlines some of the options available to the government to offset the adverse effects of these events, with particular reference to the measures announced in the government's subsequent pre-Budget report (PBR). The main thrust is to consider ways in which positive responses to high fuel tax can be encouraged in the short, medium and long term, in order to achieve the double benefit of reduced costs to motorists plus a reduction in the CO_2-intensity of the UK transport sector, and hence reliance on oil for mobility. This section considers ways of helping drivers and hauliers reduce their emissions, and then reviews technological and policy responses in the car, road freight and bus sectors, finishing with a discussion of options for changing the personal tax system to encourage reduced car dependence.

2.1 BACKGROUND

2.1.1 Fuel Duties and Transport Costs in Europe

Earlier in 2000, the Institute for European Environmental Policy (IEEP) completed a survey for the Swedish Environmental Protection Agency (SwEPA, 2000) on the state of vehicle and fuel tax policy across Europe. This considered evidence from a range of studies and other data sources on relative tax levels in different European countries. This clearly showed that fuel duty rates in the UK were the highest in Europe, especially for diesel. Several additional points emerged, however. One was that the differential in prices was much less when compared to levels of national GDP (a proxy measure of income and wealth) as follows:

Relating duty rates to per capita GDP

Petrol	GDP per capita/price (divided by 100)	*Diesel*	GDP per capita/price (divided by 100)
Luxembourg	5.4	Luxembourg	6.7
Denmark	3.1	Denmark	4.1
Austria	2.9	Austria	3.8
Ireland	2.9	Belgium	3.8
Germany	2.7	Germany	3.7
Belgium	2.6	Netherlands	3.3
Spain	2.4	France	3.3
France	2.3	Ireland	3.0
Italy	2.3	Italy	3.0
Netherlands	2.3	Finland	3.2
Finland	2.2	Spain	2.9
Sweden	2.2	Sweden	2.8
Greece	2.1	Greece	2.8
United Kingdom	2.0	Portugal	2.7
Portugal	1.9	United Kingdom	2.0

Source: Derived from Eurostat and OECD data

The report also identified other areas in which the UK had tax advantages over other EU Member States, such as lower employment taxes, and the absence of extensive motorway tolls of the type found in countries such as France and Italy. Overall, therefore, it concluded that the supposed cost disadvantages to UK motorists (especially hauliers) were far less clear-cut than addressing fuel duty alone would suggest. A report by accountants Ernst and Young (1999) also suggested that the cost disadvantage to UK hauliers was typically in the range of 5 to 10 per cent once these factors were taken into account.

Other changes have also occurred recently, including a significant reduction in Vehicle Excise Duty (VED) on certain classes of HGV in the 1999 UK budget of up to £1,800 per year, and the imposition of shorter working hours in France. These changes have shifted the balance in favour of the UK, and as a result of these, the Freight Transport Association subsequently suggested (FTA 2000) that UK hauliers faced a 5 per cent cost disadvantage relative to France, and around 10 per cent relative to Belgium and the Netherlands. This, they argued, was still very significant in an industry whose profit margins are typically under 5 per cent.

Since our work was undertaken, the differential in fuel pump prices between the UK and its neighbours has, in fact, increased by several percentage points. This, however, is more than accounted for by the fall in value of the Euro relative to sterling over the past year. That is, the relative shift is not attributable either to the underlying price of oil, or to the levels of duty imposed – if anything, rather the opposite. The difference is real enough, but is in line with changes in other cost factors resulting from the falling value of the Euro.

It also remains difficult to assess the impact of these differences in practice. It is true, for example, that UK hauliers carrying goods between the UK and the Continent increasingly find themselves in competition with other EU hauliers as the Single Market becomes a reality, and

cost differences are obviously important for them. However, the FTA notes that the cost disadvantages cited above arise principally from the UK's higher rates of diesel fuel duty, but appears to overlook the fact that, when driving on the Continent, UK hauliers have as much opportunity to benefit from cheaper fuel as do any others.

Furthermore, it should be emphasised that international haulage comprises only a very small proportion of total road freight activities in the UK. For the majority who undertake haulage within the UK, foreign competition is far less. Indeed, recent official statistics indicate that only 0.06 per cent of haulage trips within the UK were undertaken by foreign hauliers – a tiny amount in comparison to the levels experienced in most other EU Member States. The FTA argues that the threat of foreign competition is sufficient to drive down the prices which UK hauliers can charge, but it is difficult to assess the scale of this effect in the absence of any firm evidence. It is also difficult to distinguish effects arising directly from foreign competition from those which result from chronic overcapacity and cut-throat price competition within the UK industry itself.

In the PBR, the Chancellor announced further major cuts in Vehicle Excise Duty and a 3 pence per litre cut in fuel duty (discussed below). In the light of the various factors set out above, this appears more than adequate to redress any systematic cost disadvantage of UK hauliers with respect of their continental counterparts.

2.1.2 Possible Fuel Duty Concessions to Hauliers

Notwithstanding the environmental and other arguments in favour of maintaining high fuel duties, there was clearly strong public and business pressure for concessions to be made. If this was to be the case, the question naturally arose as to what concessions would be the most cost-effective and, ideally, would do least to undermine the transport and environmental objectives which gave rise to the high fuel taxes in the first place. Below, two of the options mooted for the haulage sector are discussed briefly.

Essential user rebate

Some sort of essential user rebate has been promoted by hauliers as a possible solution to their problems – a 15p per litre reduction through an 'essential user rebate' was suggested. Some points to be borne in mind here are:

- Given the FTA's own calculations as discussed above, this was always a very high figure. That is, it would bring the UK into line with fuel duty rates on the Continent, but takes no account of the other tax advantages enjoyed by UK hauliers, which the FTA and others acknowledge to one extent or another.
- It seems questionable whether hauliers actually reap much direct benefit from any duty cut. It has been argued that, with competition in the UK industry so intense, they would simply be forced to pass on their savings to customers. It has been reported, for example, that some hauliers' contracts with the major supermarkets explicitly state that any savings from changes in fuel duty rates are to be passed on to the latter immediately through price cuts.
- The European Commission is very unhappy about similar arrangements which have already been made in France, Netherlands, etc in response to recent protests, and is known to be scrutinising them very carefully on grounds of fair competition, state aid rules and the requirements of the Mineral Oils Directive (discussed below). There is therefore a distinct

possibility that they will be forced to go back on these deals, and the UK could have suffered a similar fate if it had followed this route.

'Blue diesel'

Alternatively, it has been suggested that a separate grade of 'blue diesel' might be created for use only by hauliers. This would operate in a similar way to the existing red diesel concessions for heating purposes, for use by farmers, etc. This suggestion shares a number of the drawbacks of the essential user rebate discussed above. Several additional points arise, however, which would need some consideration:

- Unlike red diesel, the new grade would probably need to be available at service stations as well as via hauliers' own depots, but in such a way that it was not accessible by diesel car drivers. If it were not openly available to foreign truckers as well, then it might well fall foul of EU competition law.
- The EU's Mineral Oils Directive, which sets out minimum allowable fuel duty rates for EU Member States, provides no derogations specific to hauliers as it does for rail operators or farmers (Article 8(2) of Directive 92/81/EEC). Such an arrangement would therefore require unanimous approval by the Council of Ministers under Article 8(4) of the same Directive. While some Member States which are themselves introducing similar schemes would no doubt support the use of blue diesel, others which are opposed to duty reductions might well object and block the proposals.

