Twentieth report : transport and the environment--developments since 1994 / Royal Commission on Environmental Pollution ; presented to Parliament by Command of Her Majesty, September 1997.

ROYAL COMMISSION

ON

ENVIRONMENTAL POLLUTION

CHAIRMAN:
SIR JOHN HOUGHTON CBE FRS

TWENTIETH REPORT

TRANSPORT AND THE ENVIRONMENT – DEVELOPMENTS SINCE 1994

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ROYAL COMMISSION
ON
ENVIRONMENTAL POLLUTION

TWENTIETH REPORT

To the Queen's Most Excellent Majesty

MAY IT PLEASE YOUR MAJESTY

We, the undersigned Commissioners, having been appointed ''to advise on matters, both national and international, concerning the pollution of the environment; on the adequacy of research in this field; and the future possibilities of danger to the environment'';

And to enquire into any such matters referred to us by one of Your Majesty's Secretaries of State or by one of Your Majesty's Ministers, or any other such matters on which we ourselves shall deem it expedient to advise:

HUMBLY SUBMIT TO YOUR MAJESTY THE FOLLOWING REPORT.

It wasn't always like this?
Perhaps it wasn't, but it is.
Put the car away; when life fails,
What's the good of going to Wales?

W.H. Auden
It's No Use Raising A Shout
(included in *As I Walked Out One Evening*,
published by Faber and Faber Limited)

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Chapter 1

FACING THE CHALLENGE

1.1 An effective transport system is vital for economic well-being and the quality of life. Yet there are many serious environmental issues about the future direction of transport. In recent years, as a result, transport policies have been the subject of extensive debate and controversy.

1.2 Because of its convenience and flexibility private road transport has grown rapidly. Above all, cars, perceived to offer comfort and security, have come to be the preferred mode of personal travel, while public transport is regarded by many people as both inconvenient and grubby. By the early 1990s, however, there was widespread concern that, without fundamental changes in policies, continuing growth in use of cars and lorries would have unacceptable consequences for health and the natural environment, and would interfere with the efficient functioning of the economy by leading to massive congestion. A major impetus for such concern was the forecast by the Department of Transport (DOT), published in 1989, that road traffic in Britain was likely to double between 1988 and 2025.[1]

1.3 The government of the day recognised there were severe limits on the amount of road space that could be provided in urban areas.[2] The transport policies for most British cities and towns were moving in the direction of combining management or restraint of traffic with encouragement of public transport.[3] Outside urban areas on the other hand, there was a much expanded programme to upgrade existing roads and build new roads.[4] This encountered increasingly vocal opposition from the public. There was a growing realisation that, over and above damage caused to the environment, neither this road programme nor even a yet larger one would be sufficient to prevent congestion worsening if traffic grew to the extent forecast.[5] Solutions had to be found either through radical improvements in technology or through changes in human behaviour or, most probably, through a combination of all the available approaches.

1.4 *Transport and the Environment*, the Commission's Eighteenth Report, was published in October 1994. It took up the challenge of finding ways to provide people with the opportunities they want for continued economic growth, for their livelihoods and for leisure, while at the same time considerably reducing the environmental damage which had become all too apparent and was threatening to become more extensive.[6] Because transport is such an important dimension of national life, and of concern to everyone in one way or other, the Commission recognised the need to seek a new consensus about appropriate solutions.[7] The report analysed the environmental effects of all modes of transport, how these would change if forecasts of road traffic growth proved accurate, and the measures that could be used to reduce such effects.

1.5 In autumn 1996 we decided to review developments since the Eighteenth Report. That decision was prompted by our conviction that the full extent of the challenge presented by the future of transport was becoming even more starkly evident. Our review therefore began well before the election of a new government which has launched its own fundamental review of transport policy. We hope publication of this report will now prove timely in relation to preparation of the planned White Paper. In the remainder of this chapter we summarise briefly the central message of the Eighteenth Report and the events that have followed its publication, and assess the extent to which present trends in transport are still incompatible with the general aim of sustainable development and some of the reasons why that situation has arisen. We then explain how our review has been conducted and the structure of this report.

The Eighteenth Report and what followed

1.6 The Eighteenth Report concluded that private road transport would remain the dominant mode for both personal travel and freight, but that the projected growth in road traffic would have

consequences which would not be acceptable environmentally or socially, or in terms of impact on the economy. It proposed eight objectives for transport policy (box 1A), which were intended to provide the basis for an environmentally sustainable transport system. It proposed 21 targets (see appendix A), and recommended 110 measures which together offered the prospect of meeting the targets. It emphasised:

> Our recommendations complement and reinforce each other, and must be viewed as a whole. The primary focus of this report is on the period from 2000 to 2020. In order to have a substantial effect on the situation after 2000 action must start now, and must be vigorously pursued. We have also had constantly in mind the position after 2020. The need is to identify and adopt a strategy which is likely to be sustainable for as far ahead as we can foresee ...[8]

BOX 1A **OBJECTIVES FOR TRANSPORT POLICY PROPOSED IN THE COMMISSION'S EIGHTEENTH REPORT**

To ensure that an effective transport policy at all levels of government is integrated with land use policy and gives priority to minimising the need for transport and increasing the proportions of trips made by environmentally less damaging modes.

To achieve standards of air quality that will prevent damage to human health and the environment.

To reduce carbon dioxide emissions from transport.

To reduce noise nuisance from transport.

To improve the quality of life, particularly in towns and cities, by reducing the dominance of cars and lorries and providing alternative means of access.

To increase the proportions of personal travel and freight transport by environmentally less damaging modes and to make the best use of existing infrastructure.

To halt any loss of land to transport infrastructure in areas of conservation, cultural, scenic or amenity value unless the use of the land for that purpose has been shown to be the best practicable environmental option.

To reduce substantially the demands which transport infrastructure and the vehicle industry place on non-renewable materials.

1.7 Two closely linked recommendations were that there should be substantially increased investment over a ten-year period in enhancing the quality and convenience of public transport and improving facilities for cyclists and pedestrians, and that this investment should be financed by reducing planned expenditure on motorways and other trunk roads to about half its then level.[9]

1.8 Two months later DOT dropped a number of road schemes from the programme it had published in March 1994.[10] The terms of the announcement took further the move away from construction of new roads on new alignments which had been apparent in previous statements.[11] Henceforth the policy would be to make maximum use of the capacity of the existing road network, which was now regarded as broadly complete; to carry out minor improvements to relieve bottlenecks and provide by-passes; and to make some increases in capacity through widening. Emphasis was placed on the contribution the private sector would make in providing transport infrastructure, and it was indicated this might allow roads to be built which were not in DOT's own programme.

1.9 On the day cuts in the road programme were announced DOT published a report by its Standing Advisory Committee on Trunk Road Assessment (SACTRA).[12] This concluded that new road schemes improve travelling conditions for users, but also generate some additional traffic. Acceptance

of this latter point in principle had considerable significance in the context of public opinion. It later became apparent however that the implications for cost-benefit analyses of individual road schemes were not clear-cut: a review of schemes remaining in the road programme reduced the ratio of benefits to costs in some cases, but none of the schemes has so far been assessed as no longer representing good value for money using present methods of appraisal.[13]

1.10 Early in 1995 the then Secretary of State for Transport promoted a national debate on transport policy by making a series of speeches, subsequently published.[14] He invited everyone to consider whether the balance between economic and environmental objectives should be altered, and if so by what measures and to what effect; and whether the consequences for 'the environment, for personal choice, for industrial competitiveness, jobs and the economy as a whole' would be acceptable. DOT was reorganised to encourage a cross-modal approach to transport policy; responsibility for trunk roads had been transferred in April 1994 to an executive agency, the Highways Agency.[15]

1.11 As the sequel to the national debate DOT published a Green Paper in April 1996,[16] the first comprehensive statement of policies on inland transport since the 1977 White Paper.[17] It emphasised five key themes which had all been explored in the Eighteenth Report:[18]

better planning of transport infrastructure;

making more efficient use of existing infrastructure;

reducing dependence on the car, especially in towns, and for that purpose empowering local decision making;

switching emphasis in spending from roads to public transport;

reducing the impacts of road freight.

1.12 There has been no indication so far of the shift of resources into investment in public transport implied by the Green Paper. Recent trends in investment and present plans are discussed in chapters 4–6.

1.13 While the national debate on transport was being conducted, changes were taking place which have far-reaching implications for the formation and implementation of transport policies:

privatisation of the railways;

concentration of the previously privatised and deregulated bus industry in a few large companies, which have now obtained some of the franchises to operate railway services;

the growing role of private finance for individual capital projects, especially in the form of design, build, finance and operate (DBFO) schemes for construction or improvement of trunk roads;

reorganisation of local government in many parts of Britain into unitary authorities covering smaller areas than the previous counties or regions.

1.14 Other developments which have considerable significance for the creation of a more sustainable transport system are changes of direction in land use planning policies (discussed in chapter 7) and the new system of local air quality management based on a National Air Quality Strategy[19] (discussed in chapter 2).

1.15 The Eighteenth Report attracted much interest in the European Union (EU) as well as in the UK. Standards for air quality are set by European Community legislation, as are the limits on emissions and noise from vehicles, requirements about quality of fuels, the frameworks for some taxes and charges on transport, and the conditions under which non-resident carriers can operate transport services within a Member State. In some circumstances the EU contributes to the cost of transport infrastructure.

1.16 The Maastricht Treaty provided for the establishment of Trans-European Networks for transport.[20] The Common Transport Policy set out in a European Commission White Paper in 1992

sought 'sustainable mobility' with the aim of reconciling transport and environmental policies, although little progress had been made in this direction by 1994.[21] Since then the priority for development of Trans-European Networks has been placed increasingly on rail and cross-modal routes rather than road routes.[22] A European Commission Green Paper has considered the scope for using economic instruments to reflect the external costs imposed by transport systems.[23] Another Green Paper on 'citizens' networks' encourages improved quality and maximum use of public transport, and planning guidance to integrate land use and transport;[24] but these are not areas of policy in which the EU has competence under the Treaties.

The forthcoming White Paper

1.17 The new government elected in May 1997 has made the relationship between transport and the environment one of its key priorities. It has made both subjects the responsibility of the Deputy Prime Minister, as Secretary of State heading the Department of the Environment, Transport and the Regions, formed by merging the Department of the Environment and DOT.

1.18 The White Paper promised for spring 1998, following a fundamental review of transport policy, will 'look at the short-term and long-term actions necessary to deliver an integrated transport system' and set out an integrated transport policy which will provide a 'sustainable framework for decision-making during the remainder of this Parliament and the years beyond that.' The Deputy Prime Minister has referred to a previously unco-ordinated approach to the provision of transport infrastructure and services and a lack of integration with the wider planning system. He emphasised that the review would be conducted in a consultative way and that he was looking for solutions which 'combined social and environmental improvements, while promoting economic growth, employment and regional competitiveness'. A consultative document is being published.[25]

1.19 In conjunction with the fundamental review the government has launched a review of buses and a strategic roads review. The first volume of the consultation paper issued for the road review covers general roads policy issues and the development of an investment strategy for the trunk road network, and sets out five 'fundamental criteria' on which the review will be based:[26]

a. integration – ensuring that all road decisions are taken in the context of a coherent, integrated transport policy covering all modes;

b. accessibility – making it easier to reach the places we wish to get to;

c. safety – making travel safer;

d. economy – getting good value for money and supporting economic activity in appropriate locations;

e. environmental impact – both positive and negative, on both the natural and built environment, and at the global, regional and local level.

Assessing sustainability

1.20 The Eighteenth Report related transport policy to the aim of sustainable development, taking as the starting-point a 'sustainable framework' for transport policy outlined briefly in January 1994 in the Sustainable Development Strategy for the UK.[27] A report by the UK Round Table on Sustainable Development, published in June 1996, emphasised that a sustainable transport sector must satisfy economic, environmental and social needs, now and in the future, and maintain the economic and environmental means to do so.[28] The government responded to this in September 1996, largely by reference to its Transport Green Paper.[29] In March 1996 an interdepartmental working group published a set of indicators, some of which derive from transport, as a first step towards establishing measures of progress towards sustainable development, showing where further progress is needed, and bringing home the main messages to businesses and individuals.[30]

1.21 In general the suggested sustainability indicators deriving from transport cover the period since 1970. Emissions of carbon dioxide and other key pollutants (except lead) have shown large increases

over this period.[31] For some pollutants emissions per freight tonne-mile (black smoke) or passenger-mile (nitrogen oxides) increased. In other cases the indicators showed reductions recently in emissions per tonne-mile or passenger-mile, although estimates of emissions are subject to large margins of error (see box 2D). Even where emissions per tonne-mile or passenger-mile have remained broadly constant or fallen, total emissions of the pollutants in question have shown large increases since 1970 because of the very large increase in the number of vehicles.[32]

1.22 Other suggested sustainability indicators were land take for roads, and car use/total passenger travel.[33] Since 1970 car travel per head of population has almost doubled, whereas travel on buses and coaches has dropped by a quarter and rail travel has remained broadly unchanged. Some other indicators pointed to some of the reasons for this growth and are discussed in later chapters (categories of journey, out-of-town retail floorspace) or later in this chapter (cost of personal transport).[34] Trends in freight are also discussed below (1.30–1.31).

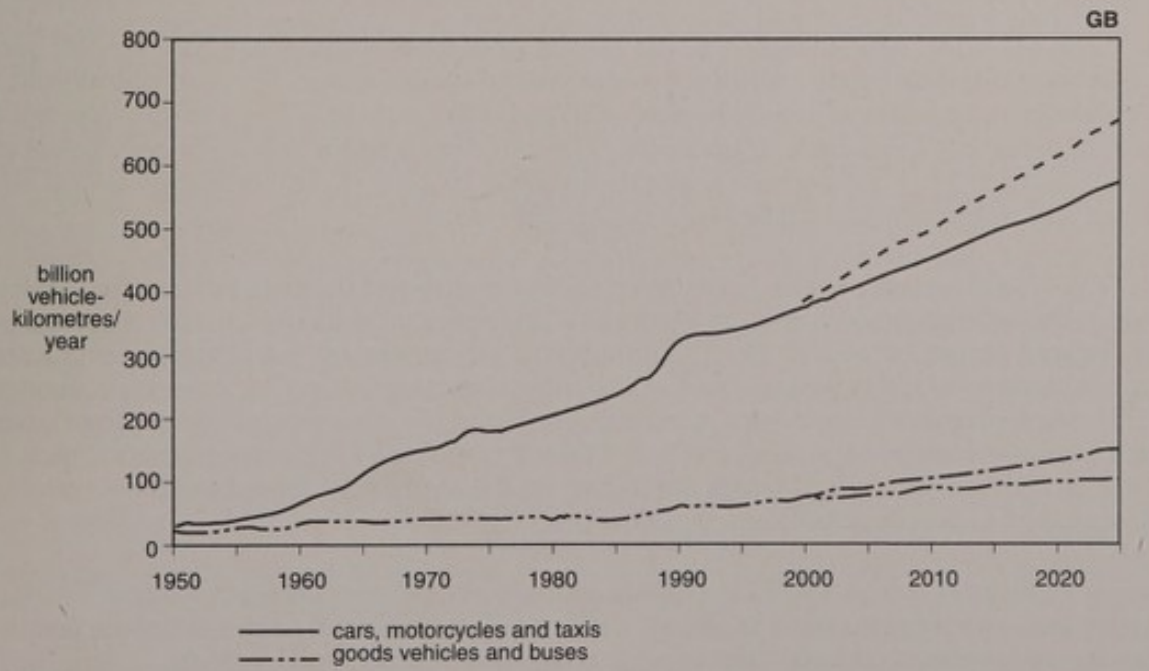
1.23 Another indicator is the total amount of traffic on the roads. Over the four years 1989 to 1993 the total amount of traffic hardly changed. It was uncertain in 1994 whether this was the result of the economic recession or reflected in part some modification in long-term trends. Since 1993 growth has resumed. The annual increase of over 2% between 1993 and 1995 was larger than the average annual increase over the last 20 years.

1.24 Meanwhile use of public transport has stagnated or fallen. Rail travel remained roughly constant between 1993 and 1995, at a level similar to that in the mid-1970s.[35] Travel by bus and coach, which has fallen by 45% since 1960, remained broadly constant between 1993 and 1995, but temporary plateaux have also occurred in the past.

1.25 Walking and cycling have also declined. Between 1989–91 and 1993–95 the average distance walked by a person in a year fell by 16%, and the average distance cycled fell by 11%.[36]

1.26 DOT has not produced any new forecasts for road traffic since 1989. Rolled forward, the 1989 forecast implies an overall increase in traffic of between 55% and 87% from 1995 to 2025.[37] The low forecast reflects past levels of economic performance in the UK and assumes the market price of fuel will increase in real terms at an average annual rate of 0.85%.[38] We consider this forecast has a higher probability than the high forecast. The growth in traffic since 1950 has been predominantly a growth in car traffic, and that is projected to continue; figure 1-I shows the growth in movements of light and heavy vehicles separately and the re-based high and low forecasts for each component up to 2025. The implications of such forecasts for emissions of pollutants in future are discussed in chapter 2 of this report.

Figure 1-I
Road traffic growth with low and high forecasts



1.27 On past trends an increase on this scale in the use of cars would entail a further major decline in public transport. A projection based on the past statistical relationship between bus journeys and car ownership shows bus journeys halving by 2015.[39] There would be particularly serious implications for the substantial proportion of households which do not have regular use of a car and remain largely reliant on public transport. In 1994 32% of households were in that position,[40] although there were large regional variations. Over the last decade increases in car ownership have come about as much through an increase in the number of households with several cars as through acquisition of a car by households which did not previously have regular use of one.[41]

1.28 It has been suggested by the motor industry that even the low forecast may prove to be unrealistically high, and that the recommendations made in the Eighteenth Report on the basis of this forecast may have been unnecessarily stringent.[42] DOT commissioned a study of the methodology for forecasting traffic levels in conditions in which traffic growth is constrained by the capacity of the road network but no conclusions have yet appeared.[43] There must inevitably be considerable uncertainty attached to forecasts for 30 years ahead but there is no reason to suppose that the underlying forces which produced more than a doubling in road traffic between 1969 and 1989 have ceased to operate. Unless and until capacity-constrained forecasts using a new methodology are available, the National Road Traffic Forecasts provide the best indication of what would be likely to happen in the absence of fundamental changes in policies. We see no reason to depart from the judgement of the Eighteenth Report that they represent an unacceptable future.

Transport growth and the economy

1.29 The growth of transport in Britain over the last half-century has parallelled the growth of the economy as represented by gross domestic product (GDP). Movements of people have grown more rapidly than the economy, because of the growth of car travel.[44] Economic growth has exerted an influence on personal travel through rising incomes and increased car ownership.

1.30 Freight transport, measured in tonne-kilometres, grew broadly in line with the economy between 1952 and 1992.[45] However, the relationship is more complex than that may suggest because patterns of transport have changed. There has been no consistent long-term growth in the total weight of goods carried by all modes. The growth in freight transport has come about through an upward trend in the average distance over which goods are carried. Since 1983 that trend has been almost entirely the result of increases in the average distance over which goods are carried by road. As the statistics for road transport reflect only distances travelled in Great Britain,[46] and international road transport has also grown, the true increases in the distances over which goods have been carried have been even larger.

1.31 Over the whole period since 1952 the growth in freight transport has been predominantly in transport by road, with freight transport by rail showing a large decline.[47] Freight transport by water (overwhelmingly by sea) rose rapidly between 1952 and 1983 because of the growth of the North Sea oil industry, but has fallen back subsequently.[48] Over the most recent period for which statistics are available, from 1993 to 1995, road transport continued to grow, freight transport by rail fell, and both rail and water transport declined in relative importance.[49]

1.32 The 1996 Transport Green Paper referred to a progressive increase in transport intensity, in the sense that 'freight movements [by road and rail] have over many years outstripped growth in manufactured output or sales'.[50] The Eighteenth Report summarised calculations showing that the transport intensity of the economy has increased in a different sense, in that gross mass movement in the UK (the aggregate of movements of goods, people and the vehicles used for transport) increased from 2.6 tonne-kilometres equivalent for each £ GDP in 1952 to 3.1 tonne-kilometres for each £ GDP in 1992 (at 1985 factor cost).[51] A substantial part of this increase in gross transport intensity came from transport of people rather than of goods.

1.33 In 1996, DOT asked SACTRA to examine the links between transport investment, transport intensity and economic growth. In March 1997 SACTRA initiated consultation on the general questions it proposes to address.[52] Its report is expected in the latter part of 1998.

1.34 Bodies representing British industry have emphasised that 'an efficient transport network is a core ingredient in creating wealth, jobs and opportunity' and have pressed for adequate finance for sustainable transport policies. The Confederation of British Industry (CBI) called in December 1995 for annual investment in all types of transport infrastructure some £2 billion above the current level in order to make the UK's transport system as efficient as those of its main European competitors.[53]

1.35 Improvements to the trunk road network over the last thirty years have undoubtedly made a large contribution to economic growth. Many of the benefits may have been related to the creation of a network of roads of motorway or near-motorway standard. The national network between important centres of population is now broadly complete. It can therefore be argued that construction of further new roads will not make a comparable contribution to economic growth. Although there continue to be pressures for improvements to the network intended to reduce congestion, construction of further roads should be resisted at least until alternatives have been fully exploited, including methods of improving the use made of existing road capacity.

1.36 While some forms of damage caused by growth of transport can be mitigated by improvements in technology, that does not apply to increased land take for infrastructure or to increased congestion costs. There has come to be a widespread view that economic growth must be achieved in future without a corresponding growth in road traffic.[54] The 1996 Transport Green Paper said much greater effort had to be devoted to reducing the transport intensity of industrial activity.[55] The CBI, among others, has said that greater emphasis should be given by businesses to reducing the intensity of traffic growth resulting from economic growth.[56] A possible explanation for increased transport intensity of the economy, which we consider below, is that transport has been underpriced in relation to other inputs. In any event the costs of freight transport have fallen as a proportion of firms' total costs and in real terms.[57]

1.37 Movements of people are estimated to account for about 70% of the energy used in transport in developed countries.[58] Any significant shift in the relationship between the growth of car traffic and the growth of the economy is likely to depend on policies to reduce the average amount of travel per person for a given level of income and to increase the proportions of travel by public transport and by walking and cycling. The ways in which that might be achieved are discussed in chapters 4, 6 and 7.