Indeed, on 15 November 2000, the European Commission published a proposal to rationalise and phase out all existing derogations for reduced duty rates for diesel in the EU after two years, and to consider their impact on the single market much more closely. These existing preferential arrangements cover Denmark, France, Italy and the Netherlands. This development marks a distinct hardening of attitude in the Commission since the fuel protests and their aftermath, and if it is successful, it will become far harder to make preferential fuel duty provisions for hauliers in the future.

Since the UK is clearly suffering pressure to reduce duty rates largely on the basis of unfair foreign competition, it might now make better sense for the UK to put its weight behind those countries which are objecting to recent concessions on the Continent and to support the Commission's proposal – ie to try to beat them rather than join them.

2.1.3 The Government Response on Fuel Duty Rates

In the PBR, the government announced a freeze in basic fuel duty rates, coupled with a proposed cut of 3p per litre for ultra-low sulphur diesel (ULSD) and 2p per litre for ultra-low sulphur petrol (ULSP). These changes caused surprise and some confusion, and are therefore explained briefly here.

ULSP is not yet widely available in the UK, in spite of a 1p duty differential introduced last year, since ULSP costs more to produce than standard unleaded petrol. The additional reduction should, however, be sufficient to bridge the cost differential between the two, and to encourage the general availability of ULSP from next year. This cleaner fuel will bring about a modest but useful reduction in conventional pollutants (including NO_x and particulates) from petrol cars, and hence contribute to air quality improvements.

Its impact on CO_2 emissions is slightly more complicated, however. The oil industry has by and large opposed the introduction of ULSP to date, arguing that the cost would be excessive and would exceed the environmental benefit. In particular, it has been argued that the additional demands in refining the fuel actually lead to a net *increase* in CO_2 emissions on a 'well to wheel' basis. Without going further into technical details, it is suggested that these claims are, at best, exaggerated. The more important long-term benefit of ULSP is that it enables motor manufacturers to use certain advanced engine technologies which offer improvements in fuel efficiency. This, the car makers have argued, is essential if they are to fulfil their voluntary commitment to cut future CO_2 emissions (as discussed below). Thus, provided that carmakers rise to the opportunity now provided to them, the net effect of the ULSP duty changes on CO_2 levels appears likely to be positive.

The same cannot be said for the further cut in ULSD duty, however. Since ULSD already has a virtually 100 per cent market share of diesel in the UK, there are no environmental benefits to be achieved here. Instead, the cost reduction will obviously encourage some increase in diesel consumption, and hence of CO_2 and other emissions. This aspect is omitted from the environmental assessment of the PBR, which claims (either misleadingly or wrongly) that reductions in NO_x and particulates will result. This, then, is a duty cut dressed up rather unconvincingly as an environmental measure.

2.1.4 Fuel Duty and the UK Climate Programme

Earlier in 2000, the UK government published its draft climate change programme to the year 2010 (DETR, 2000a). This envisaged a continuously rising CO_2 emissions trend in the Business As Usual case for road transport, from 35.7 million tonnes of carbon (MtC) in 2000 to 40.7MtC in 2010 and 45.6MtC in 2020. This included the impact of the fuel duty escalator up to 1999. Measures to at least stabilise emissions are envisaged up to 2010, however, relying principally on the voluntary agreement on passenger cars (see below) and other measures under the integrated transport white paper (DETR, 2000b).

The decision to scrap the fuel duty escalator in 1999 (the policy of increasing fuel duty by a fixed percentage above inflation in each Budget) went against the assumptions which were originally built into the UK Climate Programme. Recent changes announced in the PBR further exacerbate the problem by reducing fuel duties in real terms. As such, these decisions might have threatened the UK's ability to meet its CO_2 reduction commitments in this area at least. In the event, however, the sharp rise in the price of oil has more than compensated for the projected duty increases since that date, and prices at the pump remain approximately as high as originally envisaged. Thus the Climate Programme is not compromised at present in this respect. The critical question, however, is what will happen to duty levels (and hence fuel prices) when and if the underlying price of oil falls significantly. If duty levels are cut or remain frozen for some years, this could have much more serious implications for road transport CO_2 emissions in the medium term.

2.1.5 Diesel Duty and the External Costs of Road Haulage

Climate change is not, of course, the only external impact of road transport. Heavy trucks in particular impose other costs on society including air pollution, road damage, noise, accidents and congestion. The high rates of duty imposed upon them are intended, in part, to reflect these other costs, and to internalise them into the market for road haulage. This, nonetheless, is a

controversial area, and opinions differ widely as to the extent to which costs are internalised or whether trucks are unfairly overtaxed.

In April 2000, a group of UK consultants published a report for the DETR on *Lorry Track & Environmental Costs* (DETR 2000d). The report considered the appropriate share of road track and environmental costs that should be allocated to HGVs. Its conclusions implied that, at that time, trucks did approximately cover their costs at least as far as these could be calculated. Since that time, however, a reworking of this analysis (EWS, 2000) has suggested that the costs in this study were underestimated in a number of ways, including low costs for accidents and absence of congestion costs. With these included, the new report concluded that trucks over 33 tonnes in gross weight did not in fact pay their way by a significant margin.

This new analysis, moreover, predates the changes announced in the PBR. Since duty reductions in the latter were targeted specifically towards the heaviest trucks which operate in international haulage, it can safely be assumed that the discrepancy between costs imposed and taxes paid will now increase significantly further.

2.1.6 Fuel Duty and Transport Trends

The extent to which the price of fuel is an effective tool to influence modal choice has been the subject of some contention (Glaister and Graham, AA/UKPIA 2000). Fuel duty increases have not stopped the increase in car use and this, it is asserted, makes them ineffective (or indeed a "green" smokescreen for raising government revenue). However, it is a fact that traffic growth has slowed in recent years, and has been running under growth in income (GDP) since the early 1990s, when the fuel duty escalator was introduced. This contrasts to the period before the escalator, when traffic growth was running above GDP, sometimes (as in the late 1980s) substantially. In 1998-9, in spite of a continuing period of steady economic growth, traffic growth (in vehicle miles) was around 1 per cent, and non-motorway traffic growth was nil. In the same year, passenger rail use rose 8 per cent, rail freight grew by 6 per cent, bicycle use grew by 5 per cent and motorcycle use grew by 17 per cent (DETR, 2000b). Urban bus use has also increased in many areas.

It is likely that, as well as fuel prices, capacity constraints are also playing a role in slowing traffic growth, but – as Glaister and Graham point out – the literature suggests that fuel prices do have an impact on demand and on motorists' behaviour over the longer term. However, no single policy measure will be effective in reducing emissions and promoting modal shift or other behavioural change; a more comprehensive approach, involving packages of measures, is required.

2.2 BEHAVIOURAL RESPONSES TO HIGH FUEL PRICES

2.2.1 Encouraging fuel-efficient driving behaviour

Fuel savings can be delivered by altering the operating conditions of cars in a number of ways. These have recently been added to the Automobile Association's website, and include

- Having roof-racks on cars only when needed
- Keeping tyres inflated to correct pressures

- Avoiding unnecessary use of in-car equipment, especially air conditioning
- Avoiding unnecessary warm-up or engine idling time
- Driving at moderate speeds (eg in the 30 to 60 mph range)
- Avoiding excessive acceleration and harsh braking
- Observing motorway speed limits

The key advantage of these measures is that they are essentially free and immediately available to virtually all motorists. Typically, a 5 to 10 per cent improvement in fuel efficiency, and sometimes well over 20 per cent, can be gained in this way – more than enough to offset recent fuel price rises. In spite of this, they received remarkably little attention during the fuel crisis, and it is unclear to what extent drivers are generally aware either of the means or of the scale of the savings available. It seems clear that at present they are rarely applied or sustained by most motorists.

It is noteworthy that a future element of the government's *Are you doing your bit?* campaign is to target tyre pressures – a small step in this direction. On the other hand, unfortunately, an opportunity to address the far more important issue of driving speeds was largely squandered in the government's speed review (DETR 2000c), which rejected any reduction in the 50 and 60 mph limits on certain classes of roads, as well as the use of speed limiters to ensure compliance with maximum speed limits.

Recent experience in the Netherlands, however, gives an example of what can be achieved through a more wholehearted approach. Realising that planned reductions in transport CO_2 cannot be achieved through technology change alone, the Dutch government has embarked on a New Driving Force programme to run from 1999 to 2005. The programme is a joint initiative involving drivers' associations and manufacturers, and using modern marketing methods to promote a new driving style intended to fit better with modern vehicle technology. The communications strategy for this new style involves in-car driver information technology, but also stresses personal benefits, including greater safety and comfort, with fuel savings and cost reductions as a side benefit.

The driving techniques stressed by the programme include:

- Starting the engine without using the accelerator
- Changing up through the gears at relatively low engine revs
- Driving in the highest comfortable gear at any given speed
- Controlled use of the accelerator
- Remaining in high gear when decelerating

All driving instructors and examiners are themselves being retrained for the new techniques over a two-year period, in order both to train new drivers in better techniques and to retrain existing motorists. Instructors were surprised to find that they saved on average 13 per cent of fuel consumption on a 40 km test drive, with no change at all in driving time.

There is also an initiative to certify driving schools to an agreed quality label after training. A further major step in the plan has been the incorporation of the new techniques into guidance to new drivers – loosely equivalent to the UK's Highway Code. This forms part of an international initiative to establish a European Eco-driving standard, but the UK is not yet a member.

2.2.2 Promoting best practice in the road freight sector

There are many things that can be done to reduce diesel use in freight, eg technical modifications to improve aerodynamics; better driver training; routine maintenance; routing and logistics; combined transport; etc. While some of the larger UK hauliers lead the way in logistics management, many other measures are poorly taken up, and small scale operations are currently poorly placed to take advantage of some of the techniques available.

As with cars, driving behaviour makes a difference, but little attention is currently paid to this. It is known, for example, that merely monitoring the fuel consumption of individual drivers leads to significant reductions in fuel used. However, a recent report by the government-sponsored Energy Efficiency Best Practice Programme shows that only one in three fleet managers has an energy efficiency programme, and only 30 per cent know how much they spend on fuel anyway (which itself calls into question some of the claims which have been made on the impact of fuel duty). Participants in the Programme have saved an estimated 25 per cent on their fuel bills, but only 12.5 per cent of the UK fleet is involved.

Clearly a much more aggressive policy in this area would be desirable, and could lead to substantial savings. The above estimate of 25 per cent savings is remarkably high, but possibly quite conservative when applied to the fleet as a whole, as it is often the companies with the best management, not the worst, who participate in such schemes. One possibility is that, if concessions are to be made to hauliers, these should be conditional on participation in a programme such as the above.

In the PBR, a review of HGV driver training was announced. This is a welcome development which may provide some opportunities to tackle these problems.

Note that the Dutch driver training programme is also to target HGV drivers, and significant fuel economy improvements are expected in this sector. One mechanism which has been identified there to ensure that good driving is maintained is that the financial savings of economical drivers are shared directly with those drivers through bonus incentive schemes.

In summary, individuals and freight users can do a lot to reduce the amount of fuel they use, but their knowledge of what they can do is limited, and the government can play an important role in information and training.

2.3 THE PASSENGER CAR SECTOR

2.3.1 Technological responses

(i) Prospects for more fuel-efficient conventional cars

In 1998, European carmakers under their umbrella body ACEA agreed to cut average new car CO_2 emissions to 140 g/km by 2008 (a 25 per cent reduction from a 1995 base line). Similar

agreements were reached with Japanese and Korean importers in the following year. This agreement was to make a substantial contribution to the Community's target of 120 g/km, although additional measures (eg labelling, fiscal measures, etc) are assumed to be needed to make up the 20 g/km difference.

In spite of reservations over the likely effectiveness of the voluntary agreement, manufacturers appear to have made a promising start overall. The first annual report from the Commission on the agreement – COM (2000) 615 final – presents data on progress to date and expresses general satisfaction with what has been achieved. The European manufacturers under ACEA appear to have cut average new car emissions across the EU from a baseline in 1995 of 185 g/km to 174 g/km in 1999. This is an aggregate 6 per cent cut, achieved by fairly steady progress over the intervening years.

The improvements achieved so far have resulted partly from a range of technological developments (mainly high-speed direct injection diesel; gasoline direct injection, and continuously variable transmissions). Increased sales of small 'city' cars and some hybrids have also improved the figures, and the market share of diesel has increased. The latter trend is, however, expected to be reversed in future years as direct injection petrol engines become more common.

As noted in the above discussion of ultra-low sulphur petrol, vehicle manufacturers stress the need for very low sulphur fuels in the future if they are to reduce both CO_2 and NO_x emissions. The Commission is currently consulting on the desirability of such fuels, and has also launched an initiative to develop new super-efficient cars for Europe. There are also initiatives under way to extend the scope of the ACEA voluntary agreement to cover light-duty vans as well.

On current trends, ACEA is comfortably on target for the indicative interim target of 165-170 g/km in 2003. The Commission notes that a faster rate of progress will be needed in later years as new technologies come on stream, but this was always argued by ACEA to be the case. However, while the EU as a whole may be on track, the table below illustrates that the UK remains well above the average, and is lagging behind to a worrying degree. In 1995, the UK was 6 g/km above the EU average; by 1999, this gap had grown to 9 g/km. The UK showed the poorest rate of improvement, with the possible exception of Finland, and now has a higher sales-weighted average than Germany. Clearly this is an argument for additional moves to encourage fuel-efficient technologies – not to cut fuel taxes.