Underpricing of road transport

1.38 In considering whether transport, in particular road transport, has been underpriced, we look first at the relationship between the costs of car use and the costs of public transport, then at the external costs transport users impose in the form of environmental damage, and finally at the cost road users impose on each other.

1.39 The trend has been for the costs of car use to decline while public transport costs have risen. Government statisticians have calculated changes in the real cost of various forms of transport since 1970. Between 1974 and 1994 rail and bus fares increased by 50–70% in real terms, slightly faster than the growth in disposable incomes. The cost of private motoring, on the other hand, has fallen by 2% in real terms. Car use is therefore much more affordable in relation to disposable incomes than it was 20 years ago.[59] This trend has continued over the last couple of years, despite the continuing policy of increasing fuel duty by at least 5% a year in real terms. Between 1993 and 1995 petrol and diesel costs increased by 4% in real terms, but overall motoring costs fell by 1%. In contrast, public transport fares increased, by 0.5% for buses and by 3% for rail. The cost of rail travel relative to car travel increased by 4%, and the relative cost of bus travel rose by 1%.[60]

1.40 Motoring has thus become cheaper relative to both disposable incomes and public transport alternatives. Moreover the cost of purchasing a new car has fallen in real terms (even without making any allowance for the progressive improvement in the specification of cars or trading up to models in a higher range[61]) and the consequential decline in second-hand car prices has made it easier for a wider range of people to acquire cars. Changes in the relative prices of public and private transport have reinforced the effect of increased incomes by encouraging even more people to become car

owners, and car owners to travel less by public transport. People have found themselves able to live further away from where they work, shop and relax, and to undertake more and longer trips.

1.41 Ownership of a car is often seen as essential for work or shopping. Moreover it is perceived as bringing important benefits of an intangible kind such as comfort, a feeling of security, a sense of empowerment and enhanced social status. When the decision has been taken to purchase a car, the outlay required is a fixed sum, either for outright purchase or for servicing a loan, which is unrelated to the number of miles driven or passengers carried. This sum therefore represents a *sunk cost* for the car user. The costs of insurance and some elements of garaging and maintenance are also sunk costs.

1.42 The operators of public transport, whether road or rail, also face a cost structure which includes large sunk costs. Even when the road or track is in place there is a capital cost for vehicles, locomotives and rolling stock. It is this cost structure (combined with 'peak load' problems) which induced British Rail to offer a variety of 'cards' to the old, the young, etc, by which the payment of a modest fixed sum entitled the purchaser to travel at less than the single journey fare for a set period – usually a year. The extreme form of this is the traditional 'season ticket' under which the holder can travel as frequently as he or she wishes for the duration of the ticket. Under this arrangement the marginal cost of an extra journey is zero. This is even lower than the marginal cost of a car owner's journeys. The fixed costs of bus companies are probably lower than those of rail operators but this does not fully explain their failure to offer two-part tariffs although both season tickets and discounts for multiple journeys are widely available.

1.43 A person who only plans one journey at a time will have to pay a fare that contributes to the operator's overheads and thus exceeds the marginal cost faced by a season ticket holder, a travel card holder, or a car owner. This is sometimes seen as implying that the spread of car ownership leads to an upward bias both in the growth of journeys in general and of private in preference to public transport. Whether such 'biases' exist depends in part on the rationality of people's decision to become car owners and of public transport operators' reluctance to offer appropriate two-part tariffs. What is certain is that public transport, especially rural and suburban buses, is an industry involving local economies of scale. With twice as many passengers on a route buses can be both larger and more frequent, thus simultaneously reducing the cost and raising the quality of the service. Someone becoming a car owner and largely ceasing to use buses contributes not only to road congestion, but also to raising the cost and lowering the quality of the bus service. This may encourage others also to switch from bus to car in a cumulative process. There is clearly an external effect here: other people have been affected by one person's switch of mode.

1.44 Another market failure which has inflated demand for all forms of transport is that the costs paid by transport users do not reflect the environmental damage and disbenefits caused by the use of land for transport infrastructure and by movements of vehicles. These include deaths and injuries; the more obvious effects on the environment such as noise, airborne pollution, visual intrusion and disruption of life; the more recently appreciated contribution to the threat of global warming through carbon dioxide and other greenhouse gas emissions; the loss of or damage to the amenity or conservation value of land. The failure to take these externalities into account has resulted in misleading price signals which over a long period have encouraged transport to grow more rapidly than would otherwise have been the case. While this factor affects all modes of transport, it has been particularly important in the case of car use and road transport of freight.

1.45 Different modes of transport differ in their impact on the environment. In general the environmental damage caused when land is taken to construct new transport infrastructure of any kind, and during construction, is a strong argument for making the most intensive use of existing infrastructure, other things being equal. The Eighteenth Report concluded that road transport of freight uses more energy, produces more pollution, is more likely to lead to deaths and injuries and uses more space than alternative modes, when these are available.[62] A Dutch study has subsequently concluded that rail transport of freight uses between a fifth and a half of the energy used by road transport and is more or less comparable in energy use to inland shipping.[63] Emissions of nitrogen oxides and hydrocarbons were also estimated to be much lower per tonne-kilometre in the case of rail, although there were large uncertainties in the figures.

1.46 For personal travel, walking and cycling have almost no environmental impact, although casualty rates remain worryingly high. Public transport is safer than car travel,[64] and a bus requires much less road space than cars with the same capacity. Calculations of the specific energy consumption for different modes of personal travel for longer distances are sensitive to the assumptions made about occupancy. The available evidence is summarised in box 1B.[65] Electrically powered rail, light rail and trolley bus have the important advantage in environmental terms that electricity can be generated from a variety of sources and that, if there are emissions from its generation, they can be more readily controlled than emissions from road vehicles.

BOX 1B ENVIRONMENTAL IMPACT OF PERSONAL TRAVEL

From the data available, the Eighteenth Report concluded that for longer-distance personal travel:

the most energy-efficient mode is express coach;

if all seats are occupied, there is little difference in energy efficiency between various types of train and a relatively efficient present-day car (1.1 litre petrol or 1.8 litre diesel);

at present average occupancies long journeys by most types of train are more energy-efficient than long journeys by all but the most economical cars.

It also concluded that, even if the fuel efficiency of new cars increases by 40%, trains will still possess some advantages over cars in most circumstances, allowing for a smaller improvement in the energy efficiency of trains and higher average occupancies.

A subsequent Dutch study found that on average specific energy consumption for trains is half that for cars, and carbon dioxide emissions less than half those for cars. Energy consumption for buses is about two-thirds that for cars.

A study of London found that energy consumption for the Underground is 40% of that for cars, and carbon dioxide emissions 60% of those for cars. At present the Underground uses more energy than buses but is expected to become comparable with them, and possibly superior, when inefficient generating plant is shut down.

The comparison for other emissions depends on fuel used and age of vehicles. The Dutch study found the introduction of three-way catalytic converters for cars had reduced the advantage of trains over cars in emissions of nitrogen oxides from a factor of ten to a factor of two, although trains retain a greater superiority in hydrocarbon emissions. Similarly, the London Underground offers significant benefits over cars in emissions of nitrogen oxides and particulates, although emissions of sulphur dioxide are higher.

The Dutch study found buses emitted more nitrogen oxides then catalyst-equipped cars. For average London occupancies buses produce more particulates and sulphur dioxide than cars but less of other pollutants.

Note: All comparisons are in terms of energy consumption or pollutant emitted per passenger-kilometre.

1.47 There are other social costs imposed by transport users. When the traffic flow on a road reaches a certain level the addition of a further vehicle has the effect of reducing the speed of other vehicles. The delays and other disbenefits which road users thus impose on each other are termed *congestion costs*. The cost imposed by an extra vehicle tends to increase with the level of traffic, mainly because more vehicles are subject to any consequential delay.

1.48 To the extent that environmental and social costs are not brought to bear on users' travel decisions, through appropriate taxes or charges, road transport can be said to be underpriced and as

a result will tend to be both more extensive and more damaging than it would be if due account were taken of full costs. The gap between the private and social costs of road transport has widened in recent years as congestion has grown. The growth of road transport has therefore exceeded the optimum by a widening margin.[66]

Estimates of environmental and social costs

1.49 The Eighteenth Report looked at the evidence of a number of studies which had attempted to quantify and to value in money terms the environmental and social costs of transport, either separately or in aggregate. This evidence was used to derive broad estimates of environmental and social costs other than congestion costs, while acknowledging the very considerable difficulties both of estimating the effects of damage and of assigning money costs to them. Important elements of the costs could not be quantified in this way, even within the very large margins of error accepted, and had to be excluded from the calculations. The most important of these were loss of habitat, degradation of landscape and destruction of cultural assets, and disruption of communities.

1.50 The broad estimates of environmental and social costs in the Eighteenth Report included the full costs to the community in congested conditions of pollution, noise and other intrusive social effects, but not the congestion costs which road users impose on each other. It was recognised that congestion costs are social externalities and lead to an inefficient use of roads, but they were not included in estimates of the costs to the community. On this definition environmental and social costs were estimated to be between £10.9 billion and £20.5 billion a year for all UK transport in 1994 prices; and environmental and social costs attributed to road transport were estimated to be between £10.0 billion and £18.3 billion. The true total was considered to be substantially greater, because of the unquantified costs.[67]

1.51 This was one of the issues on which we particularly sought recent material of a factual or analytical kind when we announced the present review. Estimates of the overall external costs of road transport, by type and in total, have been made by Newbery[68] and by Maddison and Pearce.[69] As table 1.1 shows, their estimates of the types of cost quantified in the Eighteenth Report span an even wider range, from £8 billion to £32 billion a year. In 1993 Pearce estimated the cost of air pollution at £2.4 billion a year,[70] but with Maddison he revised this to £19.7 billion in 1995 on the grounds that new research findings had suggested the health effects of pollutants are more serious than

Table 1.1
Road transport: quantified environmental and social costs

GB
£ billion a year in 1994 prices

	Eighteenth Report	Newbery	Maddison and Pearce
air pollution	2.0–5.2	2.8–7.4	19.7
climate change	1.5–3.1	0.4	0.1
noise and vibration	1.0–4.6	0.6	2.6–3.1
total environmental costs	4.6–12.9	3.8–8.4	22.4–22.9
road accidents	5.4	4.5–7.5	2.9–9.4
quantified social and environmental costs other than congestion costs	10.0–18.3	8.3–15.9	25.3–32.3
congestion costs[1]	not included	19.1	19.1
total road transport externalities[2]	see paragraphs 1.49–1.50	27.4–35.0	44.4–51.4

1. The costs of delays to road users and operators and increased running costs at slow speeds in congested conditions.
2. Not including the costs of damage by vehicles to roads, which both Newbery and Maddison and Pearce included in the total; the Eighteenth Report showed separately the costs of providing, maintaining and operating roads.

previously believed. Although the 1996 Transport Green Paper discussed the scope for improving estimates of environmental costs, it will remain impossible to estimate them with precision. Caution must therefore be applied in interpreting such estimates. Nonetheless we consider they provide a valuable, if very broad, indicator of the scale of harm caused by road transport, and the distortion of resources that is likely to result.[71]

1.52 The distinction drawn in the Eighteenth Report between costs borne by road users as a group and costs which are borne in part by non-road users has been criticised. Both Newbery and Maddison and Pearce considered that estimates of the total environmental and social costs of road transport ought to include congestion costs, for which they used the same valuation of £19.1 billion a year. An estimate by the CBI put the cost of congestion to industry at £15 billion a year. Estimates of congestion costs are produced by comparing the current position with the notional situation in which traffic on all roads was completely free-flowing.

Case for greater internalisation of environmental and social costs

1.53 It is an accepted tenet of economics that for efficient resource allocation all externalities should be internalised: that each user should by some means face the full cost of the effects of his or her individual decisions. This can be achieved through charges and other economic instruments designed both to induce less harmful transport use and (through the revenue raised) to compensate the community for such damage as remains. Direct regulation may also limit the environmental harm done, but will impose costs for compliance and enforcement. Internalisation is seen as a prerequisite for a socially efficient transport system: if misleading price signals are corrected, the result should be a more efficient use of resources.[72]

1.54 Responses to the Eighteenth Report and contributions to the national debate reflected a widespread acceptance that transport users should bear the full cost of all environmental and social damage and of measures to reduce it, despite differences of view about what those costs are. The 1996 Transport Green Paper identified as one of the 'key principles' that 'Strengthening the link between prices and the wider costs of transport will tend to increase efficiency and reduce unnecessary environmental impacts'.[73] Moreover internalisation of costs provides a strong incentive for innovation and the development of new forms of technology that are less damaging to the environment.

1.55 The European Commission's Green Paper, *Towards fair and efficient pricing in transport*, identifies as the most efficient option a tax system differentiated according to mileage, place, time, and amount of air pollution and noise created. For practical purposes, however, it argues that it is not important to calculate the exact level of the externalities, provided the direction and order of magnitude of the required changes are known. In view of the difficulties in valuing external costs and in identifying the costs associated with particular roads and users, the Eighteenth Report also considered optimal road-by-road and time of day levels of charging to be impractical. Its approach was to propose the setting of targets for reducing environmental damage. Action taken to achieve these targets would be likely to bring about a closer relationship between the full costs of transport and the benefits transport yields.[75]

1.56 We discuss in the later chapters, in particular chapter 6, how taxes and charges can be best used to remedy some of the distortions created by underpricing. We are conscious of the desirability of ensuring that measures to confront companies with the full costs of their use of transport do not unduly reduce the competitiveness of UK industry.

The purpose of this review

1.57 For some time there has been a broad consensus about the direction of transport policies – those policies should be directed to ensuring the existence of an efficient transport system which meets the needs of business and leisure while reducing damage to the environment. This broad consensus conceals disagreements about the ultimate goal of change – some would wish to eliminate environmental damage of certain types entirely, whereas others would maintain that environmental damage which occurs after the internalisation of all costs (that is, after the correction of market

failure) or which is warranted by cost-benefit analysis, should properly be tolerated. However that may be, there is agreement about the general direction of policy and, furthermore, that making transport users bear their full costs will take us in that direction.

1.58 Our concern is that recent action has been too little and too slow to provide the prospect of a substantial shift in transport trends. This has left a vacuum in which there is a danger that, if credible alternatives are not being pursued, the pendulum could swing back to demands for a large road-building programme. That is what happened in the late 1980s after a period of reduced road building. There is a need for considerably increased investment in public transport. That is not at present in prospect, from either public or private sources, on the scale required. There is equally the need to ensure that the road system is maintained to a high standard and used efficiently, and that new technological options are explored.

1.59 Because of the crucial significance we believe issues about transport continue to have for sustainable development we decided it would be helpful to carry out our own review of developments over the last three years. Since 1994 there have been a large number of official reports, and reports by other bodies, on various aspects of transport; and we have tried to take as many as possible of these into account. Some of them made specific criticisms of the Eighteenth Report: we have dealt with such criticisms where they are directly relevant to the argument of this review, but we have not sought to make this review a detailed defence or justification of the Eighteenth Report.

1.60 We announced this review in October 1996 in a news release (reproduced as appendix B). The way in which the review was conducted is described in appendix C: we are most grateful to the many organisations and individuals who submitted material in response to our invitation or willingly provided information to the Secretariat on request, and who are listed there.

1.61 This review has a narrower scope than the original report. It focuses on the critical issues affecting the future development of inland surface transport. The Eighteenth Report dealt briefly with the environmental impact of shipping[75] but only to the extent of endorsing the recommendations of the Donaldson Inquiry published in 1994,[76] most of which are now being implemented, while others are still under consideration by the government. Following the grounding of the Sea Empress in 1996, Lord Donaldson has agreed to conduct an independent review of salvage and intervention operations and their command and control.[77] Air transport was considered at some length in chapter 5 of the Eighteenth Report but, as it is such a large subject in its own right, and as effective regulation can be undertaken only on a global basis, we decided not to include it in the present review.

1.62 Our functions under the royal warrant cover the whole of the United Kingdom. The challenge of creating an effective transport system that is environmentally sustainable is being faced equally in England, Scotland, Wales and Northern Ireland. Where that can be readily done, the information given in this report relates to the UK. Unless otherwise indicated, however, statistics relate to Great Britain (England, Scotland, Wales) because this is the area for which official transport statistics are compiled and published. In reviewing developments in policy since 1994, we decided it was best to simplify both analysis and presentation by concentrating on developments in England; in general therefore we have not sought to cover developments over the same period in Scotland, Wales and Northern Ireland. However, we regard our main conclusions as applicable to all parts of the UK. We comment briefly at the end of chapter 7 on the present status and future prospects of transport policies in Scotland, Wales and Northern Ireland.

Structure of this report

1.63 The structure of the remainder of the report is as follows. First we look at the scope for improvements in technology that would make the transport system less damaging to the environment. **Chapter 2** looks at emissions and fuel consumption, which are primarily attributable to road vehicles. It examines developments in reducing health-related emissions and increasing fuel efficiency, and the scope for introducing further improvements through new technology induced by direct regulation and/or the use of increased fuel duty and other economic instruments. The emphasis is on measures to make individual vehicles less polluting, but some of the measures will also directly or indirectly discourage journeys of marginal value. **Chapter 3** deals with measures to counter noise from roads

and railways; as well as modifications to vehicles, these involve the road surfaces and track used and the extent of screening provided.

1.64 The next part of the report considers how environmental damage could be reduced by changing transport patterns. **Chapter 4** reviews the categories of regular journey for which alternatives to the car could be used, and considers more generally how alternative modes of personal travel can be made more attractive. It emphasises the need for public transport systems to be integrated. **Chapter 5** considers how alternative modes of freight transport can be made more attractive and how road freight can be organised more efficiently. **Chapter 6** discusses how the existing road network can be used more efficiently, focusing on the different options available for internalising costs. **Chapter 7** considers how integrated public transport systems should be planned and financed. It looks at how other factors, such as the location of housing growth, need to be taken into account.

1.65 **Chapter 8** summarises our conclusions. It discusses in what senses transport systems need to be integrated. It considers what can be achieved by market forces and private investment, and why the role of central government is crucial. It emphasises that success will require coherent and balanced packages of incentives and restraints, appropriately scheduled over a lengthy period, but with a due regard to urgency. It considers the contributions that have to be made by firms and individuals, and the institutional requirements for a more sustainable transport policy at each level of government – local, regional, national, European.

1.66 We have not made recommendations in this report. We hope our conclusions will nevertheless have sufficient clarity and relevance to be of value to the government, to Parliament, and to all those involved in debating the future of transport policies.

Reducing environmental damage through technology

Chapter 2

CLEANER AND MORE EFFICIENT ROAD VEHICLES

What is being done, and what more could be done, to reduce the environmental impact of individual road vehicles? European legislation is reducing emissions of regulated pollutants. Further measures will, however, be needed to ensure that, in the face of rising traffic levels, changes in vehicle specifications produce sufficiently large improvements in air quality. Greater emphasis than hitherto must be placed on reducing carbon dioxide emissions from road vehicles to ensure that the transport sector makes an appropriate contribution to meeting challenging UK and global targets for greenhouse gas reduction. Rapid technological innovation will be required.

2.1 The number of road vehicles in Britain almost doubled between 1970 and 1995, and is continuing to increase.[1] The Commission's Eighteenth Report made a disturbing assessment of the resulting impact on the environment. One dimension is the use of non-renewable materials and energy in manufacturing vehicles.[2] Targets were proposed in the Eighteenth Report for the proportions of vehicles and tyres recycled (targets G1 and G2, see appendix A). We are not revisiting that issue here.[3] The importance of such recycling is now generally acknowledged; we hope the efforts being made by many motor manufacturers to design their products in ways that facilitate recycling will have the intended results in practice.

2.2 Other dimensions of the environmental impact of road vehicles depend, not only on their number, but on the use made of them. The deaths and injuries caused by traffic and the other adverse effects it can have on the quality of life in communities raise issues about urban design and management of the road network which we discuss in chapters 4, 6 and 7.

2.3 The Eighteenth Report emphasised the need to reduce three types of pollution: the damage emissions cause to air quality, and hence to health and the natural and built environment; emissions of the greenhouse gas carbon dioxide; and noise. All three types of pollution can be mitigated by improvements in technology. Chapter 3 covers the prospects for reducing noise from surface transport and this chapter deals with emissions from road vehicles. After reviewing briefly the effects of air pollution, we discuss the setting of air quality objectives for the UK and Europe and the measures being proposed in relation to the road transport sector in order to achieve those objectives. We then look at the need to reduce fuel consumption by road transport as a contribution to countering global climate change and at the measures being adopted for that purpose. We go on to discuss the interactions between controlling these two forms of pollution, and the attractions of more or less radical changes in fuel and applied vehicle technologies. We assess the prospects for achieving targets for reducing carbon dioxide emissions and objectives for air quality, and conclude that improvements in technology will have to be supplemented by measures of other kinds which we discuss in a later part of this review.