	1995 g/km	1999 g/km	% change	g/km reduction	Improvement ranking
EU-15	186	176	-5.5%	10	
A	186	170	-8.8%	16	2
B	182	170	-6.6%	12	6
Dk	189	182	-4.0%	8	12
F	177	168	-5.2%	9	9
Fin	187	184	-1.5%	3	15
Ger	195	182	-6.3%	12	7
Gr	187	173	-7.5%	14	3
Ire	180	172	-4.8%	9	10
It	180	168	-6.9%	12	5
Lux	197	183	-7.0%	14	4
Nl	188	177	-5.8%	11	8
P	172	164	-4.7%	8	11
Sp	177	170	-3.9%	7	13
Sw	221	201	-9.2%	20	1
UK	192	185	-3.3%	6	14

Source: Reweighted data from Annexes to the first annual report from the Commission on the passenger car CO_2 voluntary agreement – COM (2000) 615 final
Note: Finnish and Greek data are incomplete

Although the current agreement runs only to 2008/9, there are good technological prospects for further improvements beyond that date.

(ii) Prospects for alternative fuels

A number of alternative fuels have been promoted over the years in various parts of the world, for a range of reasons including improving emissions performance and reducing oil dependency. Some of these (notably electric vehicles) have never really delivered their supposed potential, and few have made serious headway on account of practical drawbacks or cost disadvantages relative to petrol and diesel. What follows is a very brief review of current prospects with reference to current fuel prices and CO_2 emissions.

Probably the most readily available alternatives to petrol and diesel are gaseous fuels – most notably compressed natural gas (CNG) and liquefied petroleum gas (LPG). These offer significant air quality benefits, and some reduction in CO_2, particularly relative to petrol engines, because natural gas has a lower carbon to hydrogen ratio than petrol or diesel. They are also much cheaper in terms of running costs, as the level of duty payable is much lower than that on conventional road fuels. Worldwide there are over five million gas-powered vehicles in operation. The UK has been a slow and late entrant to the market, with only a few thousand in total – but this is now increasing rapidly.

Hybrid vehicles combine an electric motor and batteries with a small conventional engine. They are technically complex and relatively expensive, but do offer benefits in terms of emissions and fuel economy. Production models are now available (Honda Insight and Toyota Prius), but have

a rather small market share. The Powershift Programme (see below) is investigating options to provide incentives for faster uptake.

For the longer term, fuel cells appear to be the technology of choice to tackle vehicle emissions of both conventional pollutants and CO_2. After a long gestation period (they were invented in the nineteenth century), they now appear to be approaching market-readiness for the light vehicle sector, with several manufacturers vying to offer the first production model, perhaps by 2004. In essence, fuel cells use a catalytic process to convert hydrogen and oxygen to water to produce electric power. They do not suffer from many of the drawbacks of battery-powered electric vehicles, and the only emission from the vehicle itself is water vapour.

As with many alternative fuels, however, it is important to consider the full life-cycle emissions of the fuel. While the end-use fuel is hydrogen, there are three main routes whereby the hydrogen can be delivered to the fuel cell:

- Hydrogen generated from natural gas in a stationary plant, and pumped into a tank in the vehicle;
- Methanol fuel, reformulated on board the vehicle;
- Petrol (with very low sulphur content) reformulated on board the vehicle.

A recent report from Canada (Pembina Institute, 2000) found that, of these, only the first option reduces greenhouse gas emissions substantially (by around two thirds). The other two offer substantially smaller savings, no better than the improvement expected over the next ten years in conventional engines. Unfortunately, the latter options are the ones likely to be favoured by a range of industrial interests, so it is important to ensure that the most environmentally-beneficial development path is the one to be pursued.

2.3.2 Policy Responses for the Passenger Car Sector

As Part 1 pointed out, the adoption of new technologies will not necessarily lead to reduced emissions, since consumers have traditionally used improved fuel efficiency to consume more fuel by buying bigger cars (and by travelling further). There is, therefore, a need for policies that encourage consumers to buy more fuel efficient vehicles.

(i) Differentiated sales tax/VED

As the Institute for Public Policy Research (IPPR, 2000) has argued, there is a case for cutting VED on existing cars to a greater degree than has currently been considered, and for reductions to cover a much larger share of the total car park. A second threshold at 1800cc, or perhaps two set at 1600cc and 2000cc, could make sense. Such a policy would be fully in keeping with stated policy to shift costs from ownership to use (indeed, this has been the stated policy of successive governments since 1990, but progress has been rather slow). It would also be far preferable as a means of compensating motorists, as it would maintain a strong price signal for fuel use at the margins.

In the event, the government opted for a rather half-hearted version of this scheme, by simply extending the scope of the current VED up to 1500cc engines. This was a disappointing move with no obvious environmental benefit in itself – except insofar as it may have helped to avert a significant cut in petrol duty.

For new cars, plans are already in place to graduate VED according to CO_2 emissions. This is a useful step in the right direction, but the duty differentials proposed so far are unlikely to be sufficient to influence the buying behaviour of motorists in most cases.

Note that the incoming system for taxation of company cars is much more steeply graduated for CO_2 emissions than the VED proposals. Since companies still buy half of all new cars in the UK, this may prove to be a stronger driver of new car fuel economy than the VED system as it currently stands.

A differentiated sales tax and/or rebate scheme would in fact provide a more effective measure than VED to influence new car purchase amongst private buyers in particular. Such a system could be based on CO_2 emissions, and could be designed in a revenue-neutral way if desired. Many European countries have such taxes, which are in some cases substantial. Indeed, once these are taken into account, overall UK ranking in motoring taxation falls well below many other countries (Scotland Office 2000). As the UK no longer has a car sales tax system (apart from flat-rate VAT), however, it seems unlikely the government would be willing at present to introduce anything which might be portrayed as a 'tax on Mondeo Man'. Failing this, a possible small step in the right direction might be to waive the new car registration fee for new cars with CO_2 emissions below the EU's 120 g/km target.

(ii) Scrappage Incentives

The Cleaner Vehicles Task Force (CVTF, 2000) recently addressed scrappage incentives as part of its remit to develop 'quick wins' in terms of the existing vehicle fleet – although primarily in the context of air quality and regulated pollutant emissions.

The report concluded, rightly, that scrappage schemes of the type employed in some other EU Member States, whereby a scrappage incentive was related to purchase of a new car, were expensive and not particularly effective. A general scrappage scheme covering all pre-catalyst cars was also recognised to be a very expensive option, since nearly half the UK fleet is still of an age to predate the requirement for catalytic converters. The CVTF did, however, favour a more targeted approach, for example to pilot a scheme for removal of old cars owned by residents in air quality management areas or clear zones.

In addition, however, an incentive structure for the oldest cars was suggested, whereby a scrappage incentive would be related to the age of the car, giving a larger incentive to newer cars and a relatively small sum for those of an age at which they would be quite likely to be scrapped anyway. This remains a rather expensive option, however, and one with only moderate advantages in terms of regulated pollutant emissions. However, the renewed emphasis on fuel consumption offers a further possibility which should be considered. That is, the incentive could be targeted not only at old cars, but at those which also had the larger engine sizes (say, above 2000cc).

This approach has a number of advantages.