Improving air quality

2.4 The eight pollutants identified for priority action under the National Air Quality Strategy (2.17) are listed in table 2.1.[4] Road vehicles are the main source of atmospheric emissions of benzene, 1,3-butadiene, carbon monoxide, lead and nitrogen oxides; and a major source of volatile organic compounds (VOCs), which take part in the chemical processes in the atmosphere that produce the priority pollutant ozone. VOCs encompass many hydrocarbon compounds, including the two priority pollutants benzene and 1,3-butadiene. Road vehicles are also a significant source of particulates, usually measured as PM_{10} (particulate matter less than 10 μm in diameter), as this is a better indicator than other parameters, such as black smoke, of the type of particle considered most likely to be deposited in the lung. Although road vehicles are estimated to produce only 26% of PM_{10} emissions nationally,[5] many of the other sources are not present in cities, where vehicles account for over 80% of primary emissions.[6] Rail vehicles are also a source of many of these pollutants, but in much smaller amounts which are likely to have only localised effects.[7]

Table 2.1
National Air Quality Strategy: standards, objectives, reported exceedances in 1995

UK

	standard	objective	sites at which standard was exceeded in 1995
benzene	5 ppb as running annual mean (EPAQS)	achieve standard by 2005	none, but likely to be exceeded at the side of heavily trafficked urban roads
1,3–butadiene	1 ppb as running annual mean (EPAQS)	achieve standard by 2005	none; unlikely to be exceeded except at a few urban background sites (or at the side of heavily trafficked roads)
carbon monoxide	10 ppm as running 8-hour mean (EPAQS)	achieve standard by 2005	West London (4 exceedances on two days) and Belfast City Centre (13 exceedances on three days)
lead	0.5 $\mu g/m^3$ as annual mean (WHO)	achieve standard by 2005	a few industrial monitoring sites; unlikely to be exceeded in urban areas
nitrogen dioxide	150 ppb as 1-hour mean (EPAQS) 21 ppb as annual mean (WHO)	*achieve both standards by 2005*	for 1-hour mean, seven urban sites on up to five days each (all but two urban sites would have exceeded the annual standard), no rural sites
ozone	50 ppb as running 8-hour mean (EPAQS)	*achieve standard at 97th percentile by 2005 (that is, standard can be exceeded on 10 days of the year at any site)*	frequent exceedances at both urban and rural sites, with greater frequency in uplands and parts of south-east England closest to the continent and lowest frequency in Scotland and Northern Ireland
fine particles (PM_{10})	50 $\mu g/m^3$ as running 24-hour mean (EPAQS)	*achieve standard at 99th percentile by 2005 (that is, standard can be exceeded on 4 days of the year at any site)*	some urban sites on up to 40–50 days, especially in London, Liverpool, Swansea and Belfast (where coal is still a major domestic fuel); all urban sites between 1992 and 1995, winter and summer, with higher readings in winter
sulphur dioxide	100 ppb as 15-minute mean (EPAQS)	*achieve standard at 99.9th percentile by 2005 (that is, standard can be exceeded for 35 15-minute periods during the year at any site)*	all except the two most remote continuous monitoring sites, with highest frequency in industrial and coal-burning areas; grounding of plumes from power stations also a factor

objectives in italics are provisional

EPAQS —standard recommended by the UK Expert Panel on Air Quality Standards
WHO —guideline recommended in the latest revision of the World Health Organization Air Quality Guidelines (not yet published)

2.5 There were deficiencies in the monitoring of air quality at the time of the Eighteenth Report; the Eighteenth Report endorsed the recommendations for improvements made by the Quality of Urban Air Review Group.[8] A rationalised and much expanded UK system now has automatic monitoring equipment at over 80 sites (including some operated by local authorities), organised in urban, rural and hydrocarbon networks; further expansion of the networks is in progress.[9] The final column in table 2.1 summarises the extent to which, according to the latest data from the automated networks, UK air quality breaches the standards in the National Air Quality Strategy.[10]

Health effects of transport-related pollutants

2.6 The Eighteenth Report expressed concern that emissions from road vehicles might be causing serious damage to human health and concluded there was a clear case for increasing the precautionary action taken to improve air quality, especially by reducing concentrations of particulates and nitrogen oxides.[11] Nothing has happened subsequently to make the Commission take a different view. In the following paragraphs are summarised the results of assessments in the UK since the Eighteenth Report. They indicate the continuing difficulty of reaching firm and quantified conclusions in this very complex area of research.

2.7 For asthma there are differences between the expert view and public perceptions of the relationship between air pollutants and adverse health effects. While the causes of asthma are still uncertain, it remains the case that there is no clear evidence that vehicle emissions cause it to develop. Whereas the Eighteenth Report drew attention to studies suggesting that individuals suffering from respiratory disorders, including asthma, may experience a worsening of symptoms when there are elevated ambient levels of nitrogen dioxide and associated pollutants, especially particulates,[12] the most recent expert view is that any effects of air pollution in this respect are small compared to other factors. A sub-group of the Department of Health's (DH's) Committee on the Medical Effects of Air Pollutants (COMEAP)[13] concluded that, although the prevalence of asthma has increased in the UK over the past 30 years, most of the available evidence does not support a causative role for non-biological outdoor air pollution. As to worsening of symptoms, it concluded that the effect of air pollution, if any, was small and relatively unimportant when compared with other factors known to provoke asthma attacks, such as infections or allergens; and that most asthmatic patients should be unaffected by exposure to such levels of non-biological air pollutants as commonly occur in the UK.

2.8 COMEAP found little or no association between the regional distribution of asthma and that of air pollution; studies comparing high and low pollution areas have not found consistent associations between outdoor air pollution and asthma prevalence; and there is no convincing evidence that asthma is more common in urban areas than in rural areas of the UK. Limited evidence from the UK and other countries suggests a modest relationship between asthma prevalence and proximity to traffic but this is difficult to reconcile with the apparent lack of urban-rural variation and the absence of a marked excess of asthma or allergic disease in studies of workers heavily exposed to traffic. A complication is the far from straightforward relationship between traffic exposure and pollutant exposure.[14] COMEAP commented that, until local traffic density has been more thoroughly validated as an indicator of personal exposure to specific pollutants of interest, it will remain difficult to place a causal interpretation on findings that suggest a relationship with proximity to traffic.

2.9 Concern about health effects attributed to particulates was endorsed by COMEAP's Working Group on Fine Particles, which concluded that:[15]

> the reported associations between daily concentrations of particles and acute health effects, including measures of lung function and mortality and hospital admissions from respiratory diseases, reflect a real relationship and are not the effect of confounding factors;
>
> it would be imprudent not to regard the demonstrated associations between daily concentrations of particles and acute effects on health as causal;
>
> although the evidence is more limited than for acute effects, it would be prudent to consider the association between long-term exposure to particles and chronic health effects as causal.

2.10 Although clear evidence on this point is lacking, it is presumed that the acute effects are observed in people with pre-existing illnesses. COMEAP considered there was no evidence that

healthy individuals are likely to experience major acute health effects as a result of exposure to the concentrations of particulates found in ambient air in the UK. More research was recommended in order to improve predictions of the likely effects of exposure to particles and investigate the possible mechanisms.

2.11 Some recent research attempting to establish a biologically plausible mechanism for the health effects of particulates points to oxidant pathways triggered by metals in particles, such as iron, nickel and chromium, and an important link between these pathways and increased blood viscosity and clotting capacity. Whereas most studies have involved particulates less than 10 μm in diameter (PM_{10}), research points to an important role for the smallest particles or ultra-fine fraction (less than 0.1 μm in diameter).[16] The US Environmental Protection Agency has proposed a national ambient air quality standard for particles less than 2.5 μm in diameter.[17]

2.12 The Eighteenth Report emphasised the need for further research into the health effects of both individual transport-related pollutants and substances in combination.[18] The view expressed by the DH Advisory Group on Medical Aspects of Air Pollution Episodes is that such evidence as exists indicates that the effects of a mixture of pollutants are likely to be the sum of their individual effects.[19]

2.13 It remains very difficult to assess the overall effects on human health from current levels of air pollution. The Eighteenth Report drew attention to quantitative American studies, the results of which, if extrapolated to this country, suggested that PM_{10} may be responsible for as many as 10,000 advanced deaths a year in England and Wales;[20] these are likely to be of people who are already ill. This is a very tentative, maximal estimate; it assumes that PM_{10} in the UK has the same composition and the same effect as that in the USA and, because it relates to the effect of exposure to ambient PM_{10} concentrations compared to no exposure, it is not helpful in estimating what the effect of reducing exposures by less than 100% would be. COMEAP concluded that although the findings of US and other epidemiological studies could be transferred at least qualitatively to the UK, there were insufficient UK data available to establish the reliability of quantitative predictions of the effects of particulates on health.[21] DH has estimated that air pollutants generally (not solely from road transport) are responsible each year for several thousand advanced deaths, for 10,000–20,000 hospital admissions and for many thousands of instances of illness, reduced activity, distress and discomfort.[22] However, recent studies of hospital admissions and deaths in London as a result of respiratory illness or coronary heart disease suggest that these figures may be too high.[23]

Damage to the natural and built environment

2.14 We emphasise that human health is not the sole criterion in judging air quality. The effects on crops, livestock, biological diversity, ecological systems and the built environment must also be taken into account. The Eighteenth Report highlighted the effects of nitrogen dioxide and ozone on plants and the effects of nitrogen compounds in causing acidification and eutrophication of waters and soils.[24] Work carried out under the auspices of the United Nations Economic Commission for Europe (UNECE) has helped establish greater international scientific consensus about the effects of air pollutants on ecosystems than exists for human health effects. The Commission's Nineteenth Report examined the effects of pollutant deposition on soils and drew attention to studies of the likely effectiveness of existing targets for reducing emissions.[25] It recommended further action to reduce emissions of nitrogen compounds.[26]

Objectives for air quality

2.15 An European Community (EC) Framework Directive on Ambient Air Quality Assessment and Management was adopted in September 1996 and will lead to the replacement and extension of standards and guidelines for air quality contained in earlier EC legislation.[27] The provisions of the Directive are summarised in box 2A.[28] Its purpose is to avoid, prevent or reduce harmful effects, not only on health, but on 'the environment as a whole'.

2.16 In the UK, part IV of the Environment Act 1995 has led to the development of air quality policy in advance of the EC Framework Directive. A duty was placed on the Secretary of State to prepare, and from time to time review, a strategy for the management and improvement of air

BOX 2A **EC FRAMEWORK DIRECTIVE ON AMBIENT AIR QUALITY ASSESSMENT AND MANAGEMENT**

The Framework Directive on Ambient Air Quality Assessment and Management introduces the European Union-wide establishment of long-term ambient air quality objectives and requires air pollution levels to be monitored and communicated to the public. A series of Daughter Directives to the Framework Directive will establish specific requirements on sampling, measurement techniques and other air quality assessment methods, as well as specifying air quality limit values (and dates for their attainment) and/or alert thresholds for individual pollutants as appropriate. The four existing air quality Directives on sulphur dioxide and suspended particulates, lead, nitrogen dioxide and ozone will be superseded. Member States will have to draw up reduction plans for those areas where limit values are being or are likely to be exceeded.

Limit values will be based on scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period and not to be exceeded once attained. Because of the transboundary nature of the ozone problem, limit values will not be proposed for this pollutant. Alert thresholds will be set at levels beyond which there is a risk to human health from brief exposure and at which immediate steps shall be taken by Member States to inform the public. Limit values for ecosystem protection will be based on critical levels for individual pollutants.

The actual limit values and long-term objectives set by the European Commission will be determined by working groups on individual pollutants. The Commission is responsible for ensuring that the working groups take account of the most recent scientific research data in the epidemiological and environmental fields concerned.

The European Commission is committed to a heavy legislative schedule in fulfilling the requirements of the Directive. The working groups have completed their work on sulphur dioxide, nitrogen dioxide, lead and particulates and proposals for these Daughter Directives are expected in summer 1997. Working groups on benzene, carbon monoxide and ozone are in progress, those on polycyclic aromatic hydrocarbons (PAHs), cadmium, arsenic, nickel and mercury have yet to start.

quality;[29] and a duty was placed on local authorities to review and assess the quality of air in their areas and the sources of air pollution, and to take action where air quality standards are breached or at risk of being breached.[30] In most areas the main source giving rise to a risk of such breaches is road vehicles. The regulations to bring the new system of local air quality management into effect and guidance on how local authorities should take forward their new responsibilities have been delayed.

2.17 The National Air Quality Strategy was published in March 1997, following consultation. The end date for the Strategy, 2005, matches the end date of the two targets for air quality proposed in the Eighteenth Report, which were:

> to achieve full compliance by 2005 with World Health Organization (WHO) health-based air quality guidelines for transport-related pollutants;
>
> to establish in appropriate areas by 2005 local air quality standards based on the critical levels required to protect sensitive ecosystems.[31]

2.18 Table 2.1 shows the standards and objectives in the Strategy for the eight priority pollutants. In the sense used in the Strategy, *standards* are benchmarks or reference points for air quality set purely with regard to medical and scientific evidence about the effects of a particular pollutant on public health; and *objectives* are policy targets set by the government in the light of the air quality standards and a judgement about what is achievable and justified in terms of costs and benefits. Most of the standards in the Strategy represent recommendations by the government's Expert Panel on Air

Quality Standards (EPAQS), which in some cases differ from WHO's recommendations. The remaining standards represent WHO's recommendations.

2.19 In rejecting the target proposed by the Eighteenth Report for establishing local air quality standards to protect ecosystems, the 1996 Transport Green Paper said that the science was not yet advanced or refined enough to set critical levels for specified pollutants which cannot be exceeded without damaging specified ecosystems; and that determination of such levels should also take account of the costs and benefits of ensuring compliance.[32]

2.20 Alternative bases for air quality standards will be discussed in our forthcoming report on environmental standards. For the purposes of the present review, we have assumed that the objectives in the National Air Quality Strategy represent broad acceptance of the Eighteenth Report's target for compliance with WHO health-based guidelines, and have concentrated on the prospects of achieving the objectives and maintaining the desired level of air quality after 2005 (2.89–2.98). The Strategy does not contain separate standards or objectives to protect ecosystems. Such standards would in some cases be more stringent and take longer to achieve.

2.21 When the Strategy was published, it was said that a first review would be initiated in 1999. The government now regards this review as being wider and more fundamental in nature and it has been brought forward with a view to producing conclusions by 1998.[33] The Strategy is nevertheless subject to change in several respects:

the objectives for nitrogen dioxide, ozone, particulates and sulphur dioxide were regarded as provisional;

the UK will be bound by the limit values and the target dates for their achievement set for individual pollutants in Daughter Directives under the EC Framework Directive (box 2A). Where necessary, separate limits will be applied outside built-up areas with the intention of protecting sensitive ecosystems and in specified areas to protect vulnerable buildings or monuments;

EPAQS recommended a review of some standards, including those for benzene, PM_{10} and 1,3-butadiene and the long-term standard for nitrogen dioxide. For PM_{10} the review will examine the case for developing standards for alternative measures of particulates;

the possibilities of extending the Strategy to other pollutants will be examined.

2.22 Under the UNECE Convention on Long-Range Transboundary Air Pollution, the UK and other countries are committed to reduce total emissions of pollutants that are carried across international boundaries. The Strategy incorporates the programmes required to comply with protocols to the Convention for the limitation and gradual reduction of emissions of nitrogen oxides and VOCs, as well as sulphur dioxide.

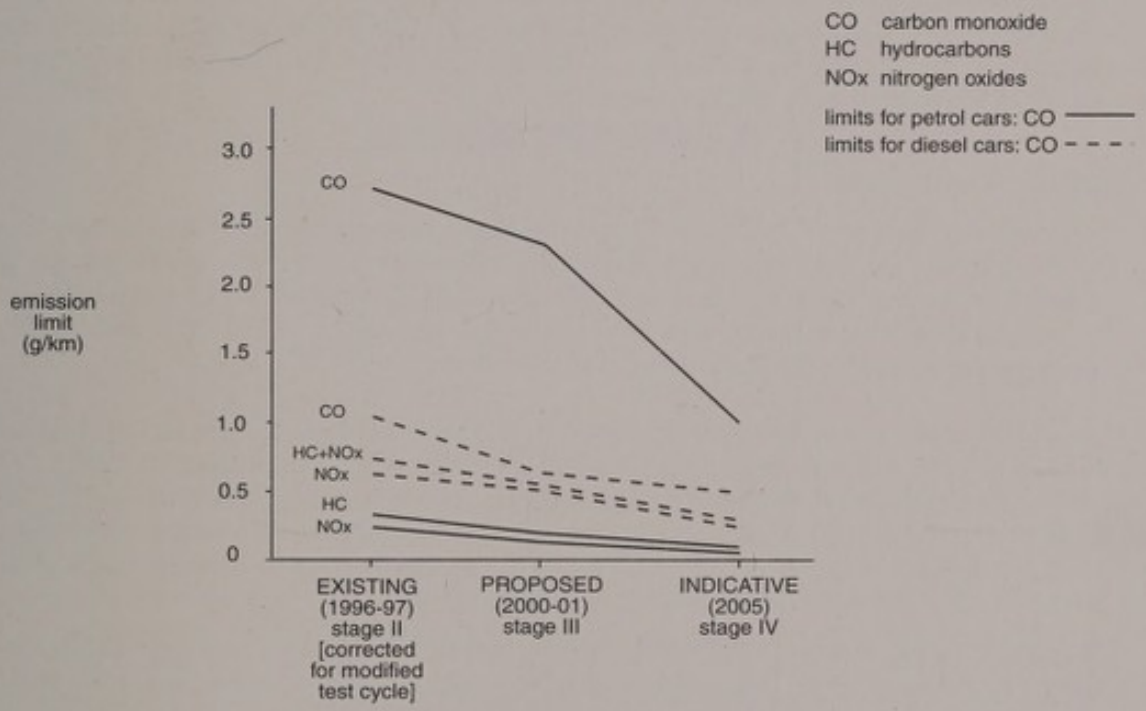
2.23 Further international commitments may be entered into, in particular to reduce levels of ozone across north-west Europe. A Ministerial Conference held in London in 1996 by eight northern European countries set a target of reducing current emissions of the precursors of ozone – nitrogen oxides and VOCs – by about 60%.[34] It called on UNECE and the European Union (EU) to move rapidly towards a pan-European ozone strategy, with a second UNECE Nitrogen Protocol as the first step. Based on the critical loads approach, this is intended to take into account all the effects of nitrogen oxides and may also cover VOCs.

2.24 The establishment of an Air Quality Forum was proposed by the Department of the Environment (DOE), bringing together representatives of all interests, to ensure that implementation of the National Air Quality Strategy is carefully monitored and reviewed, and that future priorities are identified in preparation for the first review.[35] We support the idea of such a forum; and believe its membership should include bodies involved in nature conservation and, to complement the medical advice available from COMEAP, the scientific members should include some with knowledge of UNECE's work programme on the natural environment.

EC legislation on vehicle emissions

2.25 The primary instruments for reducing emissions of pollutants from road vehicles are the standards for new vehicles and for the quality of motor fuels prescribed by EC legislation. New limits on emissions (stage III) are due to come into force in 2000 for new types of car and in 2001 for all new cars. The European Commission's proposed limits for emissions of carbon monoxide, hydrocarbons and nitrogen oxides are shown in figure 2-I, with the proposed indicative limits for stage IV in 2005.[36] The existing limit for particulate emissions from diesel passenger vehicles (1996–97, stage II) is 0.08 g/km; proposals for future limits are 0.05 g/km in 2000–01 (stage III) and an indicative limit of 0.025 g/km in 2005 (stage IV). The test cycle on which compliance is assessed now includes the 40-second idling period immediately after engine ignition, when emissions are highest. This goes some way to meet the recommendation in the Eighteenth Report that the test cycle should 'adequately represent typical operating conditions',[37] although the differences in ambient temperature in different European countries are still not taken into account.

Figure 2-I
EC emission limits for cars: existing, proposed and indicative



In stage II combined limits were set for HC and NOx; the separate limits shown above assume HC: NOx ratios of 55:45 in emissions from petrol cars and 10:90 in emissions from diesel cars.

For diesel cars limits are also set for particulates.

2.26 In order to prepare proposals for stage III the European Commission undertook a joint study with Europia and ACEA (the European trade associations for the oil and motor industries), the Auto/Oil Programme, to examine the cost-effectiveness of a wide range of measures for improving air quality. The methodology is described in appendix D. The fuel quality proposals which emerged from the Auto/Oil Programme are dealt with in the next section (2.29–2.33). During 1997 further proposals are expected on emission limits for light commercial vehicles and heavy duty engines and on strengthening inspection and maintenance requirements for all vehicles (see 2.49–2.51).

2.27 The European Commission is expected to put forward proposals by 31 December 1998 for a further Directive setting stage IV limits for cars. The indicative limits shown in figure 2-I are based on 'an assessment of the most promising environmental technologies under development', with the aim of giving Member States uniform criteria for using fiscal incentives to stimulate improvements in technology and the motor industry the advance notice needed to plan for their mass production. The

motor and oil industries oppose plans for tighter standards in 2005 on the grounds that the stage III legislation will enable air quality objectives to be met. On the basis of our own assessment we support the principle of providing indicative limits for 2005 as a clear signal to industry that emission limits will become more stringent in future.

2.28 The European Parliament proposed in January 1997 that the limits for hydrocarbon emissions from petrol-engined cars in 2000 should be more stringent than European Commission proposals (0.12 g/km rather than 0.20 g/km) and that separate limits for hydrocarbon and nitrogen oxides emissions from diesel cars should be put in place for 2000 (0.1 g/km and 0.40 g/km respectively, rather than the proposed nitrogen oxides limit of 0.50 g/km and the combined limit of 0.56 g/km). The European Commission's proposals for 2000 and 2005 were, however, agreed by the Council of Environment Ministers in June 1997 and go forward to the next stage in the co-decision procedure with the European Parliament. The stage III limits represent a relatively modest improvement on stage II. Although introduction in stage III of a separate limit on emissions of nitrogen oxides from diesel vehicles provides the basis for more precise control, the proposed limit is more than three times higher than the proposed limit for petrol vehicles. Considerable resources are being invested in developing emission control technologies for diesel engines, but progress towards a catalyst for removing nitrogen oxides has been slower than was hoped.[38] The indicative limits for 2005 presuppose that such a catalyst will be in large-scale commercial production by then, as will particulate traps for diesel engines and catalysts that are effective in dealing with emissions from petrol engines starting from cold (or other technologies with an equivalent effect).[39]

EC legislation on motor fuels

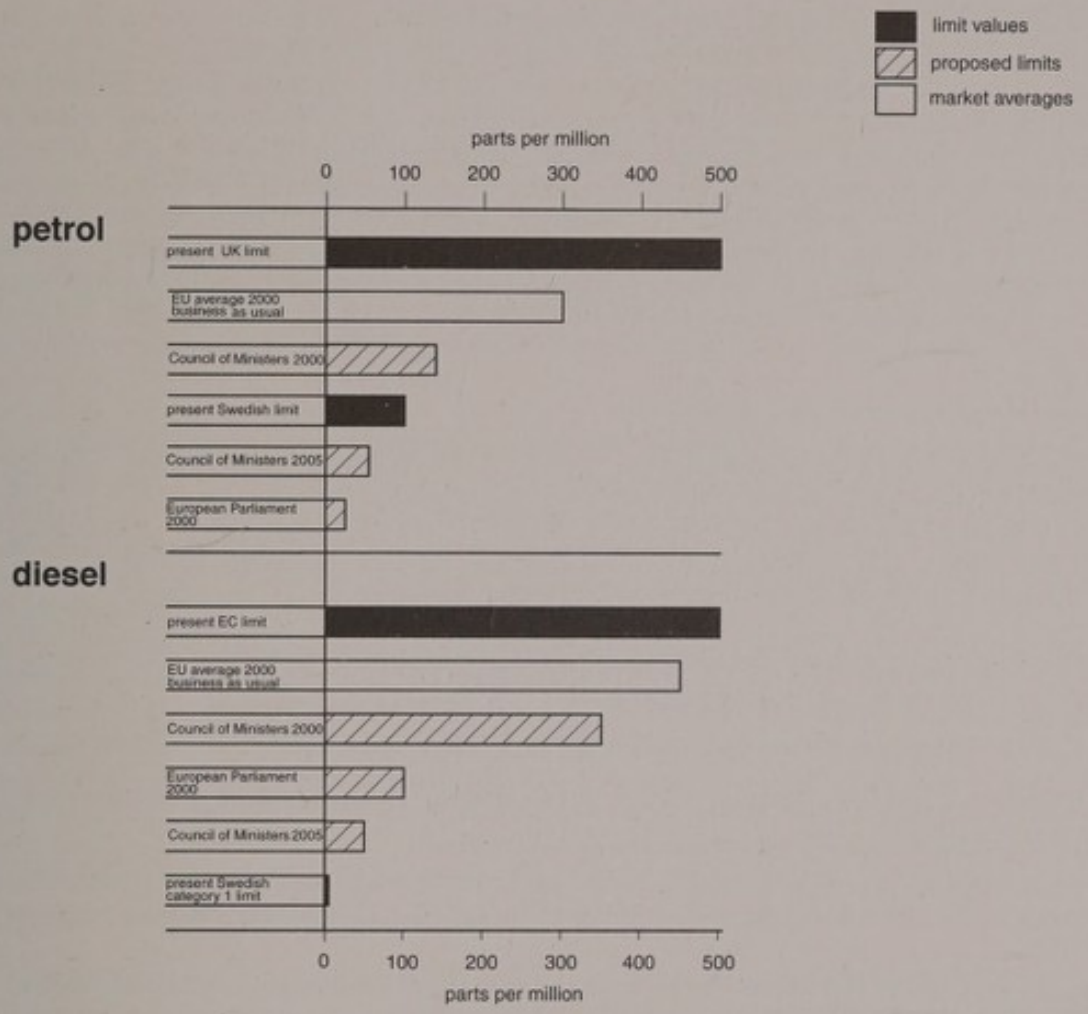
2.29 For most key aspects of fuel quality the European Commission's proposals arising from the Auto/Oil Programme for limits to apply from 2000 were not greatly different from the market averages predicted in any event for that year. These proposals have attracted more criticism than those for vehicle emissions because, as well as its direct impact on air quality, fuel quality also determines what emissions control technologies can be used.

2.30 Most controversy has surrounded the proposed limits on sulphur content, particularly in diesel. Reductions in sulphur content reduce the amounts of particulates produced by a diesel or petrol engine, as well as emissions of sulphur dioxide, and also appear to reduce other emissions.[40] Sulphur content has not so far provided an obstacle to achieving EC particulate emission limits for diesel vehicles but it will become more important as limits on emissions become more stringent. Examples of the problems sulphur causes for emission control technology are:[41]

> in petrol-engined vehicles fitted with three-way catalytic converters, sulphur increases the time taken for the catalyst to reach its operational temperature after engine ignition, inhibits the reduction of nitrogen oxides, can cause on-board diagnostic systems to malfunction, and can reduce the overall efficiency of the catalytic converter by 10–15%;[42]
>
> in continuously regenerating traps fitted to diesel vehicles, sulphur inhibits the formation of nitrogen dioxide and thus its use as an oxidant to burn off trapped particulates.

2.31 The permitted sulphur content of diesel has been reduced from 3,000 ppm (parts per million) by weight to 2,000 ppm (from 1 October 1994) to 500 ppm (from 1 October 1996).[43] The sulphur content of petrol was reduced from 1,000 ppm to 500 ppm by weight from 1 January 1995.[44] Figure 2-II shows the relationship between current limits, proposed limits agreed by the Council of Environment Ministers in June 1997, European Parliament proposals made in January 1997 and predicted market averages in the EU in 2000.[45] The Council of Ministers reduced the European Commission's proposal for sulphur in petrol in 2000 from 200 ppm to 150 ppm but accepted its proposal for diesel (350 ppm), which is considerably higher than the level of sulphur in reformulated diesel fuels widely used in Scandinavia; category 1 Swedish diesel has a maximum content of 10 ppm. We welcome the differential in favour of ultra-low sulphur diesel (maximum sulphur content of 50 ppm) announced in the autumn 1996 Budget, which should take effect in autumn 1997 following agreement in the EC.[46] We consider, however, that the difference in duties between this fuel and conventional diesel should be greater than the 1 pence/litre proposed, and are disappointed that the July 1997 Budget did not widen the differential.

Figure 2-II
Sulphur content of motor fuels



2.32 The House of Lords Select Committee on Science and Technology called for limits of 50 ppm for both petrol and diesel in 2000[47] and the European Parliament has proposed 30 ppm for petrol and 100 ppm for diesel for the same year. The Council of Ministers went beyond the European Commission's proposals in agreeing indicative limits of 50 ppm for both petrol and diesel in 2005, and we strongly support these as giving oil companies and the motor industry a firm basis on which to plan their investment programmes.

2.33 The Council of Ministers went in the direction advocated in the Eighteenth Report[48] by cutting the European Commission's proposed limit on the benzene content of petrol in 2000 from 2% to 1% by volume, compared with the current market average of 2.3%. The Council of Ministers also agreed to a general ban from 2000 on the marketing of leaded petrol. By the year 2000 only a very small amount of leaded petrol (2%) is likely to be in the market and almost the entire car fleet will be able to run on unleaded petrol. There is likely to be a derogation for a small amount of leaded petrol (not more than 0.5% of petrol sales) to be supplied for classic and historic vehicles in the UK, as long as this is done through special interest groups.

Reducing fuel consumption

2.34 Carbon dioxide is the dominant greenhouse gas affected by human activity, and is thus the main focus of concern as the cause of climate change. Emissions of carbon dioxide from transport in the UK have been rising over the last 25 years. A quarter of UK emissions of carbon dioxide are now attributable to transport, if electricity generation for transport and production of transport fuel are included.[49] This growth in such an important component of carbon dioxide emissions has been

reason for great concern against the background of international efforts to check increases in global concentrations of greenhouse gases.

2.35 Road transport is estimated to produce about four-fifths of carbon dioxide emissions from UK transport.[50] The main reason for the rise in such emissions over the last 25 years has been the increasing numbers of road vehicles and the increasing use made of them. Although the sales-weighted average fuel consumption of new cars registered fell over the 15 years preceding the Eighteenth Report, the reduction was modest.[51] Improvements in the efficiency of engines were offset by other factors. Safety features (such as structures with higher crash resistance, anti-lock brakes and airbags), emission control devices (such as catalytic converters) and equipment such as electric windows, sun-roofs and air conditioning have had the cumulative effect of adding significantly to the weight and auxiliary energy needs of cars.[52] An even more important factor is that customers have moved up-market to bigger cars with larger engines.[53]

Targets for reducing carbon dioxide emissions

2.36 The UK will meet by a comfortable margin its initial obligation under the Climate Change Convention, which was to reduce total emissions of carbon dioxide in 2000 to the 1990 level; it is estimated emissions in 2000 will be 4–8% below the 1990 level.[54] The programme of measures adopted in 1994 assumed a contribution from slowing the growth of transport emissions.[55] The major contribution has, however, come from electricity generation.

2.37 The Eighteenth Report identified reducing carbon dioxide emissions from transport as an important policy objective and proposed the following targets for the UK:[56]

> to limit emissions of carbon dioxide from surface transport in 2000 to the 1990 level;
>
> to reduce emissions of carbon dioxide from surface transport in 2020 to no more than 80% of the 1990 level;
>
> to increase the average fuel efficiency of new cars sold in the UK by 40% between 1990 and 2005, that of new light goods vehicles by 20% and that of new heavy duty vehicles by 10%.

2.38 A meeting under the Framework Convention in Kyoto later this year is intended to lead to international agreement on achieving reductions in greenhouse gas emissions by 2010. The EU has reached a common negotiating position for the basket of three main greenhouse gases (carbon dioxide, nitrous oxide and methane), weighted by their global warming potential. Under this the EU as a whole would accept a 15% reduction in the 1990 level of emissions in 2010, and the UK would accept a 10% reduction.[57] Apart from the continuing effect of increases in fuel duty (2.44–2.45), no programmes of measures have been announced for meeting targets for the UK beyond 2000.[58] UK emissions of the basket of gases are projected to be 5.6% below 1990 levels in 2010, mostly through reductions in emissions of nitrous oxide and methane; carbon dioxide emissions are projected to be 1.5% above 1990 levels in 2010.[59] The new government has announced a target of reducing total UK emissions of carbon dioxide in 2010 to 20% below the 1990 level.[60] This is a very challenging target and it seems inconceivable it will be met without a considerable contribution from the transport sector.

2.39 There has been criticism of the idea of setting separate targets for emissions from transport. It is certainly the case that, because it is the fastest growing source of carbon dioxide emissions, a given percentage reduction in 1990 emissions entails a larger reduction in projected emissions from transport than from other sectors. It has been argued that it could be acceptable, and would be economically efficient, to allow carbon dioxide emissions from transport to rise if it were more cost-effective to achieve a given percentage reduction in total emissions by making larger than proportional reductions in other sectors.[61] On the other hand, it can be argued that transport is a sector where many of the policies required to reduce emissions also have a positive rather than negative effect on the economy, especially in internalising external costs and limiting congestion.[62] That applies in particular to a tax on fuel, which is a convenient and attractive way of representing the other environmental and social costs of transport.[63] From this point of view, it would be cost-effective for transport to make a larger than average contribution. Moreover, vehicles are replaced at much shorter intervals than buildings

and there are thus more opportunities to incorporate energy-efficient technology into their basic design. On balance, we believe it is justifiable to set separate, and challenging, targets for reducing carbon dioxide emissions from UK transport. This is partly because of the scale of the reductions in total carbon dioxide emissions now being seen as necessary and partly because the development of more energy-efficient transport technologies will also have benefits for the reduction of carbon dioxide emissions in other countries.

Measures for reducing fuel consumption

2.40 As one route to reducing carbon dioxide emissions the Eighteenth Report proposed separate targets for increasing the fuel efficiency of vehicles, on the assumption that these could be met within existing technologies. It thought the scope for the target reduction for cars (40%) was much larger than for heavy goods vehicles (HGVs) because of operational constraints on the size and weight of HGVs, and because their designers and customers have tended to place more importance on operating costs.

2.41 In contrast to other types of emission, there has been no EC legislation regulating carbon dioxide emissions from individual road vehicles through reducing their fuel consumption. Many manufacturers are now promising bigger improvements than the 10% between 1993 and 2005 which the industry considered feasible at the time of the Eighteenth Report.[64] The German car industry committed itself in 1995 to cut the average fuel consumption of the cars it sells in Germany by 25% between 1990 and 2005. This has subsequently been matched by Volvo for the cars it sells in the EU. The French manufacturers PSA and Renault have committed themselves to reduce the average carbon dioxide emissions from their new cars to 150 g/km by 2005; this level of emissions is equivalent to fuel consumption of about 6.2 litres/100 km for a petrol car and 5.7 litres/100 km for a diesel car; about 46 and 50 miles per gallon respectively.[65] In June 1996 the Council of Environment Ministers gave the European Commission a mandate to negotiate a Europe-wide agreement with car manufacturers. The European Commission is seeking a reduction of about a third on present average emissions, to 120 g/km (equivalent to a fuel consumption of 5 litres/100 km for petrol-engined cars and 4.5 litres/100 km for diesel cars); the target date is 2005, with a possible extension to 2010. ACEA has expressed reservations about the feasibility of achieving 120 g/km by 2005.[66]

2.42 The 10% improvement quoted by the industry at the time of the Eighteenth Report assumed that existing patterns of sales and customer preference would continue. One route towards reducing average fuel consumption would be a trend towards smaller cars with lighter engines and less equipment. This approach has been demonstrated by Greenpeace in developing its 'SmILE' (Small, Intelligent, Light and Efficient) car, claimed to have roughly half the fuel consumption of its conventional counterparts,[67] and by Mercedes-Benz and the Swiss company SMH (makers of the Swatch watch) in their 'Smart' car for urban driving.[68] Several major manufacturers are marketing smaller cars, for example Ford with the Ka and Daihatsu with the Move. In the absence of government-induced changes, however, it seems unlikely that swings in customer preference could in themselves have a large beneficial impact on average fuel consumption, and more likely that the previous move up-market (2.35) will continue, leading to increased sales of four-wheel drive vehicles and 'multi-purpose vehicles'.

2.43 Another route would involve more radical changes in design based on technology which is already available but has not so far been utilised. A study by the Organization for Economic Co-operation and Development concluded that there are many technical options which have been ready for production for some time, but that in current regulatory and market conditions most of them will probably remain unexploited. It estimated that combinations of such options could produce reductions in fuel consumption of 37–73% by 2010.[69] We look later at more radical changes in technology which could reduce fuel consumption (2.72–2.80).

2.44 The main instrument adopted by the UK to reduce carbon dioxide emissions from transport has been a market signal in the form of increased tax to encourage customers to seek, and manufacturers to develop and market, vehicles with a lower fuel consumption.[70] There have been successive increases in duty on motor fuel since 1993. Since 1994 these have been on average more than 5% a year in real terms; the previous government committed itself to maintaining the average

year-by-year increase at this level until 2000. This commitment implied an increase in pump prices approaching 4% a year in real terms, if the market price of fuel before tax increases in line with the prices of other goods. In recent years, however, the market price of fuel has fallen. That has not affected the value of the increases in fuel duty, as fuel duty is expressed in cash terms rather than as a percentage, but it has considerably offset their effect on pump prices. For example, in the two years from April 1994 to April 1996 duty on unleaded petrol increased by 21%, but the retail price before duty and value added tax fell by 17%; as a result, the pump price increased by only 8%. During that time the retail price index increased by 5%; so, despite increases in duty at more than the committed rate, the pump price of petrol increased by only about 1.5% a year in real terms.[71]

2.45 The July 1997 Budget announced an increased commitment to raise fuel duty in future by at least 6% on average a year in real terms. It remains to be seen whether this will provide an adequate incentive to reduce fuel consumption. What the Eighteenth Report recommended was that the annual increases in fuel duty should be large enough to double the price of motor fuel in real terms by 2005. It was thought this might require fuel duty to increase by 9% a year above the rate of inflation.[72] In the circumstances which have actually applied, in which the market price of fuel has been falling, larger annual increases in fuel duty to offset the fall in the market price would have been required to maintain progress towards the recommended doubling in real prices.

2.46 We do not consider that the reductions in average fuel consumption being offered by some motor manufacturers, nor even the one-third reduction being sought by the European Commission, are on a significantly large scale. Nor do we consider that the fuel duty strategy being pursued by the UK government will be adequate on its own. We review at later points in this chapter other measures that could reduce fuel consumption, and assess at the end of this chapter the overall adequacy of the measures currently in place or planned.

Interactions between air quality and fuel consumption

2.47 The goals of improved air quality and lower fuel consumption are not incompatible but the relationship between them is complex and conflicts may arise within the framework of current technologies. For example, fitting a catalytic converter to a petrol-engined car in itself produces a small loss in fuel efficiency. As another example, the amount of nitrogen oxides produced by heavy diesel engines increases with combustion temperature, and in order to comply with EC stage I and II limits on emissions it has been necessary to limit combustion temperatures, thus constraining improvements in fuel efficiency.[73] Perhaps the most obvious example is the conflict in choice of fuel between the higher fuel efficiency of diesel vehicles and their higher particulate emissions compared to petrol-engined vehicles; fuel choice is considered separately below (2.59–2.71). We have reviewed other interactions between air quality and fuel consumption that arise in the contexts of the use, maintenance and replacement of vehicles.

Vehicle use

2.48 The ways in which vehicles are used have important implications for both air quality and fuel efficiency. Fuel consumption and emissions of pollutants can be reduced by smoothing traffic flows, by better enforcement of speed limits outside built-up areas, by reducing such speed limits and (perhaps the most significant single factor) by modifying driving styles.[74] Speed cameras have been introduced widely to achieve more effective enforcement of speed limits, especially for cars, as the Eighteenth Report advocated.[75] We are concerned, however, that the authorities have had to curtail use of the equipment now installed because they do not have the resources to handle the resulting cases. We welcome the increased efforts the Department of the Environment, Transport and the Regions (DETR) is making to increase environmental awareness among car drivers, for example, through liaison and partnership with motor manufacturers, motoring organisations and environmental groups.

Vehicle maintenance

2.49 Emissions are also much affected by a vehicle's state of maintenance. In this case it is the effect on air quality rather than on fuel consumption which has attracted most attention. It has been

estimated that over 50% of vehicle emissions are produced by only 10% of the vehicle fleet,[76] although doubts have been expressed about the validity of this estimate. The primary legislative tool available is inspection and maintenance (I/M) programmes. The EC Roadworthiness Directive[77] sets out the basic requirements for inspection and maintenance and is implemented in UK Vehicle Testing Regulations. The standards set for emissions in I/M programmes are less stringent than those applying to new vehicles and are intended to deal with more grossly polluting vehicles. We welcome the European Commission's proposal that stage III legislation should follow the USA in requiring all new petrol cars with catalytic converters to be fitted with an on-board diagnostic system to indicate catalyst failure, along with 'in-use compliance control' to verify that appropriate repairs have been carried out.

2.50 A three-year study carried out for the European Commission on improved I/M tests for cars is due to finish in summer 1997. The European Commission is likely to come forward with proposals to strengthen I/M requirements for vehicles, including encouragement of Member States to carry out roadside inspections. The UK government announced in February 1996 that local authorities would try out new powers for suitably qualified local authority staff to check vehicle emissions at the roadside and, if necessary, impose a fixed penalty. It was intended that the scheme should be self-financing. The regulations allowing these trials to go ahead have regrettably been delayed.

2.51 In considering how I/M requirements can best be strengthened, the lessons of US programmes will be important. I/M programmes are a feature of many air quality improvement strategies in the USA; more than 30 states have them in place and it is estimated that one-third of the nation's cars will be included in I/M programmes by 2000.[78] Whilst the US Environmental Protection Agency's Office of Mobile Sources claims that I/M programmes are having real effects on air quality, their success has been questioned in other quarters. It has been suggested that tampering with engines both pre- and post-testing is common and that repairs carried out on non-compliant vehicles are not sufficiently durable. Analysis of the results of US programmes indicates that none of the I/M programmes has achieved their predicted levels of benefit; some, for whatever reasons, produce almost no benefit and some provide a measurable but not large benefit.[79]

Vehicle replacement

2.52 However well they are maintained and tuned, a substantial proportion of vehicles will not meet the limits that apply to emissions of pollutants from new vehicles because they were not designed to do so. It is estimated that in 2000 about 30% of the cars in use in the UK will not have been designed to meet the EC stage I standard and will therefore not be fitted with catalytic converters.[80] Possible measures to deal with this problem fall into three main areas:

inspection and maintenance: tighten the legislation so that older vehicles with poor emissions performance will be unable to pass annual roadworthiness tests and will have to be replaced (see above);

grants, either for scrappage or for retrofitting;

fiscal measures, in the form of adjustments to the annual vehicle excise duty.

2.53 *Scrappage* schemes aim to give the owners of old vehicles, especially cars, a direct incentive to cease to operate them. They have been introduced for various periods in several European countries, including France, Greece, Spain and Ireland. Because they increase the number of new car registrations, at least some of the funding may be provided by the industry; in France, the scheme was set up to provide support for the car industry. The purchase of a new car may take place at one or more removes from the original owner, who in most cases will replace the scrapped car with a second-hand car. While speeding up turnover of the car fleet in this way is likely to have beneficial effects on air quality, it will bring benefits in terms of reduced fuel consumption only if the average fuel consumption of new cars has reduced over time and buyers are not encouraged at any stage to purchase models with higher fuel consumption than models they would otherwise have chosen. The second condition could be met in principle if a scheme was restricted to owners replacing an old car with a small new diesel car, which has lower fuel consumption; but the value of the scheme in improving air quality would then be less clear-cut. Moreover, in assessing the justification for a scheme

of this kind, allowance has to be made for the energy required to manufacture a new vehicle (typically equivalent to two years' fuel consumption).

2.54 The UK motor industry has proposed a scrappage scheme for cars and other vehicles at least ten years old and has estimated that in its first year reductions in emissions of regulated pollutants would be one-fifth greater than would have been achieved through normal turnover of the vehicle fleet; the greatest impact would probably be in urban areas.[81] We see no reason however to dissent from the conclusion of the Eighteenth Report that a scrappage scheme for private cars would not be a cost-effective way of using public money to improve air quality.[82]

2.55 In theory, *vehicle excise duty* (VED) could be graduated in relation to either the fuel consumption of a vehicle or the standards it is designed to achieve for emissions or some combination of these two factors. The German Parliament has agreed to graduate its equivalent annual tax with effect from 1 July 1997 to encourage the purchase of vehicles with better performance in terms of both air quality and fuel consumption.[83] We believe, however, that the priority in such a system should be to provide a further incentive for owners to favour cars with lower fuel consumption, in order to reinforce the impact of a progressive increase in fuel prices.