- It would limit the scope and cost of the scheme, while targeting it on cars which were not only 'dirty', but also 'gas guzzlers'. If a significant proportion of such cars were scrapped,

this would also increase the second-hand price of those that remained, thereby steering second-hand car buyers towards smaller and more economical choices.

- Such a scheme would reinforce the effect of graduated VED as discussed above, and help to accelerate the transformation of the existing car fleet towards better fuel economy. This is an important benefit because improvements in new car fuel economy take many years to permeate the entire car fleet.

  This would help poorer motorists in particular, as otherwise they are excluded from the benefits of improving new car fuel economy, and have relatively little choice but to opt for what is available on the second-hand market.
- Car manufacturers would presumably be supportive of such a scheme because (a) it would indirectly stimulate demand for new cars and (b) it would help to reduce their future liability for scrappage and recycling of older cars under the newly-agreed End-of-Life Vehicles Directive. Indeed, they might perhaps be persuaded to contribute financially towards the costs of such a scheme for these reasons.

(iii) Promoting Alternative Fuels

The Powershift Programme under the Energy Savings Trust offers some funding incentives for alternative-fuelled vehicles, either bought new or converted from conventional fuel. As yet, however, the funding available and its impact have been rather limited. Retrofits, for example, are only supported on vehicles under one year old, and only a limited range of models of car are approved for financial support under the scheme.

The funding of the scheme is already expanding, from £2 million per year in 1996-8, to £3.3 million in 1999/2000 and £10 million for 2000/2001. Further increases in funding are desirable, however, as these would allow the scheme to be broadened to cover slightly older cars and to be marketed more actively. This would have the benefit not only of increasing the uptake of alternative fuels, but also of reducing their unit costs by encouraging a more mature mass market.

Powershift has already begun to be involved in fuel cell demonstration projects, of which a few are currently in operation. Again, increased funds and administrative capacity should help the programme to foster hydrogen-fuelled fuel cell technology.

Further details of Powershift are available at their website http://www.est-powershift.org.uk

The PBR announced that further duty reductions would become available for 'green' fuels in the future. It is not at present clear what fuels are likely to be covered, but this may provide a further incentive to promote the uptake of gaseous fuels.

In addition, for longer term development, the Carbon Trust, being set up with money from the Climate Change Levy, should fund research and development into low carbon technologies. It is important that its remit should explicitly address alternative transport fuels such as hydrogen and the most environmentally benign fuel cell configurations. The Institute for Public Policy Research (2000) recommends that its remit be extended in this area, and backed up by an extra £25 million hypothecated from road fuel duty.

2.4. THE ROAD FREIGHT SECTOR

2.4.1 Technological Responses: Prospects for more fuel-efficient conventional HGVs

Recent research from the Energy Technology Support Unit (ETSU) suggests that there is still significant scope for fuel efficiency savings in trucks, eg through use of lighter materials. The effect of these will be to give extra carrying capacity to a truck of the same gross weight and engine power. Higher fuel prices should stimulate this demand, but instead there tends to be an emphasis on engines with higher power output.

There also remain additional opportunities for improving the fuel efficiency of conventional HGV technology. Some manufacturers, for example, do market their vehicles partly on the basis of fuel efficiency. Improved aerodynamics can also be achieved through retrofit kits to many HGVs.

Prospects for alternative fuels are rather more limited for HGVs than for some other classes of vehicle. CNG offers some benefits in terms of CO_2 reductions, and is likely to be better in terms of total greenhouse gas reductions, provided that methane emissions from the tailpipe are minimised through lean burn or appropriate aftertreatment. The principal drawback is that there is not an adequate refuelling infrastructure for CNG, which makes it impractical currently for long-distance haulage. It does, however, offer environmental and cost benefits for vehicle fleets which operate deliveries from a central depot. Several supermarkets are developing CNG delivery fleets on this basis. Relatively few HGV manufacturers offer CNG trucks at present, however.

2.4.2 Policy Responses for the Road Freight Sector

(i) Differentiated sales tax/VED

In the UK, vehicle excise duty (VED) on trucks is already heavily differentiated, although largely on the basis of the number and weight of axles. Reduced rates are, however, available for 'Environmentally Enhanced Vehicles' which meet tighter emission limits for conventional pollutants, and these are reported to have had some success in accelerating the rate of vehicle replacement in some fleets. As yet, this approach has not been applied to more fuel-efficient conventional trucks, but should be considered as a means of developing the market demand for these.

(ii) Scrappage incentives

As with cars, scrappage incentives have not hitherto been applied in the UK for HGVs. However, the PBR included an announcement of a ring-fenced fund of £100 million to promote the scrappage of older trucks and the uptake of cleaner technology. This may well help with conventional pollutants, but a central difficulty in the freight sector is that, as explained above, a new truck will not necessarily be more fuel-efficient than an old one. This point requires further careful consideration by the government before the fund is introduced, or an important opportunity may be missed. Two possibilities suggest themselves for further consideration.

- Scrappage incentives could be offered through the Powershift Programme, but only where a truck was to be replaced with a CNG vehicle or a conventional diesel certified to a high standard of fuel efficiency.

- Scrappage incentives might be offered only on old trucks that were not being replaced – eg on cancellation of an O-licence for a small operator leaving the sector. In this case, the incentive would contribute towards a degree of industrial restructuring and help to reduce the apparent overcapacity amongst small haulage firms.

(iii) Eurovignette/Weight Distance Tax

One element of the PBR widely reported in the press is a 'Britdisc' licence to be paid by foreign hauliers to use UK roads, in order to offset their cost advantage and balance out the UK's relatively high rates of VED (which to an extent reflect road track costs). The initial announcement was, however, rather vague, and confusing reports have since suggested that an annual charge of up to £1,500 might be levied, solely on foreign trucks.

However, both of these elements of the reports appear misleading. It is, for example, almost certain that a separate charge applied only to foreign hauliers would be ruled illegal under the so-called 'Eurovignette' Directive (1999/62/EC), which establishes rules and allowable rates for VED and road tolls in the EU. Article 7(4) of this Directive states that:

> 'Tolls and user charges may not discriminate, directly or indirectly, on the grounds of the nationality of the haulier or the origin or destination of the vehicle.'

Instead, therefore, such an approach will in effect require the UK to charge UK as well as foreign-registered vehicles, as in the existing Eurovignette scheme run jointly by a number of other European countries. Under the EU directive governing such schemes, maximum rates of road user charges are also specified, dependent on a vehicle's emissions as set out in the table below.

Maximum road user charges (Euros), including administrative costs

Annual	Maximum three axles	Minimum four axles
NON-EURO	960	1,550
EURO I	850	1,400
EURO II	750	1,250

Monthly and weekly charges should be in proportion to the duration of the use of the infrastructure, and a daily charge is set at 8 Euros. It is clear from this, therefore, that the maximum allowable charge is significantly less than has been suggested, and rather low by comparison to aggregate HGV duty rates in the UK.