2.56 The House of Lords Select Committee on Science and Technology has recommended abolition of VED on private and light goods vehicles with an engine size of less than 1500 cc, with the lost revenue being recovered through increased fuel duty.[84] The approach preferred in the Eighteenth Report was to introduce steeply graduated rates of VED based on the certified fuel efficiency of a car when new.[85] This would achieve a more direct relationship with fuel consumption, influence decisions over the full range of car models and avert attempts to avoid duty by marketing cars just below the threshold. Fuel consumption figures are readily available for new cars, based on EC-approved test protocols.[86] To the extent that comparable figures are not available for older cars, it should nevertheless be possible to assign them to tax bands without undue difficulty (on the basis of the fuel consumption of that model when new rather than the current fuel consumption of an actual car). The scheme could readily be extended to light goods vehicles.

2.57 In the case of HGVs, the amounts payable in VED are much larger and variations in the rate can therefore be expected to have an even greater impact, but the potential for reducing the fuel consumption is less. We believe the priority in their case is to seek to reduce emissions of pollutants, in particular nitrogen oxides and particulates. The autumn 1996 Budget announced a scheme that will take effect in 1998 to reduce VED by up to £500 for lorries producing low particulate emissions.[87] The July 1997 Budget proposed extending the scheme to include buses.[88] As well as providing an incentive to operators encouraging purchase of new vehicles designed to meet future standards and to cease to use older vehicles, this will provide an incentive for *retrofitting* present-day technology in older vehicles, either in the form of particulate traps or, for smaller lorries, conversion to gas. We welcome the introduction of this kind of incentive, as the Commission has been advocating grants for retrofitting of heavy diesel vehicles since its Fifteenth Report in 1991.

2.58 The Eighteenth Report drew attention to the detrimental effects on fuel consumption of some features of the taxation arrangements for company cars.[89] As over half the new cars sold in the UK each year are bought by companies,[90] any change in their preferences would have a significant impact on motor manufacturers, and also in due course on the fuel consumption of cars in the second-hand market. We support the proposal in a recent report[91] that, to encourage purchase of cars with lower fuel consumption, the fuel consumption of the relevant model should be the future basis for taxing the benefit provided by a company car, either as a factor applied to the list price (the current basis for taxation) or instead of the list price. Other issues about company cars are discussed in chapter 6.

Choice of fuel

2.59 The choice of fuel has an impact on both air quality and fuel consumption. A major area of conflict is the choice between petrol engines and the more efficient diesel engines for cars and the smallest goods vehicles. The carbon dioxide emissions resulting from use of a diesel vehicle are 20–30% lower than those resulting from use of a comparable petrol vehicle.[92] Compared to catalyst-equipped petrol cars, diesel cars emit less carbon monoxide and hydrocarbons but more nitrogen

oxides and a greater mass of particulate matter. These characteristics were recognised in the EC stage II limits, which set a limit for the emission of particulates only in the case of diesel cars, allowed diesel cars a higher limit than petrol cars for the combined amount of hydrocarbons and nitrogen oxides emitted, but required diesel cars to meet a lower limit for carbon monoxide (see figure 2-I). The relative positions are similar when the comparison is made on a life-cycle basis. In terms of in-use performance, diesel cars appear to be superior to petrol cars, other things being equal, because their emissions vary little from vehicle to vehicle and seem to show little deterioration over the life of a vehicle.[93]

2.60 A large-scale switch from petrol to diesel could make a contribution to achieving targets for reducing carbon dioxide emissions. There is considerable scope for such a switch in the UK, in that only 9% of cars, run on diesel.[94] A study by the Energy Technology Support Unit (ETSU) looked at the effects on energy consumption and emissions; some of the principal findings are summarised in box 2B.[95] Perhaps the main implication of this study is that reducing the fuel consumption of cars generally would be a more effective strategy than relying on a switch from petrol to diesel.

BOX 2B **EFFECTS OF SWITCH TO DIESEL FOR CARS AND LIGHT GOODS VEHICLES**

ETSU examined four scenarios for increasing diesel penetration over the period 1990–2005 leading to the following proportions of diesel cars in use in 2005:

10% (a decline in registrations of new diesel cars)
20% (registrations similar to 1993 levels)
30% (steady growth in diesel car registrations)
40% (very rapid growth in diesel car registrations).

The rate of growth of traffic was taken as the mean of the high and low National Road Traffic Forecasts.

On the assumption that there would be no reduction in the fuel consumption of petrol cars or diesel cars, energy use by UK vehicles and at refineries was estimated to increase by 20–25% over the period 1990–2005, depending on the proportion of diesel cars. Carbon dioxide emissions were estimated to increase by 32–36% over that period. In all four scenarios emissions of regulated pollutants fell: carbon monoxide by at least 65%, hydrocarbons by at least 86%, nitrogen oxides by approximately 66%. Emissions of particulates fell by 46–60%, depending on the proportion of diesel cars.

On the assumption that average fuel consumption would fall by 1% a year for both new petrol cars and new diesel cars, it was estimated that energy use by UK vehicles (disregarding energy use at refineries) would increase by only 13–17% over the period 1990–2005 (depending on the proportion of diesel cars), and carbon dioxide emissions by only 26–29%. With no reductions in fuel consumption, on the other hand, energy use by UK vehicles would increase by 22–25% and carbon dioxide emissions by 35–38%.

2.61 The USA faces a similar dilemma, in that only the heaviest vehicles there have diesel engines and there is scope for substituting diesel for petrol as the fuel for lighter goods vehicles. Manufacturers are interested in promoting use of diesel in these vehicles, as it would align their US product range more closely with that required for other markets. As in the UK, there is concern about the health effects of diesel emissions. It is not clear yet how strong the opposition will be, and whether the change will be allowed to proceed.[96]

2.62 The Eighteenth Report placed emphasis on the health effects of particulates and nitrogen oxides and took the view that the precautionary principle precluded a major shift to diesel cars until more stringent limits had been placed on emissions of those substances.[97] It gave support to more stringent stage III emission limits for diesel cars than have actually been proposed,[98] envisaging that setting stringent standards would give a powerful boost to technological developments. The probable stage

III limits reflect the apparent lack of progress in the development of particulate traps and de-NO_x catalysts (2.28). The implication is that replacing a stage II petrol car with a stage III diesel car can be regarded as adding to air quality problems. Although less polluting than a petrol car in other respects, it is likely to have substantially higher emissions of nitrogen oxides and particulates than a stage II petrol car, let alone a stage III petrol car.

2.63 The Eighteenth Report's pre-conditions about emission limits for diesel cars have not been effectively addressed. The earliest date by which more stringent limits on emissions of nitrogen oxides and particulates from diesel cars could be implemented is 2005–06 (through EC stage IV). We see no reason to alter the conclusion of the Eighteenth Report and do not believe that a switch to diesel should be a main element of the strategy for reducing carbon dioxide emissions until at least that date.

2.64 A lower rate of fuel duty on diesel than on petrol was introduced in 1982. The differential was regarded as justifiable on health grounds because diesel does not contain lead. That justification has disappeared following the reduction in the lead content of leaded petrol, the ready availability of unleaded petrol and growth of concerns about the health effects of particulates and nitrogen oxides. Since 1994 diesel has been taxed at the same amount per litre as unleaded petrol on the ground that it has 'no perceived overall environmental benefits over unleaded'.[99] As diesel is denser than petrol, however, that represents a lower rate of tax on its energy content.

2.65 Within the general strategy of increasing the price of motor fuel to encourage economy in its use, there should continue to be differentials to encourage use of those fuels which are less damaging to the environment. Thus a differential was introduced in the 1995 Budget to make super unleaded petrol, which has a higher aromatics content, less attractive than unleaded. We consider conventional diesel should carry a higher tax per litre than petrol but with a significant differential in favour of cleaner forms of diesel (2.31).

2.66 There are other fuel options available which have potential advantages for air quality. The use of reformulated petrol is well established in the USA and is mandatory in some areas with acute air quality problems; California introduced phase I reformulated gasoline in 1992; since June 1996 only phase II reformulated gasoline can be sold in the state.[100] Reformulation reduces the benzene and aromatic content of petrol and its volatility. As this reduces its anti-knock qualities, oxygen-bearing compounds or oxygenates, such as methyl tertiary butyl ether (MTBE), are added to compensate.

2.67 A fully reformulated petrol can reduce carbon monoxide emissions by 30%, hydrocarbons by 20% and nitrogen oxides by 15%.[101] California phase II gasoline is estimated to reduce emissions of hydrocarbons and nitrogen oxides by 15%, carbon monoxide by 11% and benzene by 50%, equivalent to removing 3.5 million vehicles from Californian roads. A small increase in fuel consumption (1%) is expected as a result of its use.[102] The emissions benefits of California phase II gasoline were assessed for European cars within the Auto/Oil Programme (appendix D); emissions reductions of 15% for hydrocarbons and 20% for carbon monoxide were demonstrated.[103]

2.68 In Europe, although the maximum benzene content of petrol will be reduced from 2000 (2.33), the European Commission did not make proposals for thoroughgoing reformulation or use of oxygenates. The benefits of using oxygenates are still under debate. A major concern is that their use results in increased emissions of potentially harmful aldehydes. They were introduced in the USA primarily to reduce carbon monoxide levels but carbon monoxide objectives in Europe are expected to be met by existing measures (see appendix E).[104] They are not an essential measure for reducing ozone formation because there are other options for reducing the aromatics content of petrol whilst keeping its octane rating high.[105]

2.69 The Eighteenth Report concluded that there would be environmental advantages in replacing diesel with compressed natural gas (CNG), which is predominantly methane, or liquefied petroleum gas (LPG) in heavy vehicles that make frequent stops in urban areas but, apart from that, there would be no overall advantage by way of reduced environmental impact in the widespread use in the UK of alternative fuels for internal combustion engines, in particular their use in private cars.[106] A study by ETSU examined the implications for fuel consumption and air quality of a number of alternative

transport fuels, which were compared on a life-cycle basis so as to take into account energy use and emissions associated with production and distribution as well as use in vehicles.[107] This study broadly confirms that CNG and LPG are the two most promising alternative fuels for use at present. The French Academy of Science in its report on transport-induced air pollution has also endorsed use of these fuels both for heavy vehicles, including buses, and light utility vehicles.[108]

2.70 The House of Lords Select Committee on Science and Technology concluded that CNG and LPG vehicles could have an immediate impact in reducing urban air pollution. The Committee recommended that the government and local authorities encourage alternative technologies by using gas or electric vehicles themselves where appropriate, by promoting information exchange about practical experience with such vehicles, and by giving incentives to taxi owners and bus and other fleet operators to replace their existing vehicles.[109] The Eighteenth Report asked the government to 'consider the case for incentives to operators of fleets of heavy vehicles in urban areas to use natural gas-powered vehicles'.[110] There has been no direct government response to this recommendation.[111]

2.71 The rate of fuel duty on CNG and LPG supplied for transport purposes was, however, reduced by a quarter in the autumn 1996 Budget, and was frozen in the July 1997 Budget, effectively increasing the differential in their favour. Government support is also being provided for these fuels by the Powershift programme. The first phase[112] includes pilot use of, for example, LPG-fuelled ambulances in Oxford and CNG buses in the West Midlands. The second phase, recently announced by the Energy Saving Trust, aims to lower the cost of purchasing cleaner vehicles powered by electricity, CNG or LPG by grouping buyers into 'funding partnerships' and funding up to 50% of either the cost of conversion to the alternative fuel or the difference in cost between an alternative-fuelled vehicle and the petrol or diesel equivalent.

Future technology for road vehicles

2.72 The present technology used for road vehicles has been extremely successful in providing mobility for people and goods at low cost, and high performance vehicles for fast travel, but is not ideally suited to doing either in ways that minimise damage to the environment. The conditions under which conventional vehicles operate most efficiently, a steady speed in the range of 35–55 miles per hour, are not frequently encountered in practice. We have also noted certain conflicts between reducing carbon dioxide emissions by maximising the fuel efficiency of engines and reducing those emissions that are of concern in relation to health and the natural and built environment. Those conflicts are becoming more difficult and intractable as numbers of vehicles increase and as the objectives for fuel efficiency and air quality become more and more rigorous. To what extent can the problems be overcome by improvements in technology? Some experts have concluded that, if road traffic continues to increase, and if the pressures to reduce emissions of various kinds continue, radical changes in applied technologies will be needed in order to produce vehicles with an acceptable performance and cost.[113]

2.73 Oil is unlikely to be replaced in the medium term as the source of power for the great majority of road vehicles. Although consumption has greatly increased over the last few decades, the ratios of known reserves of oil and gas to present production rates have also increased. Oil is nevertheless a finite resource and reliance on it for transportation cannot be regarded as a sustainable course of action in the long term. Eventually an alternative or alternatives will have to be found.[114]

2.74 Over the next ten years the main methods adopted to reduce emissions are likely to be applications of already established technology which has not hitherto fitted the industry's marketing strategy or to fall into the category of modifications to existing technology, such as emission control devices fitted to exhaust pipes or improved forms of lean-burn in petrol engines and fuel injection. One approach to reconciling the needs for low fuel consumption and low emissions of regulated pollutants is the direct injection petrol engine, already on the market in Japan.[115] This has a higher thermal efficiency than light duty direct injection diesel engines, and low emissions on start-up, but tends to be heavier.[116] Lean-burn engines are an attractive way of reducing fuel consumption but, because they operate at a high temperature, produce larger amounts of nitrogen oxides and are incompatible with the standard technology for removing nitrogen oxides from exhaust emissions (three-way catalytic converters). Alternative technologies for removing nitrogen oxides require low

sulphur petrol,[117] as do direct injection petrol engines. The indication is that low sulphur petrol will be required in the EU under stage IV legislation (2.32), and these are therefore promising technologies for general introduction on that time-scale.

2.75 An increasing proportion of the industry's research and development world-wide is being devoted to more innovative technologies, with a growing emphasis on hybrid propulsion and on fuel cells, for example, in the 'Partnership for a New Generation of Vehicles' launched in the USA in 1993,[118] and within the EU, in the 'Car of Tomorrow' Task Force established in 1995.[119] The unsuccessful attempts over a number of years to develop competitive vehicles powered by electric batteries are, however, a reminder that bringing novel technologies to the point of widespread commercial application may be, at best, a lengthy process.

Fuel cells

2.76 Fuel cells use either hydrogen or hydrogen-rich fuels. The overall impact on the environment depends on the fuel used and the source from which it is obtained; cells fuelled by hydrogen emit no carbon dioxide in use and only very small amounts of other pollutants and, if it proves possible to produce hydrogen for this purpose by using renewable energy, the implications for greenhouse gas emissions will be very favourable. The House of Lords Select Committee on Science and Technology has drawn attention to the rapid pace of recent development based on proton exchange membranes.[120] Trials of buses propelled by hydrogen-powered fuel cells are already in progress.[121] We agree with the Committee, however, that 'further basic research is still needed to bring about substantial improvements in fuel cell performance', as well as developments to reduce cost substantially.[122] An intensive research and development effort could bring about introduction of hydrogen-fuelled vehicles and the supporting infrastructure in 2005–10.[123] A viable, privately owned, fuel cell-powered car is perhaps 20–30 years away.[124]

Electric batteries

2.77 Vehicles powered by electric batteries do not emit carbon dioxide or regulated pollutants at their point of use. When emissions from electricity generation are taken into account on a life-cycle basis, it appears that such vehicles bring overall benefits in reducing emissions of carbon dioxide and VOCs but can in some circumstances give rise to overall increases in emissions of nitrogen oxides and sulphur dioxide. Although trials of electric vehicles continue, batteries have continued to look unattractive as a source of power because of their low energy density. Some types (for example, nickel-metal hydride and lithium-based batteries) appear to have promising characteristics, but it seems likely that even types with a higher energy density than lead-acid batteries will continue to suffer from other disadvantages, including the time required for recharging. Alternative methods of energy storage such as flywheels and ultra-capacitors have not turned out to represent a technological breakthrough. Whereas the Eighteenth Report saw the main potential for use of electric propulsion in public transport and fleet vehicles in urban areas, development has in practice concentrated on cars and light goods vehicles, under the spur of Californian legislation which would have required 2% of light duty vehicles on sale from 1998 onwards to have zero emissions (and similar legislation in Massachusetts and New York). Following acceptance that progress has been slower than was hoped, the 1998 deadline has been replaced by a memorandum of understanding; the statutory requirement that from 2003 10% of vehicles on sale must have zero emissions remains in place for the time being.[125]

Hybrid vehicles

2.78 In the last few years there has been increasing interest in an alternative role for batteries as part of hybrid systems. As one of the largest drawbacks of the battery-powered electric vehicle is its limited range, there is an obvious appeal in adding a generator and small conventional engine (petrol or diesel) so that the battery can be recharged on the move, thus extending the range. Hybrid electric vehicles fall into two classes according to their drive arrangements. In parallel-hybrids, both the prime mover (the engine) and the electric motor can be linked to the transmission and can drive together for maximum output. In series-hybrids, the drive is purely electric and the prime mover's only function is to drive the generator which recharges the battery.[126] Hybrid electric vehicles potentially have high energy efficiencies because the engine can run nearer its peak efficiency for a much higher proportion

of the time. This approach also opens up the possibility of using a form of engine, the gas turbine, which operates under ultra lean-burn conditions but has not hitherto been used in road vehicles because it does not cope well with varying loads. It is possible for hybrid vehicles with combustion engines to be used as zero emission vehicles within specified zones. Whether they can be used in this way in practice depends on the relationship between distance travelled inside the zone and distance travelled outside the zone (and other factors that affect the power requirements inside the zone). Many major motor companies have developed prototype hybrid electric vehicles.

2.79 The longer-term development of vehicle propulsion is likely to involve a combination of an ultra-light body and hybrid propulsion based on separate electric motors on each wheel, with the prime mover initially a petrol or diesel engine, but at a later stage a fuel cell. This kind of design can in principle give very large improvements in energy efficiency.[127]

2.80 Looking beyond the potential use of alternative fuels, the Eighteenth Report's main conclusions about new technology remain valid:[128]

> electric and hybrid propulsion should be developed for certain markets;
>
> in the long term the preferred technology for electric propulsion may be to generate electricity on board vehicles through an electrochemical reaction between hydrogen and oxygen within a fuel cell.

The House of Lords Select Committee on Science and Technology surveyed the field and reached broadly similar conclusions on these issues;[129] the French Academy of Science also wishes to see the development of electric and hybrid vehicles promoted.[130]

Adequacy of planned measures to reduce fuel consumption

2.81 In assessing the adequacy of action at present being taken or planned to pursue agreed policy objectives, we look first at targets for reducing carbon dioxide emissions and then at the objectives for priority pollutants in the National Air Quality Strategy. In each case we review current trends, assess the likely effectiveness of planned measures, and consider whether they are sufficient to achieve targets in the medium term. We then set out our overall conclusions about the priorities for improving road vehicle technology, and about additional measures that will be needed as part of an environmentally sustainable transport policy.

2.82 The main policy instrument used in the UK for reducing carbon dioxide emissions from road transport has been increases in fuel duty. Although the increases so far made have been offset to a large extent by falls in the retail price of fuel before tax (2.44), the expectation of a sustained rise in prices which has now been created has probably itself had an effect. There is some indication of a change in marketing strategies and customer preferences in that, following an increase of 4.5% between 1987 and 1993 in the sales-weighted average fuel consumption of new petrol cars there was a reduction of 2.5% between 1993 and 1995.[131] This is too short a period to extrapolate with any confidence however. There are also contrary influences, as customers show a continuing tendency to choose larger vehicles. The proportion of cars sold in the UK with engines under 1400 cc has fallen from 46% in 1994 to 40% in 1996;[132] the average fuel consumption figures above do not include four-wheel drive vehicles.

2.83 The responsiveness of fuel use to changes in price of fuel is the outcome, not only of decisions on vehicle purchase but also of other behavioural changes, such as adoption of more fuel-efficient driving styles and some reduction in journeys made because of the higher cost. Studies of the effects of price increases published since 1994 have tended to draw upon estimates derived from earlier research, which was taken into account in the Eighteenth Report.[133] These estimates give a reasonably narrow range of values. It remains unclear, however, whether they are applicable to very large changes in prices, or how the effects may change over time as users adapt to changed circumstances.[134] A study for the Department of Transport did not find any evidence that responses to large increases in motor fuel prices are disproportionately larger than responses to smaller price increases;[135] but this

conclusion was based on replies by respondents to hypothetical questions, which may not be a satisfactory method for investigating long-term effects.

2.84 We have advocated steep graduation in vehicle excise duty for cars based on certified fuel efficiency (2.56) in order to provide a strong additional incentive for manufacturers to develop and market and users to purchase vehicles with lower fuel consumption. We also believe the motor industry has a major contribution to make through modified designs and improved technology. We welcome moves by the European Commission to obtain formal commitments from manufacturers to achieve specified improvements in carbon dioxide emissions from new cars by a specified date (2.41). Negotiations have been given impetus by the Commission's statement that, if an acceptable agreement cannot be reached, it will consider other measures, which might include draft legislation containing binding limit values for carbon dioxide emissions.[136] The CAFE (Corporate Average Fleet Economy) system in the USA provides a precedent for placing limits on the fuel consumption of all cars sold by a manufacturer. Although the average sales-weighted fuel consumption permitted (8.55 litres/100 km) is high in relation to the figures now under discussion in Europe, it has been credited with bringing about the significant reduction in the average fuel consumption of US cars occurring between 1970 and 1990,[137] although in recent years it has had less effect. However only 60% of light vehicles sold in the USA are now cars, and the average fuel consumption of light vehicles is rising.[138]

2.85 The government has set a target of reducing total UK carbon dioxide emissions in 2010 to 20% below the 1990 level (2.38). It seems clear that a substantial proportion of the necessary reduction in emissions will have to come from road transport. The Eighteenth Report proposed targets for carbon dioxide emissions from surface transport in 2000 and 2020. Box 2C[139] compares the scales of the additional reductions in emissions from transport implied by these various targets. It includes two alternatives for the size of transport's contribution to the government's overall target for 2010: 25% of the required reduction, broadly proportional to its contribution to emissions, and 44%, as recently suggested by an environmental group.[140]

2.86 Appendix D to the Eighteenth Report described a programme of measures that would achieve the targets it proposed, and this provides a starting point for considering what measures are likely to be required in the transport sector in order to achieve the target now set by the government. The four main measures were

> larger increases in motor fuel prices than those so far planned by the government, so as to double them in real terms between 1995 and 2005;
>
> a 40% improvement in the average fuel efficiency of new cars sold in the UK by 2005, together with a 20% improvement for new light goods vehicles and a 10% improvement for new heavy duty vehicles;
>
> increased enforcement of 60 and 70 miles per hour speed limits;
>
> halving growth of car traffic in urban areas.

2.87 The official estimate is that the fuel duty strategy reduced carbon dioxide emissions by between 1.5 and 2 million tonnes of carbon (MtC) in 1996. It was estimated that the original strategy of increasing duty by 5% a year in real terms would deliver a saving of 3 MtC a year in 2000, representing 8% of emissions from road transport. Official estimates of carbon dioxide emissions from transport up to 2020 and the effect of the original strategy of increasing fuel duty by 5% a year in real terms until 2000 are shown in figure 2-III.[141] No estimates have been published of the effect of the modified strategy of increases of 6% a year in real terms until 2002, except that the effect in 2010 is expected to be an additional reduction of 2.5 MtC (box 2C).

2.88 Obtaining the reduction in use of fuel by cars that we consider to be necessary on environmental grounds will depend on a package of measures designed to change perceptions and expectations and have mutually reinforcing effects. They must include forcing the development of vehicle technology and changing customer preferences. That in turn will require both economic instruments, with the policy of fuel price increases applied more effectively and reinforced by graduated vehicle excise duty, and direct pressure on manufacturers, either through agreements or if necessary through legislation. Because of the integration of the European market, agreements and legislation will have to be at

BOX 2C **TRANSPORT'S CONTRIBUTION TO MEETING GOVERNMENT TARGET FOR CARBON DIOXIDE**

Limiting *carbon dioxide emissions from surface transport in 2000* to the 1990 level implies a further saving of 4.4 million tonnes carbon (MtC) in addition to that estimated to be produced by the original fuel duty strategy to 2000. That represents a further 12% reduction in transport emissions in 2000. It seems unlikely that this target proposed in the Eighteenth Report can now be achieved.

The government's target to reduce *total UK carbon dioxide emissions in 2010* to 20% below the 1990 level implies further savings from all sources in that year, in addition to those provided by policies adopted up to February 1997, of 35.8 MtC. If transport were to contribute a quarter of the total savings needed, in proportion to its contribution to total emissions, the savings required in addition to those provided by the fuel duty strategy to 2000 would be 9.0 MtC, that is, a further 21% reduction in transport emissions in 2010. If transport were to contribute 44% of the total savings needed, the savings required in addition to those provided by the fuel duty strategy to 2000 would be 15.8 MtC, that is, a further 38% reduction in transport emissions in 2010.

On the assumption that the modified fuel duty strategy to 2002 will provide additional savings of 2.5 MtC from the road transport sector in 2010, the additional reductions in transport emissions required over and above that would be 16% with a 25% contribution from transport and 32% with a 44% contribution.

The additional reductions required to provide *a 25% contribution from transport* will be achieved if the Eighteenth Report's target of a 40% improvement by 2005 in the average fuel efficiency of new cars sold in the UK (2.37) is achieved. This calculation makes allowance for the effect the fuel duty strategy will in any case have had in reducing the fuel consumption of new cars sold in the UK below what it would otherwise have been. It is more difficult to estimate the effect on UK emissions of achieving the proposed European Commission target that carbon dioxide emissions from new cars sold in the EU in 2005 should average 120 g/km (2.41); but it seems unlikely that would be sufficient in itself to provide a 25% contribution to meeting the government's target for UK emissions in 2010, and it would certainly be insufficient if the target date for achieving the specified average for new cars were put back to 2010. The reduction in emissions produced by achieving the Eighteenth Report's target for fuel efficiency of new cars would be only about half that required to provide *a 44% contribution from transport* to meeting the government's target for 2010. It has been suggested the rest of the reductions could come from a 20% reduction in the average distance cars travel annually in the UK, to the average level in Germany.

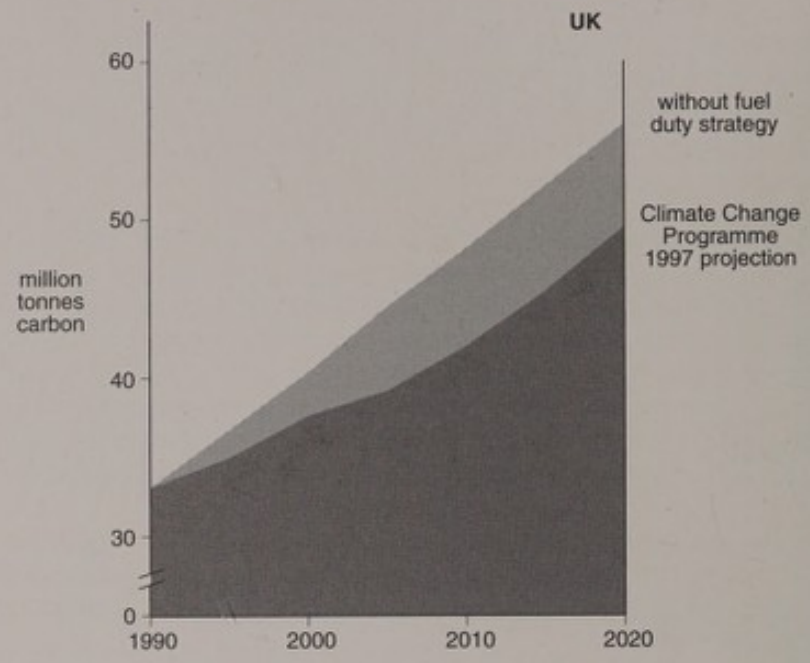
The target proposed in the Eighteenth Report of reducing *carbon dioxide emissions from surface transport in 2020* to 20% below the 1990 level implies a further saving of 22.7 MtC in addition to that provided by the fuel duty strategy to 2000, a further 46% reduction in transport emissions in 2020.

European level. But neither the reductions at present being offered by motor manufacturers nor those being sought by the European Commission are on a sufficiently large scale. To achieve targets for reduction of carbon dioxide emissions, the package will also have to include measures of other kinds, in particular measures to encourage use of alternative modes which are more efficient in energy terms.

Adequacy of planned measures to improve air quality

2.89 Action to deal with vehicle emissions will be the major factor in achieving the objectives of the National Air Quality Strategy and in complying with EC legislation on air quality. EC standards for new vehicles have been progressively tightened. For carbon monoxide and hydrocarbons the stage II limits for cars, which have come into effect in 1996–97, are less than one-tenth of the limits under the original EC Directive of 1970.[142]

Figure 2-III
Carbon dioxide emissions from transport to 2020 showing effect of original fuel duty strategy



2.90 Besides the standards applying to new vehicles, however, air quality depends on the total number of vehicles, their age and condition, where and how they are used, and processes occurring in the atmosphere. Official estimates show reductions in total emissions from road transport of the regulated pollutants. Doubts are being expressed, however, about whether action taken to reduce emissions has yet produced real improvements in urban air quality.[143] There are indications that concentrations of carbon monoxide have fallen, but concentrations of nitrogen dioxide have risen in central London, and perhaps more generally in urban areas. There are as yet no time series data for concentrations of particulates. The available evidence is reviewed in box 2D.[144]

2.91 In looking at prospects for the future, we consider first the National Air Quality Strategy, then the assessment made by the European Commission. The Strategy made the assumption that measures already in place, in all sectors not just transport, will be sufficient to secure the objectives for 2005 set out in table 2.1 for four of the eight priority pollutants: benzene, 1,3-butadiene, carbon monoxide and lead. The projections of emissions which supported that assumption are summarised in appendix E. In the case of road transport, key measures were existing EC legislation on vehicle emission limits (stages I and II), fuel quality and petrol vapour recovery.

2.92 For nitrogen dioxide and particulates the Strategy envisaged that most of the reduction in vehicle emissions needed to meet the objectives would be produced by EC stage III legislation. However, as the effects on nitrogen dioxide concentrations of stage II legislation are not yet evident (box 2D), it is not clear that the smaller reductions resulting from the probable stage III limits (figure 2-I) will have a significant immediate effect. In any event, the Strategy accepted that further measures at national and local levels would be necessary to achieve the objectives for nitrogen dioxide and particulates. It took a similar view about sulphur dioxide, which is not considered in detail here as road transport produces only about 2% of emissions.

2.93 Achievement of the objective for ozone will depend on concerted action being taken across Europe. The target of 60% reductions in emissions of ozone precursors set by eight northern European countries (2.23) is intended to eliminate exceedances of the alert threshold of 90 ppb (as an hourly mean) set by the 1992 EC Ozone Directive, but will not be sufficient to ensure that the objective in the National Air Quality Strategy (50 ppb as a running 8-hour mean to be achieved at the 97th percentile) is met. The Strategy accepted that further measures at all levels will be necessary to reduce emissions of ozone precursors.

BOX 2D RECENT TRENDS IN EMISSIONS AND AIR QUALITY

Estimates are made of *total emissions* of the main pollutants from all UK sources each year. The latest estimates, for 1995, can be compared with the 1992 estimates available at the time of the Eighteenth Report. Emissions of nitrogen oxides, carbon monoxide, lead and volatile organic compounds (VOCs) from road transport have continued a downward trend established prior to 1992. Emissions of black smoke and PM_{10} from road transport appear to have peaked in around 1991–92 and have now begun to decline; sulphur dioxide emissions from road transport declined between 1994 and 1995.

The estimates produced are considered to have wide margins of error: ±30% for nitrogen oxides, ±40% for carbon monoxide, and ±50% for (non-methane) VOCs. Any conclusions about recent trends are therefore subject to uncertainty.

An analysis of trends in *air quality* to 1995, using data from sites within the national monitoring network, found a downward trend in concentrations of carbon monoxide, sulphur dioxide and (except in central London, where an upward trend was observed) nitrogen dioxide; the analysis did not cover other pollutants. Data from Birmingham and Edinburgh suggest a lack of improvement, even a deterioration, in nitrogen dioxide levels in other areas in recent years. The most recent data from the UK national nitrogen dioxide survey, based on diffusion tube monitoring at over 1,200 locations, show that between 1993 and 1995 average nitrogen dioxide concentrations increased at all three types of locations (kerbside, intermediate and urban background). Because of the short period involved, it is difficult to be sure these last results indicate a long-term trend.

The reason for the apparent lack of progress in reducing nitrogen dioxide concentrations is not known. Bearing in mind the rate at which vehicles are replaced, it may be too early to detect a clear improvement in air quality as a result of the introduction of three-way catalytic converters, which have had to be fitted to all petrol cars only since the beginning of 1993. Other factors may be the predominance in urban areas of short journeys under cold-start conditions and the chemistry by which nitrogen dioxide is formed in the atmosphere. Air quality is also affected by considerable variation in meteorological conditions.

In addition, national figures for total emissions may conceal large regional and local variations. Analysis of Driver and Vehicle Licensing Agency statistics of vehicle registration by postcode indicates significant regional variations in vehicle type and turnover. Urban areas generally contain higher proportions of buses and taxis, which are much older on average than private cars.

2.94 The modelling carried out in the Auto/Oil Programme, which formed the basis for the European Commission's proposals for stage III emission limits, is described in appendix D. It assumed that a corresponding contribution will be made by reductions in emissions from sources other than road transport. It also assumed that other types of local and national measure will make a considerable contribution to reducing emissions from road transport (appendix D, D.15). The set of local measures analysed was road pricing, bans on traffic, subsidies to public transport, scrappage schemes (2.53–2.54) and conversion of urban buses to alternative fuels (appendix D, D.11). The costs and benefits of increased enforcement against emissions from vehicles in use, another local measure, were analysed as part of a set of measures to improve durability of emission control systems (appendix D, D.10); there is likely to be separate EC legislation on that front (2.50).

2.95 According to the National Air Quality Strategy one of the roles of the new system of local air quality management (2.16) is to provide 'a fine tuning or corrective system where existing central policies are not sufficient to meet the targets, and further national measures would be too blunt or expensive an option'. Draft guidance to local authorities on air quality and traffic management issued

in December 1996[145] said that a successful air quality action plan is likely to entail measures on several fronts:

> channelling traffic along the routes best able to cope with it. This might mean discouraging through traffic from entering town centres or residential areas by improving the alternative routes, and might include restricting access by all vehicles, or particular types of vehicles, to particular areas or roads to protect sensitive areas;
>
> encouraging alternatives to the car (walking, cycling, public transport) by investing in dedicated infrastructure and taking steps to make them more attractive;
>
> deterring 'inappropriate' and indiscriminate car use, such as very short trips in town, by making it more expensive or less convenient;
>
> smoothing traffic flow and regulating speed;
>
> working with businesses and the public to increase awareness of how their transport decisions affect air quality.

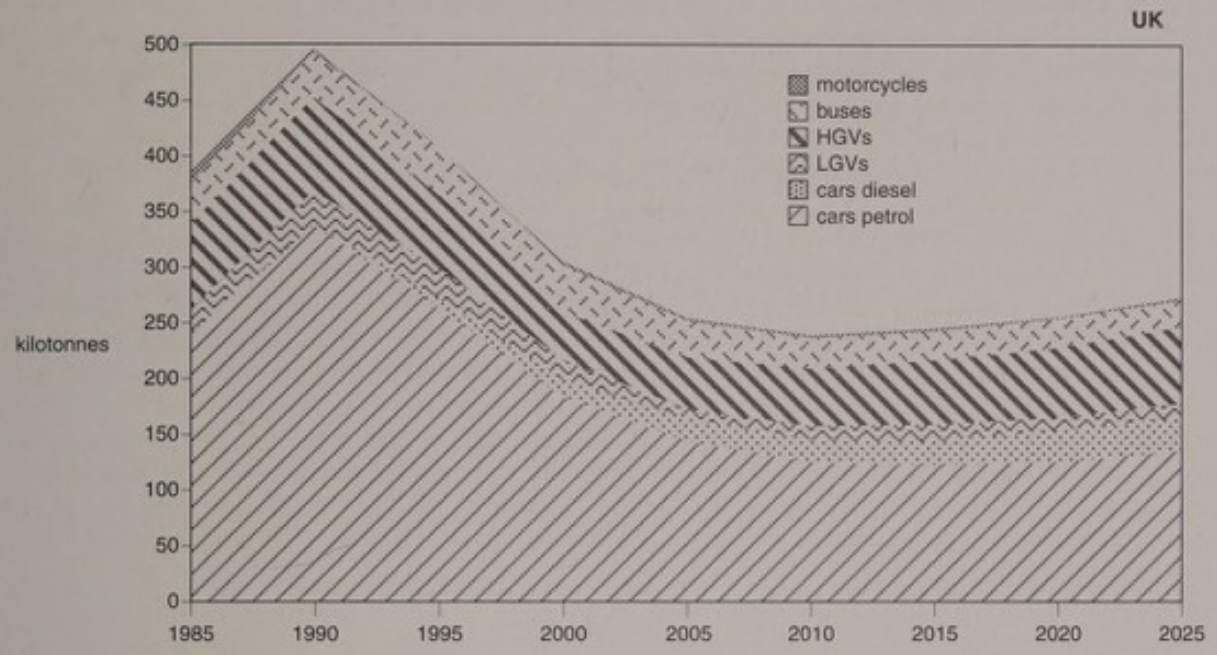
Traffic management schemes based on a single policy measure are unlikely to be accepted by central government.

2.96 It is accepted that local measures will not be effective in reducing ozone levels. There are also indications that concentrations of particulates tend to be similar over wide areas, suggesting a non-local or even transboundary source.[146] Objectives for some other pollutants will be achieved even without local measures. The question is how effective local measures can be in reducing concentrations of nitrogen dioxide and particulates. A review paper commissioned by DOE examined the effects of various traffic management measures, all of which might form part of a local authority action plan, including parking measures; pedestrianisation and traffic restricted zones; tolls, area licences and congestion pricing; traffic calming and area-wide speed limits; urban traffic control (UTC) systems; improvement in public transport services; public education; promotion of cycling and walking.[147] It concluded that a combination of measures is needed to achieve significant benefits. For example, more people will be encouraged to use new or improved public transport services and cycling provision if some form of car restraint is introduced at the same time. Although the city-wide benefits of a package of measures may be relatively small, perhaps only reducing vehicle emissions by 5–10%, the areas within a town or city which exceed air quality objectives, or may exceed them in the future if no action is taken, may also be relatively small. It is important, however, that measures taken to solve air quality problems in one area do not simply shift the same or another problem to another area.[148]

2.97 We have focused so far on achievement of air quality objectives for 2005. A crucial issue is what is likely to happen after 2005. The Eighteenth Report contained projections extending to 2025 for total road transport emissions in Britain and for road transport emissions in urban areas of Britain. These showed emissions of the main pollutants falling until 2007, but then rising again on the assumption that traffic continues to grow in accordance with the National Road Traffic Forecasts.[149] Even on the low forecast of traffic growth made in 1989, emissions of some pollutants from road transport in 2025 would represent a substantial proportion of the 1990 total; 24% for VOCs, 30% for carbon monoxide and 42% for nitrogen oxides. If diesel cars had gained 40% of the market, rather than the present 20%, emissions of particulates in 2025 were projected to be at 50% of the 1990 level on the low forecast of traffic growth;[150] and in urban areas at as much as 93% of the 1990 level on the high forecast of traffic growth.[151] These projections were based on what have turned out to be over-optimistic assumptions about the stringency of EC stage III limits.[152] The long-term prospects for air quality are therefore a matter of considerable concern.

2.98 The National Air Quality Strategy confirms this. It presents projected emissions of nitrogen oxides and PM_{10} from urban road transport to 2025, assuming current policies and with no allowance for EC stage III legislation. It was assumed that 20% of new cars will continue to be diesel. Reductions in emissions from road transport reverse after 2010 as the forecast increases in traffic begin to outweigh the benefits of improved technology (figures 2-IV and 2-V). Emissions of carbon monoxide could follow a similar path. Such reversals run counter to the principles of sustainable development. Even making allowance for the effects of stage III legislation, the Strategy concludes that further

Figure 2-IV
Projected emissions of nitrogen oxides from road transport in urban areas

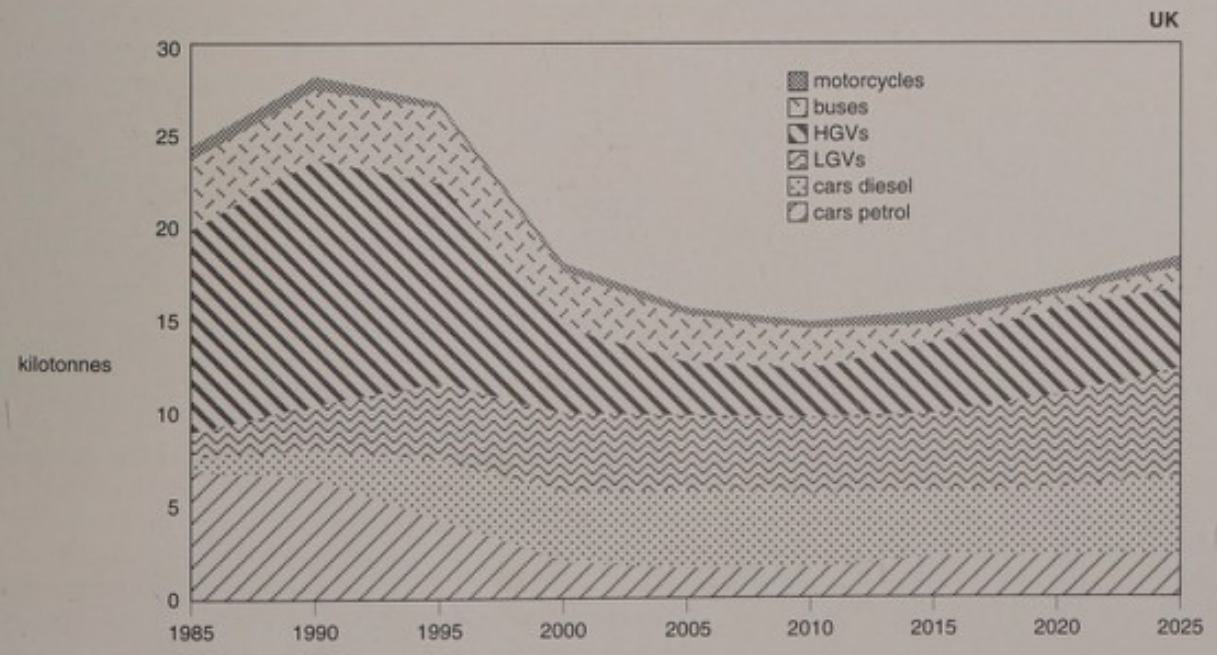


measures will be required to maintain the downward trend in emissions, and that possible technological changes include modifications to catalysts to reduce cold-start emissions, further reductions in sulphur content of fuels and use of alternative fuels such as CNG and LPG in urban vehicle fleets. The first two measures are already under discussion in the context of a possible stage IV of EC legislation on vehicle emissions.