These charges must be applied to domestic as well as overseas operators. For UK operators, however, the annual charge could be offset by a corresponding reduction in VED, as the UK rates are well above the minimum levels specified in the Directive. The Treasury has hitherto opposed such a move, arguing that the cost of administering a scheme for overseas hauliers entering the UK would outweigh the income gained. It would, however, be a start, and the costs would be easily covered by the income from HGV duties overall. The Transport Select Committee has also argued for this approach, suggesting that the UK should join the

Eurovignette and then explore all avenues to secure an increase in the chargeable rates, including an amendment to the Directive. The rates are to be reviewed in 2002.

Beyond this, there is growing interest in the development of a weight-distance related tax system for heavy goods vehicles. Switzerland, Austria and Germany have undertaken to introduce such a system in the next two years, and others are likely to follow suit, making this system the probable successor to the Eurovignette. If the UK were to participate actively in the development of such a system from the outset, it is more likely that it would develop in a way which suited British interests.

(iv) Intermodality

Shifting freight to rail, especially for long-distance hauls, offers a range of benefits, including reduced CO_2 emissions (provided that the rail system operates reasonably efficiently). Successive governments have for some years offered financial incentives for new railheads where these would encourage a shift from road transport. Initially the sums of money available were very limited, but they have been increased in recent years. Further increases in funding could further accelerate the revival of rail freight.

More broadly, however, it is essential that rail policy help to provide fast and reliable rail freight services which can compete more effectively with the flexibility, speed and reliability of road haulage. The measures required to achieve this are many and varied – they could include:

- lower track access charges
- increased grants to take account of the environmental benefits of railfreight
- Investment in enhancing the capability and capacity of the rail network to overcome constraints and allow for longer, heavier and larger trains, and new technologies such as "piggyback"
- New intermodal terminals and the identification and safeguarding of sites for such terminals in local and regional planning

Many of these measures, and the funding for them, are in fact included in the government's ten-year plan for transport (DETR 2000d) and will be taken forward by the new Strategic Rail Authority. However, the reductions in lorry VED and duty on diesel discussed above, and the approval of an increase in maximum lorry weight to 44 tonnes, have worsened the competitive position of railfreight relative to roads.

It is sometimes argued that increasing railfreight will make only a marginal difference to road freight. This is wrong, because it confuses freight trips, most of which are very local and carried out by small vehicles, with lorry mileage and tonne-mileage. A small proportion of freight trips account for a large proportion of tonne- and vehicle-miles. Hence it has been calculated that, if railfreight were doubled exclusively from journeys by vehicles of 17 tonnes exceeding 150 miles, total mileage by HGVs would fall by over 40 per cent (Transport 2000 1990).

(v) Encouraging Alternative Fuels

The Powershift Programme (discussed above) is offering financial assistance with the substantial capital costs of installing gas compressors at some refuelling depots. As with cars, an

increase in the available funds could allow an extension of this programme, thereby stimulating the market for CNG for heavy-duty vehicles.

2.5 BUSES

2.5.1 Technological responses

(i) Conventional Buses

Buses use relatively large quantities of fuel, especially in urban operations, but their emissions performance is much more favourable when expressed on a per capita basis. In particular, buses perform significantly better than either taxis or private cars in terms of carbon dioxide emissions, always assuming a reasonable load factor.

For technical reasons, the switch to Euro II engines from 1996 resulted in a trend towards larger and more powerful engines. As a result, the average fuel economy of newer buses is often poorer than that of their older counterparts, and hence their CO_2 emissions are higher. However, London Transport Buses considers that this trend is now beginning to be reversed, and anticipates that smaller and less powerful engines will soon contribute to improving fuel consumption and hence lower unit CO_2 emissions from conventional buses (LTB, 1999).

(ii) Alternative Fuels

Gas-based fuels offer benefits for buses in terms of CO_2 emissions and other environmental impacts. Buses are also a relatively promising application for alternative fuels in practical terms, as they are generally large vehicles, cover limited mileages at only moderate speeds, and generally have dedicated refuelling and maintenance infrastructure at depots. In some other countries, large fleets of alternatively-fuelled buses are already in service, but in the absence of significant government support in the past, they comprise a very small proportion of the UK bus fleet.

2.5.2 Policy Responses

Buses pay relatively low rates of VED and receive a rebate of a substantial portion of their fuel costs. Indeed, there is pressure to fully rebate their fuel costs in the wake of recent fuel price rises. As a result, there is little scope to improve CO_2 performance through duty reductions (such as those discussed above for cars and heavy goods vehicles) in the bus sector.

Other, positive incentives to encourage more fuel-efficient or alternatively fuelled buses are therefore needed. The Powershift Programme already has some interest in this area, for example through offering financial support for the installation of gas compressors at bus depots. As elsewhere, however, greater financial resources may be needed in order to encourage a major improvement.

2.6 PROVIDING INCENTIVES THROUGH THE PERSONAL TAXATION SYSTEM

So far, we have looked at taxes on vehicle use and ownership, and fiscal measures in the transport sector have concentrated on these. Policy measures for particular locations or uses, such as commuting, have largely been addressed by actions other than taxation policy (eg grants

to build or upgrade public transport systems, revenue subsidies to public transport, regulation and parking controls etc). However, it is hard to provide positive incentives in the vehicle and fuel taxation system (other than paying less tax than others, as a reformed VED system allows, or not incurring parking charges by using the bus instead). The personal taxation regime offers an opportunity to provide real carrots rather than simply smaller sticks. This can complement vehicle and fuel taxation to make the whole system both more effective and politically acceptable.

Under the British taxation system, the cost of travelling between home and work is not an allowable deduction against Income Tax and National Insurance Contributions (NICs)[4]. This also applies to employer-provided commuting benefits, although employer-provided car parking is a commuting benefit that has been exempt for a number of years, as has been the value of interest-free loans to buy public transport tickets, bikes or cars.

This tax treatment of company-provided commuting benefits caused a number of difficulties for employers who were developing Travel Plans to "green" the commuting of their staff by reducing single-occupancy car commuting. As a number of Travel Plans had arisen to fulfil planning requirements, employers thought it perverse that, whereas car parking was tax free, almost all company-provided alternatives to car commuting involved a series of tax charges and not inconsiderable administrative costs.

The March 1999 Budget marked the first significant move to provide personal tax incentives that rewarded 'greener' commuting. It removed many of the major areas of uncertainty and administrative complexity that were hindering the adoption of company Travel Plans. In detail these reforms, taking effect from 6 April 1999, were that no tax would be liable on the following employer-provided Travel Plan benefits:

- Works buses of 12 or more seats used mainly to bring employees to and from work
- General subsidies to public bus services used substantially for commuting, provided that the employees pay the same fare as other members of the public
- Bicycles and cycling safety equipment
- Workplace parking for bicycles
- Alternative transport for car sharers to get home in exceptional circumstances, such as working late, domestic emergencies etc

In addition to these tax concessions, there were two other measures of benefit to Travel Plans:

- The tax-free mileage rate for employees using their own bicycle was raised to 12p per mile, and if their employer provides no payment, employees can claim tax relief of 12p per mile.
- Employees who use their own bicycle for business travel can claim capital allowances on a proportion of the cost of a bicycle.