Conclusions

2.99 It remains very difficult to reach firm and quantified conclusions about the effects of air pollution, largely caused by vehicles, on human health. There are demonstrable effects on the natural and built environment. We welcome publication of the UK National Air Quality Strategy and the

Figure 2-V
Projected emissions of PM_{10} from road transport in urban areas



development of EC legislation which will require action at all levels to bring about improvements in air quality. Amongst other things there will need to be a continuing development of technology to ensure that vehicle emissions continue to decrease. Demanding standards must be set well ahead of the scheduled date of implementation to provide a stimulus to rapid technological innovation. The UK government should maintain pressure for more stringent EC stage IV limits to come into effect in 2005–06, despite industry resistance. The permitted sulphur content of petrol and diesel must be reduced (as soon as possible to 50 ppm) to bring immediate benefits in reduced emissions and remove obstacles to the introduction of advanced vehicle technologies.

2.100 An issue that has assumed even greater importance since the Eighteenth Report is the contribution road transport makes to carbon dioxide emissions in the UK. It is the only sector which, despite the measures taken within the UK's Climate Change Programme, is forecast to maintain growth in emissions to 2020. Reducing carbon dioxide emissions from road vehicles needs to be given greater emphasis than hitherto. We do not consider that the price signals given thus far will have sufficient effect on consumer demand for vehicles with lower fuel consumption and on industry marketing strategies. Urgent consideration should be given to the best way of making manufacturers take up the challenge of producing more energy-efficient road vehicles. To this end the UK government should be prepared to support EC legislation to limit carbon dioxide emissions from cars and to ensure that increases in motor fuel prices are made on a phased basis throughout the EU (see appendix F).

2.101 We believe there should be a concerted campaign to change public attitudes to cars. There must be much greater awareness of the fuel consumption of different models and their potential to cause air pollution. The former Departments of the Environment and Transport planned to make available more comprehensive information about the environmental performance of new cars, covering fuel consumption, pollutant emissions and noise. It is regrettable this has been delayed.

2.102 Both the UK National Air Quality Strategy and EU policies presuppose that local measures, including roadside testing of emissions, will play an important role in achieving acceptable standards of air quality in urban areas. Local measures such as traffic management schemes will also play an important part in reducing carbon dioxide emissions. We consider in chapter 7 how those contributions should be planned and organised.

2.103 Another essential element in creating an environmentally sustainable transport system will be policies to encourage a switch of personal travel and freight transport to modes which are less damaging to the environment. We discuss in chapters 4–6 how that can be brought about.

Chapter 3

COUNTERING NOISE

What is being done, and what more could be done, to reduce noise from roads and railways? Quieter road vehicles are legislated for at European level. Quieter road surfaces, and methods of screening people from noise, have been developed, although they have not so far been widely utilised in the UK. If use of railways is going to increase, especially for freight, measures to counter noise from them should receive greater emphasis than hitherto.

Recent trends

3.1 As far back as its Fourth Report, the Commission raised concerns about the continuing deterioration of the noise climate in the UK, especially with respect to road traffic noise.[1] More recently, the Eighteenth Report reiterated these concerns, noting that noise is the aspect of transport that causes the most nuisance to the most people in the UK.[2] No new Noise Attitude Surveys have been carried out in the UK since those cited in the Eighteenth Report. Although the most common form of complaint about noise received by local authority Environmental Health Officers in England and Wales concerns noise from domestic premises and complaints in this category rose by nearly three-quarters between 1990/91 and 1994/95, the number of complaints received concerning road traffic noise also rose by 30%, to 60 per million people, over the same period.[3] It should be noted, however, that most traffic-related complaints are usually addressed to highway authorities or Regional Directors and will not necessarily be included in these figures. The 1995 Eurobarometer environment survey found that noise from all sources (no breakdown provided) was the fifth most important area of complaint about the local environment in the European Union (after traffic, air pollution, landscape and waste) but was the only issue about which respondents complained more than in 1992.[4] There is no evidence, therefore, that the problem of transport noise is diminishing, and some suggestion that people are becoming more sensitive to it.

Policy objectives

3.2 In recognition of the widespread and potentially detrimental effect of transport noise on the population, the Eighteenth Report made several recommendations concerning noise from roads, railways and aircraft under the general objective of reducing noise nuisance from transport and proposed two targets (units are defined in box 3A):

BOX 3A — **UNITS OF NOISE EXPOSURE**

The following units of noise exposure are used in this chapter:

- dB – the (logarithm of the) sound-pressure level (or magnitude of sound) expressed in decibels and measured relative to the lower threshold of hearing
- dB(A) – the scale used in assessing human exposure to noise, weighted according to the frequency response of the normal human ear
- dBL_{Aeq} – mean sound pressure level, i.e. mean level of the sound, quoted for and averaged over a defined period of time, as below
- $dBL_{Aeq.16h}$ – mean daytime sound level, i.e. average sound energy over 16 daytime hours
- $dBL_{Aeq.8h}$ – mean night-time sound level, i.e. average sound energy over 8 night-time hours
- dBL_{Amax} – maximum sound pressure level

to reduce daytime exposure to road and rail noise to not more than 65 $dBL_{Aeq.16h}$ at the external walls of housing;

to reduce night-time exposure to road and rail noise to not more than 59 $dBL_{Aeq.8h}$ at the external walls of housing.

3.3 It was intended that compliance with these target levels should be an important factor in the environmental assessment of proposals to construct new roads and railway lines and to make more intensive use of existing infrastructure and that they should also apply to existing roads and railways. The Eighteenth Report recommended that the Department of Transport should accept responsibility for making progress towards the noise target levels and should place corresponding obligations on the Highways Agency, on Railtrack and on local authorities. It was, however, recognised that achievement of these targets for external noise levels may not be practicable in all cases.[5]

3.4 The World Health Organization recognises noise as a health hazard and suggested that daytime outdoor noise levels should not exceed 65 dBL_{Aeq} and that it is desirable for them to be less than 55 dBL_{Aeq} (57 dBL_{Aeq} for aircraft noise).[6] The Eighteenth Report's targets accorded with these guidelines but were more ambitious than European Commission proposals contained in the Fifth Environmental Action Programme. These included a number of broad targets for night-time noise on which to base action up to the year 2000, as follows: at no point in time should a noise level of 85 dBL_{Aeq} be exceeded; exposure to noise levels greater than 65 dBL_{Aeq} should be phased out; there should be no increase in existing noise levels in areas where the present level is below 65 dBL_{Aeq}.[7]

Measures available to achieve targets

3.5 Achievement of the targets contained in the European Community (EC) Fifth Environmental Action Programme was to be through implementation of proposals for noise abatement programmes; standardisation of noise measurement and rating; directives further reducing noise from transportation; and measures related to infrastructure and planning. Work on developing a Community noise abatement programme has, however, been slow. Reviews of the Fifth Action Programme called for more intensified efforts and, to this end, a Green Paper was published in 1996 to stimulate public discussion on future noise policy,[8] focusing on the areas where the European Commission believes the Community's involvement in co-operation with Member States and local authorities can bring added value and be of particular benefit for the public at large.

3.6 Existing EC Directives on environmental noise focus on fixing maximum sound emission levels for individual sources such as vehicles, aeroplanes and machinery. The original legislation on mechanical noise from motor vehicles was adopted in 1970 (Directive 70/157/EEC) and has since been amended nine times. The original Directives and subsequent amendments had two purposes, to ensure that noise limits set by individual Member States do not create barriers to trade, and progressively to reduce noise limits for environmental reasons. Directives were of the kind known as 'optional' or as providing 'optional harmonisation'.[9] The latest amendment (Directive 92/97/EEC), however, introduces mandatory noise limits which Member States are obliged to apply. The amendment came into force in the UK on 1 October 1996 for all new vehicles and represents a reduction of 85% (8 dB(A)) in noise levels for cars and over 90% (11 dB(A)) for heavy lorries compared to the situation in the early 1970s. The limits for cars and for other vehicles of less than 3.5 tonnes gross vehicle weight are 1 dB(A) higher if the engine is diesel.[10]

3.7 Motorcycle noise can be more intrusive and disturbing than that from other road vehicles. A series of EC Directives limits motorcycle noise specifically, laying down standards for replacement exhausts and silencers, and prohibiting the marketing and use of those which do not meet those standards. In the UK, regulations made under the Motor Cycle Act 1987 make it an offence to sell or supply exhaust systems and silencers that do not meet British Standard specifications for noise performance.[11]

3.8 The Green Paper questions the overall success of the legislation on individual vehicles, suggesting that predicted reductions in noise levels have not been achieved in practice and overall reductions in exposure levels to environmental noise have not been significant. Studies suggest the reduction in

actual road traffic noise levels as a result of legislation has been only 1–2 dB(A). Reasons for this include slow replacement of older, noisier vehicles; significant growth in traffic; the increased relative contribution of tyre and road noise; and a test procedure which does not reflect realistic driving conditions. In addition, although noise is included as an element to be checked as part of basic EC roadworthiness testing, this is generally only represented by a check to ensure that silencers are intact. Without a regular inspection procedure to ensure maintenance of acoustic design features, performance will inevitably deteriorate with time. The Green Paper recommends that noise should be more formally incorporated into legislation on the roadworthiness testing of vehicles.

3.9 As the limits have fallen, tyre noise has become more significant and, with the new limits, it will be the main component of road vehicle noise at speeds above 50 km/hour. The Green Paper considered that further reductions in noise limit values of 2 dB(A) are technically feasible but are likely to be expensive. In addition, further modifications may affect the weight of vehicles and thus have adverse implications for fuel consumption.[12] It states that 'the point has now been reached where without action to address tyre/road noise, a further lowering of the limits would not be effective'. The 1992 amendment to the original 1970 Directive thus calls on the European Commission to present a proposal to address the problem of tyre/road noise.

3.10 The Eighteenth Report also recognised that the scope for further improvements in sound levels from internal combustion engines was limited; it noted the greater contribution which heavy vehicles make to overall levels of traffic noise and suggested that achievement of its targets would depend to a considerable extent on traffic management, the use of quieter surfacing materials and screening rather than improvements in vehicle design and performance.[13] Thus the Commission's specific recommendations on the use, where appropriate, of 'porous asphalt' and 'whisper concrete', continuing research and development of road-surfacing materials with better performance and the more innovative use of barriers to control traffic noise.[14]

3.11 Quieter roads through the use of quieter road-surfacing materials are the objectives of many local residents' action groups (box 3B[15]). One such material, porous asphalt, is acknowledged to be significantly quieter than typical hot-rolled asphalt surfaces used on UK motorways. Initially the benefit in terms of noise reduction is of the order of 5 dB(A); after a number of years the difference reduces to 3 dB(A) but this is still equivalent to halving the volume of traffic. Porous asphalt laid on a stretch of the M4 near Cardiff led to noise reductions equivalent to a cut in traffic of 85%; this greater than average improvement in noise levels was the result of the poor condition of the original road surface.[16] Porous asphalt has not been used extensively in the UK, although in the Netherlands any road carrying more than 35,000 vehicles a day must be laid with porous asphalt.[17]

BOX 3B **TRAFFIC NOISE AND ROAD SURFACING**

Marlow, Buckinghamshire – Half of the 15,000 population of Marlow are affected by noise from the A404. The problem is compounded by the fact that the road is raised on an embankment, so that the noise is generated at height, travels further and is reflected off surrounding hills back into the town's residential areas. Residents have been campaigning for several years for a noise-reducing surface to be used when the road next needs resurfacing.

Warblington, Sussex – Residents are campaigning for resurfacing of the A27 Havant–Chichester, a stretch of eight miles of dual carriageway with a ridged concrete surface. The section of road cost £20 million to design and construct and it is claimed that nearly £22 million in compensation has been paid to 2,488 people to date.

Gosford, Oxfordshire – Residents campaigning against noise pollution from the A34 Gosford by-pass have lodged a complaint with the Ombudsman. They accused DOT of refusing to act on proof of excessive noise from the road's 'defectively-designed concrete carriageway surface'. It is argued that residents were not informed at the public inquiry into the by-pass that a ridged concrete carriageway might be specified. It is also claimed that a report from the Transport Research Laboratory found that the A34 stretch was the noisiest road of its type in the country and that noise levels are 5 dB(A) higher than predicted on the basis of DOT methodology. Traffic flows are claimed to be 20% above forecast levels. The six mile by-pass, opened in 1990, is not due for resurfacing for 20–40 years.

3.12 Porous asphalt has clear advantages in reducing noise over conventional hot-rolled asphalt surfaces. However, its disadvantages should also be acknowledged. Compared to hot-rolled asphalt, the surface is more expensive to lay and maintain, uses many times more high quality crushed rock (primary aggregate) to ensure skidding resistance and needs more frequent salting to keep it free of ice in winter. As a result of the latter, a winter safety problem has arisen in both Austria and the Netherlands where porous asphalt has been used extensively. Whisper concrete, a cheaper surface, producing typical noise reductions of 1–2 dB(A) relative to hot-rolled asphalt, has been introduced in Belgium and Austria to reduce the accident problem.

3.13 In addition to reducing noise, resurfacing roads can reduce skidding and improve road safety. The use of porous asphalt is said to reduce roadspray and could thus reduce road accidents in wet weather conditions. However, the precise linkage between roadspray and accidents is not clear. Although spray is reduced by porous asphalt, people tend to drive more quickly as a result of improved visibility and there has not been a corresponding reduction in wet weather accidents as a result of its use.[18] The advantages and disadvantages of porous asphalt as described above highlight the many different environmental factors – resource use, potential ecosystem damage and road safety as well as noise – which must be taken into consideration when selecting a road-surfacing material.

3.14 The UK has carried out research and development on road-surfacing materials for many years and a great deal of work at the Transport Research Laboratory has focused on both skidding performance and durability. One such development is the use of thin bituminous overlays, recently accepted for use in the UK. They were developed in France and Germany and have a noise performance similar to whisper concrete. They are cheaper than both porous and hot-rolled asphalt and technically suitable as overlays for existing roads, not the case for porous asphalt. They are increasingly being used in this country to restore riding quality and skidding performance where other surface dressing methods, although cheaper, would generate excessive tyre noise.[19]

3.15 As well as recommending more use of quieter road-surfacing materials, the Eighteenth Report argued that there should be more extensive and innovative use of barriers. The Highways Agency has issued advice on improving the aesthetic design and performance of noise barriers and box 3C provides an example of a county council which has made full use of noise barriers and actively implemented the spirit of the Commission's recommendations.[20]

BOX 3C **NOISE MITIGATION IN THE BLACKWATER VALLEY**

Surrey County Council has taken great care to reduce noise from the new Blackwater Valley Route in the north-east of the county, as follows:

- the road has been taken under the Basingstoke Canal, a railway line and the Aldershot Road in concrete troughs lined with noise absorbent blocks;
- porous asphalt has been used;
- on some stretches of the road, 2-metre high earth bunds provide landscaped noise barriers;
- where space is limited, noise barrier fences have been erected.

The narrowness of the valley is such that about 100 houses are located within 100 metres of the new road. By taking these mitigation measures, the County Council expects road traffic noise will be well below the levels for which residential property insulation would be available under the 1975 Noise Insulation Regulations.

The barriers also provide visual screening. Care was taken to retain existing trees and shrubs close to the road. These, together with new planting, help to reduce the road's visual impact on the landscape.

3.16 Another source of noise associated with road transport which causes a great deal of annoyance is car burglar alarms. They are classed as a statutory nuisance and come under local authority control. Car alarms are covered by The Road Vehicles (Construction and Use) Regulations, which limit their continuous

sounding to a maximum of five minutes. The government has proposed to amend these Regulations to introduce standards for car alarms and thus help to control nuisance from this source. A consultation paper proposed that car alarms fitted to or used in cars after 1 August 1992 should meet the following requirements: no audible sound to be emitted for more than 30 seconds; the signal should be emitted by the vehicle horn or a device which conforms to vehicle horn-type approval requirements; any audible or visual alarm signal should not repeat unless the vehicle is tampered with. No action has yet been taken to introduce the necessary amending Regulations.[21]

3.17 Rail noise, like aircraft noise but unlike road noise, is characterised by high noise levels of relatively short duration. At low speed, the main source of noise is the engine, while at travelling speeds the noise produced by the interaction of track and wheels exceeds that of the engine. The level of noise is dependent on the condition of the wheel; its characteristics; the construction of the rolling stock; speed; and the condition of the track. Noise levels produced by freight trains travelling at speeds of 100 km/hour are about 4–5 dB(A) higher than that of passenger trains at speeds of 200 km/hour.[22]

3.18 European Commission proposals dating from 1983 related to maximum permitted noise emission levels of rail-mounted vehicles were withdrawn in 1993. In the meantime, some Member States have considered introducing their own controls on railway noise emissions; noise limits have been introduced in Austria. Noise emissions from individual trains have fallen; this has been associated with the change from diesel to electric passenger trains, the introduction of welded rails to replace jointed rail and the greater use of disc-braked rolling stock.

3.19 At very high speeds, aerodynamic noise is the most important component of railway noise and the development of high speed rail is an issue of particular concern. Noise is the main subject of complaint when new lines are under discussion; the development of the high speed link from London to the Channel Tunnel is causing especial concern in south-east England. Current practice is to include noise abatement measures in the planning and construction of such lines. This was the approach adopted by British Rail/ Railfreight Distribution with respect to Channel Tunnel traffic; noise mitigation schemes were agreed with Kent and Surrey County Councils and the London Borough of Bromley, with acoustic barriers being erected at affected places alongside existing lines to and from the Tunnel.[23]

3.20 Mitigation of railway noise is an important area. Achievement of a better balance between different modes of travel is a priority for Community transport policy, as well as being a cornerstone of the recommendations of the Eighteenth Report; this will in turn mean a greater role for rail. However, there is opposition in some areas to increased use of the existing infrastructure, especially at night. Increased noise abatement efforts are required if the expansion of rail traffic, and especially rail freight traffic, is to gain wider acceptance.

3.21 At the moment, the locomotives used for freight trains in Britain are elderly. Their replacement should have significant effect in reducing noise (5.10 refers to investment plans by the main rail freight operating company). The other area where there is potential for improvement is noise from wagon bodies; designs that reduce noise considerably have been developed in Britain and the USA.[24] Given the prospect of some form of European legislation eventually on railway noise (3.26*c*), it would be prudent for companies investing in new wagons to ensure that they take advantage of the latest technology for noise reduction.

Adequacy of existing measures and need for additional measures

3.22 The targets for noise reduction proposed in the Eighteenth Report have not been accepted. The Transport Green Paper stated further reductions in noise levels from road traffic were desired but that the EC legislation on road vehicles as individual sources of noise implemented in the UK should achieve this. Further, it is stated that the advice given on use of barriers, the development in conjunction with the concrete industry of whisper concrete[25] and the use where appropriate of porous asphalt will help to reduce overall noise levels from roads. Research continues into quieter road-surfacing materials and noise mitigation barriers.[26] In specifically rejecting noise targets, it was stated that 'targets for noise exposure and reduction cannot be set until an assessment of the current noise climate has been carried out, a reliable basis for levels in terms of public health has been set, and an analysis of the costs and benefits of the measures which would be needed to achieve them has been completed'.[27]

3.23 Noise is, however, taken into account in individual land use planning decisions. Environmental impact assessment ensures that the likely impact on noise levels of new roads or railway lines is assessed early in the planning stage. There is statutory provision for noise insulation grants or compensation for owners of qualifying properties affected by noise from new roads and regulations which bring rail into line with roads came into force in March 1996. The Eighteenth Report proposed changes to the grants for insulation and compensation for loss of value of properties available to those affected by road and rail noise such that the number of householders eligible for help would be extended.[28] The situation in this respect remains unchanged at present, although we are informed that a review of the costs of implementing such changes is in progress.

3.24 Another strand of noise policy is represented by guidance to ensure that noise exposure for new housing and other noise-sensitive developments, such as schools and hospitals, is taken into account. Planning Policy Guidance Note 24 (PPG 24), produced in 1994, discusses noise mitigation measures and recommends levels of noise exposure by category (road traffic, aircraft and railways as well as mixed stationary sources) for new dwellings near existing sources.[29] The Eighteenth Report recommended linking planning guidance on noise with the specific targets it proposed.[30] Although the targets of 65 $dBL_{Aeq.16h}$ and 59 $dBL_{Aeq.8h}$ for daytime and night-time noise have not been accepted, they are in fact close to the noise levels at the boundary of noise exposure categories B and C contained in PPG 24, representing the point above which planning permission should not normally be given (box 3D[31]).

3.25 Local authorities are expected to play a major role in noise policy. The 1996 Transport Green Paper stated that noise must be considered alongside other environmental impacts in developing transport strategies and local authorities will often need to balance the aim of improving road safety with other aims of reducing noise, improving air quality and maintaining accessibility. For example, traffic calming may be effective in reducing the noise in residential areas and provide additional benefits in terms of road safety but there may be penalties in terms of deterioration of air quality and traffic diversion which may merely transfer the noise from one area to another.

3.26 The European Commission's Green Paper outlines the options for future action on noise being considered for Europe. Measures fall into five main areas, two of which, reducing noise from air transport and from outdoor machinery, are not considered in this review. The remaining three are:

a. harmonisation. The available data on noise exposure are generally poor compared to those collected for other environmental problems, with different measurement and assessment methods being used in different countries. Improvements in noise data, their comparability and monitoring and the provision of information to the public are the main priorities for short- and medium-term action. Measures that could be included in legislation include establishment of a common EC noise exposure index; the development and use of harmonised prediction and measurement methods for assessing environmental noise from different source categories; the exchange of comparable information on noise exposure between Member States; the assessment of environmental noise exposure by competent authorities in the Member States; and provision of information on exposure to the public.

b. reduction of road traffic noise. The European Commission has already been asked to come forward with a proposal on tyre noise. The cost-effectiveness of a variety of other options will also be assessed, including: whether more differentiation in existing annual vehicle and fuel taxes to take account of noise costs could be an effective instrument; a technical revision of the test procedure to make it reflect driving conditions more realistically; amending legislation on roadworthiness tests to include specific noise testing of in-use vehicles; and actions to promote the use of low noise surfaces.

c. reduction of railway noise. The problem of noise from high speed rail is being addressed in Directive 96/48/EEC on interoperability on the high speed network. The European Commission is also investigating the possibilities of other instruments including: economic instruments such as a variable track charge which would enable the infrastructure fee for the use of the track to be differentiated according to the noise levels of the wagons; legislation on emission limits; a negotiated agreement with the railways industry on targets for noise reductions; and measures to ensure maintenance of in-use equipment.