[4] Full details of what employee travel does and does not qualify for income tax and NICs relief is contained in the Inland Revenue Booklet 490 Employee Travel.

Shortly afterwards, the government issued a major report encouraging employers to adopt Travel Plans (DETR, 1999), an action that would have been difficult if nothing had been done to address these tax barriers to Travel Plan measures.

The pre-Budget report proposes further changes:

- an allowance of 2p per mile for car sharers
- a further increase in the cycle mileage allowance to 20p
- bringing works buses of 8-12 seats into the scope of tax relief

However, employer-provided public transport tickets and other commuting benefits in kind remain subject to tax and employee NICs. Indeed the tax situation for these remaining liable benefits worsened from April 2000 as Employer NICs are now also charged on all employer-provided benefits.

In some other countries, a policy of targeted tax concessions for employer support for 'greener' commuting has been pursued. This has tended to cap the amount that can be claimed, which is important for two reasons. Firstly, an uncapped tax concession disproportionately benefits wealthy long-distance commuters. Secondly, an uncapped concession is also likely to stimulate trip lengthening and metropolitan decentralisation, and thus increase travel dependence. A capped concession addresses both these problems. It has been calculated (Potter et all for DETR 2000) that it would be possible, at a relatively modest cost to the Exchequer (around £200 million per annum), to build upon the existing taxation reforms to provide an effective set of tax exemptions.

It would be important to include measures that are appropriate for urban fringes and rural areas as well as major conurbations. Thus a capped allowance of around £500 - £600 per person per year tax exempt personal travel benefits could be used on measures such as company-organised shared taxi and community transport services, as well as on all forms of conventional public transport.

In practice, and in particular to avoid the creation of any tax loopholes, the tax concessions on these modes could be integrated by a 'Travel Vouchers' scheme. Under such a scheme, employers could issue Travel Vouchers to staff up to their individual allowance, which could then be used to pay for a range of 'greener' commuting modes.

Part 3. The limits of taxation: using tax revenues to address transport problems

The gathering of taxation revenue can be effective for some transport and environmental objectives, such as the promotion of Travel Plans, but in itself it is only a partially effective policy instrument. In designing an effective fiscal policy regime, the systems boundary needs to be drawn more widely to encompass how the tax revenues are spent, as well as how they are gathered. In recent years the concept of earmarking transport revenues for transport expenditure ('hypothecation') has gathered support. In the UK this has particularly applied to new discretionary local sources of funds represented by the Workplace Parking Levy and Roadspace Charges. Outside the UK, the use of such local hypothecated funds is widespread; in France, for example, the Versement local employer tax has provided funds for the upgrading of the Paris Metro and new metro developments in provincial towns and cities.

The Rural Motoring Conundrum

The need to view both the gathering and spending of transport tax revenues is illustrated well by the thorny problem of the effect of high motor fuel costs and high car reliance in rural areas. Logically there are several possible approaches to the problem:

- Lowering motoring costs in rural areas (through reduced petrol prices or Vehicle Excise Duty)
- Granting financial compensation by other instruments to individuals (council tax or income tax rebates)
- Improving alternative transport provision to the car (bus, rail, community transport and, to a lesser extent, walking, and cycling).
- Improving services within the rural areas themselves and thus reducing the need to travel

The first two of these explore possible tax gathering changes, whereas the other two are about the spending of public money.

LOWERING MOTORING COSTS IN RURAL AREAS

On average, petrol in rural areas is usually more expensive than in urban areas. Therefore, the most direct way of dealing with the problem is to lower the price of petrol in rural areas through a reduction in fuel duty. This could go to suppliers, who would then need to pledge to pass on the price cut to users. There is a danger of the subsidy being absorbed by suppliers. A major problem would be the creation of a boundary effect, as making petrol cheaper in rural areas would just create an Ireland-style problem – whereby city dwellers would drive for miles to fill up with cheap petrol adding even more useless car miles to the roads. There is also a problem of providing a legal definition of what is 'rural'.

Another way to reduce the financial transport burden on rural drivers could be to reduce the fixed costs of owning a vehicle, such as Vehicle Excise Duty. This would again require a legal definition of 'rural' with boundary effects again in evidence, and could be administratively

complex. The Irish Republic reportedly considered such a scheme but appears to have rejected it.

One problem of all these supply-led responses is the lack of distinction between the poor and the more affluent. As the main concern is that of the poorer rural motorist, much of a general supply subsidy would go to those who do not need it. Such an approach would be entirely regressive, though vehicle excise duty reductions in rural areas would be less regressive than fuel duty reductions.

There may, however, be a case for measures that equalise the cost of fuel between rural and urban areas. It has been suggested that a national maximum retail price could be established, enforced through local weights and measures inspectors. In theory, this could help the environment by reducing incentives to drive to the town to get cheaper petrol, but in practice, it might actually lead to the closure of more rural filling stations. The higher prices in rural areas reflect the extra costs of distribution of fuel, and closures would follow unless a fixed maximum were accompanied by measures to control the wholesale prices charged by oil companies to smaller rural fuel retailers, or by subsidy to those retailers.

It has also been suggested that assistance should be focused on farmers. There is, however, little scope for fuel duty concessions to farmers as a specific target group, as they already pay less than 3p per litre in fuel duty. Thus the effect of abolishing the duty altogether would be rather small in terms of their operating costs, and significantly less than the impact of recent fluctuations in the underlying price of oil. Other measures which are being pursued and which seek to address the serious structural problems in the UK farming industry therefore make far better political and economic sense.

COMPENSATING THE INDIVIDUAL

If there are difficulties in reducing transport costs via a supply-led approach, can the rural user be subsidised on a personal basis? This could be through:

- new income tax code rural transport allowance
- tax credits for the unemployed
- benefit payment (like the state pension or child benefit is made to mothers)
- travel vouchers or tokens

A tax code would apply to all income earners (not the unemployed), whereas the tax credits and benefit payments could be targeted according to income. The first three are not transport-specific, but would simply be an allowance to reflect additional transport costs. Travel Vouchers could be targeted upon lower income groups and also used for public transport use. It would also be possible to design these to support public transport, for example by their being worth twice as much on buses and trains as when spent on petrol. There is a risk that such vouchers would produce a parallel economy in the vouchers or tokens.

On a property basis, subsidy could be offered through a rebate on primary dwellings in the lowest Council Tax bands. The assumption is that the rural poor are virtually all covered by the

lowest Council Tax band, but this may not be the case. The cut in Council Tax would, presumably, be paid for by central government as part of the settlement for local authorities. There are also no local powers for councils to vary the lowest band charge independently.

Again, in any such system, there would need to be a definition of what is 'rural'. This could be a contentious issue. Council Tax records would need to be amended to include this definition, which they do not have at the moment. There is thus a very practical problem of local authority computer systems and software. A label would have to be attached to the defined 'rural' households or a postcode system devised. At the moment, postcodes are used for address purposes and not as a factor to vary the charge.

There could also be problems of constitutional/administrative law. There is an issue of 'hybridity' concerning the circumstances where one group in the population can be favoured over another. There are legally accepted factors for Council Tax, such as income and property value, but geography has not been used to vary liability for taxation and so it is uncertain if it could count as a legally acceptable factor.

AN ALTERNATIVE APPROACH: USING TAX REVENUES TO HELP RURAL AREAS

There are serious problems associated with varying taxation by geography. There are no such problems with the use of tax revenues and direct subsidies for rural developments, which are constitutionally recognised and accepted, and have existing administrative arrangements. Moving to an emphasis on the spending of tax revenues raises the issue of hypothecation. The clear earmarking of a proportion of revenues from rural motoring taxes represents a more practical way forward than trying to cut travel costs.

IMPROVING RURAL TRANSPORT PROVISION

A package of measures was suggested in a report for the Joseph Rowntree Association. This recommended that, given the paucity of public transport in many countryside areas, unemployed people living there should be offered grants to help them buy cars once they are offered a job. It also suggested that means-tested help should be given to pay for road tax and insurance, and that driving lessons should be provided at school or through New Deal schemes (Shucksmith, 2000).

The Rowntree report also suggested that fuel duty collected in rural areas could be used to subsidise public transport, dial-a-ride schemes, or paid into a fund to help village shops and schools to remain open. Various projects financed by the rural bus grant and rural rail developments represent clear examples of this, together with road improvements to help people get to remote facilities. Other development measures could include car sharing, shared taxis, community bus schemes, post bus carrying shopping and people, schoolbuses able to carry adults by prior arrangement.

IMPROVING RURAL SERVICES

There is a danger in such an approach. The cause of the rural transport problem is more to do with long-term structural changes leading to rural areas becoming even more denuded of facilities, and thus people have become increasingly dependent on travelling to urban areas (or urban fringes) for their everyday needs. Therefore, the issue is really not about making it easier and cheaper for the rural poor to drive (or take the bus) to use the urban fringe shopping centre, but about maintaining and enhancing services and facilities in the countryside. If you help the rural poor to desert services and facilities in the countryside, it will make things worse, and not better, for rural areas. A subsidy would be another nail in the coffin for rural shops, schools, post offices etc.

Such a conclusion leads to a consideration of a new set of rural policy actions. This would involve a focus on reducing the need to travel to cities. This would involve an acceptance that subsidising rural services was a legitimate policy activity, together with measures to promote innovative and cost effective ways to enhance rural access. These might include teleworking centres, visiting markets, combined mobile services. As noted above, this was suggested by the Rowntree report, and some of these ideas are not new, having been put forward in a report to the Department of the Environment more than twenty years ago (Moseley et al, 1977).

Overall, this exploration of the 'rural conundrum' has shown that there is no easy tax fix. Indeed, this wider exploration has shown the 'rural fuel costs' issue to be a symptom and not the root cause of a wider rural problem. The bottom line is that the issue of rural petrol prices and high car dependence leading to demands to reduce rural petrol costs is merely a symptom of the rural crisis. In actual fact, lower petrol prices would probably worsen things – making it easier for money to flow out from rural to urban areas. Instead, a radical rethink of how we can improve and enhance rural facilities – and so strengthen rural economy, not help it to decline – is required.

As well as failing to get to the root of the problem, cutting the cost of travel in rural areas by tax concessions appears to be very difficult. A more viable approach is to hypothecate tax revenues to regenerating the rural economy by improving local services, reducing the need to travel, and by improving transport alternatives to the car. The Rural White Paper (DETR/MAFF 2000) in fact follows this approach in principle, though it does not state it openly, by focusing on supporting local services in rural areas and alternatives to cars.

USING TAX REVENUES TO CUT TRANSPORT EMISSIONS

This case study on rural motoring shows the need to accept that reforming the gathering of tax revenues, although important, cannot address the full range of policy needs. The combined tax gathering/spending of revenue system is key, and increasingly the use of hypothecated flows is necessary to win public confidence and acceptance.

This takes us back to the first part of this paper. We saw from that analysis that improved technology alone cannot produce the required reductions in carbon dioxide emissions from transport, assuming that transport has to bear its share proportionately. Modal shift and changes in the trend of travel patterns will be necessary as well. These will require public funding. Other

measures suggested in this paper, such as grants for adopting clean engine technologies and tax-free "travel vouchers", will also require public funding.

A hypothecated "green transport fund", drawn from revenues from motoring taxes, to pay for these measures could therefore be established as a means of making more transparent the environmental purposes of motoring taxation, and of linking that taxation more clearly into a wider policy package. An immediate opportunity to set up such a fund is available by using the tax windfall from recent fuel price rises, made up of petroleum revenue tax and VAT revenues. The pre-Budget report moved a step in this direction by announcing a "green fuel challenge".

The analysis in the first part of this paper also suggests that public spending on transport, whether in a specific fund or not, needs to be assessed for its effect on carbon dioxide emissions. The 10-year plan for transport, published by the government in July (DETR, 2000b), does include such an analysis, and this is welcome. Reductions in CO_2 are predicted to come from the adoption of fuel and vehicle technologies, from moves to promote better utilisation of lorries and from investment in public transport. Within the plan, however, is a programme of road building that will, on the government's own analysis, add 0.1 mt of carbon emissions by 2010. Given that the road building is projected for years 8-10 of the Plan, the full long-term effect on CO_2 is likely to be greater.

The plan promotes and allows for the effects of road user charging and workplace parking levies being proposed by local authorities under the powers in the Transport Act 2000, and these charges can clearly help reduce traffic or traffic growth and CO_2 emissions as well. But it lays less emphasis on smaller measures and projects such as:

- employer travel plans;
- safe routes to school;
- quality bus partnerships;
- improved accessibility to public transport vehicles and stops/stations;
- personal security measures on streets and on public transport;
- high quality continuous cycle routes and bus lanes; and
- parking restraint measures.

The plan leaves these largely to local authorities. Yet these small-scale measures can collectively contribute significantly to reducing carbon dioxide emissions from transport, and will indeed be essential to achieve the behaviourial change (reducing journey lengths, promoting walking and cycling) and modal shift that our earlier analysis has shown to be necessary to reducing transport emissions. We have already noted that traffic measures such as speed reduction, primarily promoted at local level, can contribute directly to CO_2 reductions.

The track record of these smaller and more local measures in reducing car travel is clear from local case studies. Employer travel plans have produced 10-15 per cent reductions in single-occupancy car commuting, for example at Boots in Nottingham and at Southampton hospital. Car traffic in Oxford has stabilised as a result of traffic restraint and bus priority measures.

These measures do not only contribute to CO_2 reduction; they can also help reduce car dependence, and hence reliance on oil for mobility. The September protests have shown just how dependent the UK economy and society are on oil. The global requirement to reduce carbon dioxide emissions should therefore be supplemented by the practical need to reduce the economy's and society's vulnerability to disruption – which could potentially come from many sources – of oil supplies. Within the government's spending plans, therefore, priority should be given to measures that reduce dependence on oil. A "green transport fund" might be a visible way of doing this, and could cover support for rural facilities, grants for non-oil technologies, travel vouchers and local transport measures, including the funding already committed in the 10-year plan and the rural White Paper.

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