BOX 3D PLANNING POLICY GUIDANCE NOTE ON NOISE (PPG 24)

Planning Policy Guidance Note 24 sets out the general principles of how noise should be taken into account in the planning process; it deals with noise from road traffic, aircraft and railways as well as stationary noise sources. For each of four noise exposure categories (A–D), the limits in the following table are recommended for daytime (0700–2300) and night-time (2300–0700) exposure when assessing any proposal for residential developments near an existing noise source. The noise levels used when deciding the noise exposure category of a site should be representative of typical conditions.

$dBL_{Aeq,T}$

	noise exposure category			
noise source	A	B	C	D
road traffic				
0700–2300	<55	55–63	63–72	>72
2300–0700	<45	45–57	57–66	>66
rail traffic				
0700–2300	<55	55–66	66–74	>74
2300–0700	<45	45–59	59–66	>66
air traffic				
0700–2300	<57	57–66	66–72	>72
2300–0700	<48	48–57	57–66	>66
mixed sources				
0700–2300	<55	55–63	63–72	>72
2300–0700	<45	45–57	57–66	>66

The noise exposure categories are defined as follows:

A: Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as desirable.

B: Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.

C: Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.

D: Planning permission should normally be refused.

3.27 The UK's response to the Green Paper was submitted in March 1997; its main points, including those dealing specifically with road and railway noise, are summarised in box 3E.[32] Although the Green Paper is said to 'promote a useful and important debate', the UK opposed proposals seeking to extend the European Commission's role beyond its traditional and accepted one relating to the reduction of noise at source, especially from vehicles and equipment.

3.28 The then government expressed doubts that the costs of acting on these proposals would be justified by the environmental benefits accrued. The costs of reduction measures will depend on the specific targets chosen but, as an example, the costs of achieving the Eighteenth Report's targets for daytime and night-time road and rail noise (3.2) were estimated at between £4 and £5 billion. There

BOX 3E **UK RESPONSE TO THE EUROPEAN COMMISSION'S GREEN PAPER ON FUTURE NOISE POLICY**

In its response sent to the European Commission in March 1997 the UK:

welcomed the opportunity to participate in a wider debate about the often difficult issues relating to environmental noise and its effects;

was pleased to participate in discussions concerning the unreliability and problems of comparability of data on noise exposure and health impacts and to encourage initiatives to improve knowledge of these subjects. But it had concerns about the use of partial and not always comparable data in justifying the Green Paper proposals;

had very considerable concerns that the Green Paper contained no assessment of the potential costs and benefits of the proposals it contained;

strongly believed there was no justification for Community legislation to harmonise methods of assessment of noise exposure, exchange information, establish target noise values and reduction plans to achieve them. Such action would open up a new field of Community activity which traditionally and rightly had been the exclusive concern of national, regional and local authorities;

welcomed the suggestion that the Commission would assess the most effective combinations of measures for the three main transport noise sources and that it should continue to support research in these areas. The UK government looked forward to participating fully in consideration of possible options for future noise reduction in all three areas;

believed that action on tyre/road surface noise may be justified once the safety implications have been fully explored;

had concerns about the proposal to introduce variable railway track charges;

believed that a number of the Green Paper proposals are premature and that more work was required, through research and exchange of information amongst technical experts and policy-makers, in order to inform national, regional and local noise policies. The Commission could play a useful role in facilitating and co-ordinating this work.

are also concerns that variable rail track charges could make the railways less attractive for freight. The previous government did, however, believe that the Green Paper identified a useful new role for the Community in relation to research, exchange of information and best practice. Following a conference on the Green Paper in the Netherlands, the European Commission has been advised to carry out preparatory work on future noise policy in separate working groups covering such topics as noise calculation methodology; noise effects; cost-effectiveness; emission limits for railway freight wagons; noise maps; and guidelines for local authorities. The terms of reference for the working groups are due to be discussed at a conference in autumn 1997.[33]

3.29 We conclude that exposure to transport noise in the UK remains a serious problem and welcome the development of EC activities which treat exposure to environmental noise more seriously than hitherto. However, we share the previous government's concerns about the possible effects of variable track charges on reducing the attractiveness of the railways compared to the roads. We acknowledge the potential conflict existing between the desire to increase rail's share of traffic, particularly of freight traffic, and public antagonism towards noisy railways. The need to transfer traffic onto the railways and use the railway network more efficiently will inevitably mean increased rail movements. We believe that developments in quieter track and rolling stock have been made and that greater priority should now be given to updating the existing network and rolling stock and reducing railway noise.

3.30 We note the following UK research commitments in the field of transport noise: to monitor the performance of whisper concrete and initiate trials of other low noise surfaces; to confirm the

relationship between surface characteristics and skidding performance; to continue research on the effectiveness of barriers and their interaction with porous surfaces and cuttings.[34] In our view, with respect to quieter road surfaces, as soon as their safety, durability and efficacy is established, the UK should adopt a policy, like that in the Netherlands, requiring roads carrying heavy traffic to be surfaced using these materials.

3.31 We believe that technical measures are available to make both road and rail transport quieter. These measures should be taken as soon as possible in pursuit of the targets proposed in the Eighteenth Report which we believe are still valid.

Reducing environmental damage by changing transport patterns

Chapter 4

GETTING ABOUT IN OTHER WAYS

What is being done, and what more could be done, to make alternatives to car journeys more attractive? One aspect is the scope for avoiding some journeys altogether. Another aspect is the scope for transferring particular types of journey to other modes. To be attractive in competition with cars, not only must rail, bus, light rail, cycling and walking be much improved in terms of quality of services and facilities, they must also become elements in an integrated system.

4.1 This part of our report deals with ways of reducing environmental damage by changing transport patterns. Two of the objectives proposed for transport policy in the Eighteenth Report (box 1A) were:

> to improve the quality of life, particularly in towns and cities, by reducing the dominance of cars and lorries and providing alternative means of access;
>
> to increase the proportions of personal travel and freight transport by environmentally less damaging modes and to make the best use of existing infrastructure.

Pursuing these objectives was seen as an essential contribution to other policy objectives. Other modes use less energy than cars and lorries (1.45–1.46 and box 1B). They generally have less effect on air quality (although further action is needed to deal with emissions of particulates and nitrogen oxides from diesel buses). They are also generally less noisy. Use of modes other than cars and lorries limits congestion by reducing the number of movements by road vehicles and the demand for road space. This facilitates the efficient functioning of the economy. It also averts pressures to use further land for road building.

4.2 Analysis of how people get about in Britain at present shows the dominance of cars, although the numbers differ according to whether the analysis is by journeys or by distance travelled (table 4.1[1]), and whether journeys of less than a mile are excluded (as in table 4.2, where the bottom row

Table 4.1
How people get about

percentages rounded to nearest whole number

	proportion of journeys	proportion of distance travelled
on foot	29	3
by cycle	2	1
by car	59	81
by local bus	6	4
by rail	1	5
in other ways	3	7
all modes	100	100

This analysis covers journeys made in Great Britain in 1993/95, *including* journeys of less than one mile, but excluding any distance travelled outside Great Britain in the course of a journey.
Where a journey involved use of more than one mode, it was assigned to the mode used for the longest part of the journey.

can be compared with the left-hand column of table 4.1). Journeys are a more relevant measure in urban areas where it is the number of vehicles moving or parked that causes problems, and where short car journeys are disproportionately polluting. Distance travelled may be a more relevant measure in the context of carbon dioxide emissions or land take. The targets proposed in the Eighteenth Report for changing the use made of different modes recognised these differences (see appendix A).

4.3 The concept of setting national targets for modal shares has been criticised. It was central to the Eighteenth Report that transport policies must have both specific objectives and quantified targets, against which progress towards the objectives can be monitored and reviewed. Within that general approach, we remain convinced of the value of targets for modal shares in fostering a strategic approach to complex issues. Even where achieving particular targets lies outside the direct power of central government, they can provide important guidance to local authorities, transport operators, transport users and suppliers about the extent and direction of change required. Setting challenging targets can help stimulate new thinking about solutions to difficult problems. The proposals in the Eighteenth Report about specific targets were presented as subject to detailed evaluation and modification by government; we have not attempted to carry out that task ourselves in this review.

4.4 This chapter looks at what can be done to make alternatives to car travel more attractive; movement of freight is discussed in the next chapter. Choices of mode will be much affected by measures to secure better use of the existing road network, which are discussed in chapter 6. Later sections of this chapter discuss how better use can be made of the existing infrastructure for public transport, and in what respects it needs to be augmented. Because the use made of cars is itself increasing, reducing the proportions of either distance travelled or journeys for which a car is used (rather than simply increasing the use made of other modes) is a particularly challenging objective. It entails a reversal of longstanding trends, of which there is little sign as yet (1.21–1.28). That reversal is in our view a pre-condition for an environmentally sustainable transport system.

Car dependence

4.5 For some people dependence on a car may be the result of disability[2] or age.[3] Many people, however, have to a certain extent chosen to build their present way of life around their car, and depend on it for most regular and occasional journeys. This has been characterised as 'car dependence' and studied in a report commissioned by the RAC Foundation for Motoring and the Environment.[4] For most people such lifestyles are to a degree the product of land use patterns which it will take many decades to change. The report also took into account the importance of cars as social signals and psychological symbols. It concluded that as few as 20% of car trips are necessary and have to be made by car. The bulk of car trips (50–70%) 'do not inherently have to be made by car, or in some cases at all, but the current options on offer make it unattractive to use an alternative mode, and there is no great incentive to avoid or consolidate the trip.'[5] This leaves a proportion of current car trips (5–30%) that could easily be avoided or made in other ways. Transfer of the trips in this last category from cars to other modes would be, at minimum, a big contribution to achieving the targets for reduced car use in urban areas proposed in the Eighteenth Report (target C1, see appendix A).

4.6 In reality, shifting the balance away from private road transport does not mean transferring a defined set of journeys from cars to other modes. There are many ways in which people can participate in the social and economic activities of everyday life (and in which goods and services can be delivered efficiently). If the relative importance of different modes changes, some of the journeys made subsequently will be for different purposes or to different destinations or at different times of day.

4.7 Some local authorities are seeking to change attitudes to car travel through publicity campaigns. The TravelWise initiative, started in Hertfordshire in 1993 and now taken up by 50 local authorities throughout Britain, aims to encourage individuals and organisations to consider using alternative modes. It includes discussions with target groups and brokering the formation of partnerships which can bring about change. This approach is based on the belief that, before behaviour is influenced, people's attitudes will need to change. Many TravelWise authorities are conducting surveys to monitor both attitudes and traffic levels. The organisers of the Hertfordshire campaign feel that the effects will be longer-term, and that it will be a few years before they are easily measurable.[6]

4.8 Another approach to reducing car dependence is to wean people away from regarding ownership of a car as a necessity. 'Car clubs' which make a car available to a member when required are believed to operate in over 300 towns and cities in continental Europe. The first British car club is due to start in an area of Edinburgh in January 1998 with the intention that, if this pilot is successful, clubs will be formed in other parts of the city. A member will be able to book a car for use at any time, and will obtain the car key from a safe to which he or she will have access. Experience in Germany is that, when someone joins such a scheme, the distance he or she travels by car falls by up to 50%.[7]

4.9 General surveys of public attitudes show a shift over the last five years or so away from support for road building and towards measures to improve public transport and to restrain car travel or increase its cost.[8] However, people's behaviour does not always correspond with their expressed attitudes. Some campaigns have been successful in changing behaviour, such as that against drinking and driving; experience shows that the most effective results are obtained when concerted national publicity is complemented by other forms of government action (in that example, more rigorous enforcement of the law against driving after drinking).[9]

Targeting regular journeys

4.10 Cars are likely to remain the dominant mode for many types of journey. Attempts to encourage use of other modes may be most effective if they focus on particular categories of journey, starting with journeys for which an alternative is readily available. Policies can then be progressively extended to other types of journey for which satisfactory alternatives can be made available by improving public transport or the facilities for cycling or walking or reducing the number of journeys needed.[10] The reasons people make journeys and the modes they currently use for those journeys are summarised in table 4.2.[11] Despite the volatility of travel patterns there are types of regular journey which are at present made predominantly by car and together account for a substantial proportion of personal travel. The suggested sustainability indicators for the UK (1.20) picked out journeys to and from work, for education, and for shopping.[12] We look at each of these in turn, and more briefly at journeys for recreation and leisure.

Journeys to and from work

4.11 Travel to and from work accounts for 19% of all journeys over one mile, of which 75% are made by car as either driver or passenger. This is an area where, by careful planning and co-operation, more could be done to make alternatives to car travel possible and attractive. Information received for the review shows some innovative schemes but it appears that much more could be done to encourage employers to take responsibility for ensuring that there is provision for alternatives to the private car and arrangements for car-pooling or car-sharing and to discourage car dependence for commuting.

4.12 Where new companies and other organisations are being developed or existing ones expanded the planning system can be used to address transport issues for example by imposing a limit on the number of car parking spaces and encouraging the provision of access by alternative modes. In some instances action is being taken to persuade companies to encourage alternatives to the car on a voluntary basis, for example through Business TravelWise in Hertfordshire, a development of the TravelWise initiative (4.7). Business TravelWise was launched a year ago and is directed at encouraging companies to develop commuter plans with the objective of reducing the number of staff who travel to and from work in single-occupancy cars. Companies are encouraged to consider and promote alternatives. The benefits to the company in terms of cost, health of employees and public image are highlighted and the campaign coordinators help to forge links between companies and other relevant organisations such as the highway authorities. So far 13 employers in Hertfordshire (some of them quite major companies) have joined the scheme and are preparing commuter plans. The success of such initiatives will in the end depend on the extent to which fiscal and other policies are pulling in the same direction. The provision of company cars and tax arrangements relating to

Table 4.2
Why and how people travel

percentages rounded to nearest whole number

proportion of journeys	proportion of distance travelled		proportion of journeys for each purpose made wholly or mainly								
			on foot	by cycle	by car		by local bus	by rail	in other ways	all modes
					driver	*passenger*				
31	42	leisure	11	2	*39* 76	*38*	5	1	5	100
19	13	other personal business	4	1	*56* 87	*31*	5	1	3	100
19	19	to and from work	4	3	*62* 75	*14*	9	4	5	100
19	12	shopping	7	1	*46* 75	*29*	14	1	2	100
5	11	business	1	1	*82* 90	*8*	1	2	4	100
8	4	education	14	3	*27* 58	*31*	17	1	8	100
100	100	all purposes	7	2	*49* 77	*28*	8	1	4	100

This analysis covers journeys made in Great Britain in 1993/95, *excluding* journeys of less than one mile, and excluding any distance travelled outside Great Britain in the course of a journey. Where a journey involved use of more than one mode, it was assigned to the mode used for the longest part of the journey.

such provision lead to distortions which appear to result in a level of car use than would otherwise be the case (6.7–6.8).

4.13 The degree to which telecommunications and teleworking could be helpful in reducing overall levels of travel is unclear.[13] It appears that there is much greater potential for distance-working and distance-communication (for example, through video-conferencing) than has so far been realised in the UK but there are various factors, particularly social factors, working against its wider adoption. These include the general preference for working as part of a team or at least in the same physical environment as colleagues and the fear of being overlooked for promotion if not 'seen' in the workplace. It is also not clear to what extent teleworking would actually reduce overall traffic movements since, for example, freedom from commuting journeys may allow more time for other types of journey. While there is no conclusive information for the UK either about the amount of distance-working or its potential for reducing traffic movements this may be a potential growth area and an increase in teleworking might produce some net benefit in terms of reducing the adverse environmental impacts of transport. It could also have other benefits – savings in costs, reduction of congestion at peak hours and giving people greater freedom of choice about where to live. It is an area that merits further attention in the context of reducing commuter and some other business journeys.

Journeys to and from school

4.14 The Eighteenth Report highlighted the particular problem of journeys to school where social trends mean that a much higher proportion of children travel to school by car than did so a generation ago. Three in ten children are driven to school (table 4.2), the proportion being highest for younger children.[14] There are many reasons for this, including fears for the safety of children, increased car ownership, lifestyle changes and, in some areas, the greater distances that have to be travelled to reach a school than may have been the case in the past. The vulnerability of school children to traffic risks is a real problem (but one that is increased as more parents drive their children to school) and the concern of parents to protect them is duly responsible, but clearly there are both environmental and health benefits to be gained if journeys by cars can be safely reduced.

4.15 The Transport Green Paper identified journeys to school as a key area in which changes in public behaviour could make a real difference. Twenty per cent of peak-hour car journeys now consist of school escort journeys.[15] Governmental and non-governmental organisations have published literature on safe pedestrian routes to school and produced some guidelines (box 4A).[16,17] The registered charity Sustrans provides Teacher Resource Packs.

4.16 Safe routes to school need to be part of a package of measures and, as well as moves to encourage parents to allow their children to walk to school, there must also be some more forceful measures. Camden local authority has allowed the Royal School in Hampstead to expand its day-pupil capacity by 50% on the condition that it reduce the number of cars on the 'school run' by a third within three years. Council officers have worked with the school's advisers to produce a travel plan. Promotion of alternative means of transport includes formal car-sharing arrangements, encouraging parents to use cars with smaller engines, increased use of public transport, and of school buses.[18]

4.17 In the USA much more use is made of school buses to get children to and from school, and this model could be followed in the UK in appropriate areas.

Shopping

4.18 Shopping accounts for 19% of journeys over one mile and of these 75% are made by car. Here the use of the car is regarded by many as a necessity because of the difficulty of carrying heavy shopping on public transport. Out-of-town shopping centres have developed to help people shop by car without becoming involved in town-centre congestion and parking problems but have thus also increased car travel and in their turn often generated further areas of congestion. Shopping is an area where innovative methods of operating should be considered to help to reduce the amount of personal travel.

BOX 4A WALKING SAFELY TO SCHOOL: SUMMARY OF GOOD PRACTICE

Routes should follow those currently used by the majority of pupils for their journey to school and be continuous and direct – children, like adults, do not like to go the long way round.

Routes should be as wide as possible as children like to travel in company.

Routes are likely to consist of a combination of traffic-calmed roads, and traffic-free sections. Traffic calming is essential for safe routes – research by the Transport Research Laboratory shows that accidents involving children fall by an average of 67% in 20 miles per hour zones. Road traffic accidents are the leading cause of death in five to 15 year olds. The danger is more than 50 times greater than the risk of being killed by a stranger.

In some areas 'safe houses' might be designated, where children can go if they feel threatened in any way.

Pupils' and parents' fears and perceptions of hazards must be considered as well as actual accident statistics and all routes should be designed so that secondary and older primary school children are happy to travel unaccompanied by adults.

4.19 In *Delivering Alternatives*,[19] the potential for home delivery services to reduce travel for food shopping is assessed in a study of 58 companies operating in nine countries. The study considers the potential for land use planning to reduce car use for everyday activities and states:

> Food shopping is clearly a routine activity that few would choose to travel for, and supermarkets are one of the most dynamic categories of land use, with the massive increase of out of town superstores attracting growing condemnation.

The study concludes that home delivery services could make a useful contribution to reducing the need to travel and that:

> delivery services are never going to be attractive to all of the people all of the time but they can appeal to some, and potential support may come from a broader social spectrum than is usually supposed ... given that current trends may be particularly conducive to their development, then it is plausible, that with a little more incentive, delivery of goods could become an important part of grocery retailing in the future. Together with other policy initiatives, this could result in substantial benefits, both for car owners and non-car owners alike.

The study does not quantify the impact such services could make on the volume of travel but, given that a significant proportion of journeys are for shopping, anything which makes inroads into this would be helpful in restraining overall travel growth.

4.20 Other projections suggest that a fifth of all grocery shopping could soon be carried out through home deliveries and about 16% of the entire grocery spend could transfer to home delivery or 'drive thru' collection within the next few years.[20,21] As with teleworking, it will be important to know more about the likely scale and nature of development of home deliveries and teleshopping, the social and cultural dimension of such developments and the transport implications. The result of a greater use of home delivery may not necessarily be all gain so far as reducing the amount of road transport is concerned. For example the car, freed from the shopping trip, might be used for other, possibly longer, journeys while a delivery van trip is also generated and this may be made over a greater distance than the alternative car journey would have been. On the other hand a number of deliveries can be consolidated onto one van replacing individual car journeys. Being able to shop without a car might persuade some people to do without a car. Another aspect to consider is the likely effect of an increase in home deliveries on shopping and distribution patterns more generally. For example, a possible reduction in business at the check-out for supermarkets may affect the development of large stores and also have a knock-on effect on other shops and shopping centres, which, depending on

location, might have either positive or negative effect so far as reducing car dependency is concerned.[22,23] More research needs to be done both into the transport implications of distance shopping and the factors needed to encourage the development of distance shopping in a way that will be conducive to sustainable transport. As with all other aspects of improving transport efficiency no measures can be considered in isolation but must form part of a package which both reduces the need to travel and discourages reliance on private motor vehicles.

Travel for recreation and leisure

4.21 Thirty-one per cent of journeys are for leisure purposes and 76% of these are made by car. Commercial leisure facilities are increasingly being provided on out-of-town sites.[24] To be competitive, public transport has to provide safe and frequent late night services.

4.22 Access to the countryside for recreation poses particular problems given the lack of adequate transport provision to many rural areas and the damage that can be done to some sensitive areas of countryside by their very popularity.

Cycling

4.23 We now look in turn at each of the transport modes which provide a potential alternative to cars, the extent to which it is used at present, and what can be done to make it more attractive both for regular journeys and for other journeys. Cycles are used for less than 1% of distance travelled in Britain and less than 2% of journeys made. Ownership of cycles is higher than ever,[25] but the use made of them has fluctuated in recent years, at a much lower level than in the 1950s.[26] The proportion of journeys made by cycle is much higher in some other European countries: 11% in Germany, 18% in Denmark and 27% in the Netherlands.[27] Differences in topography and climate may explain some of the difference, but by no means all of it. In some British cities, for example Cambridge, York and Kingston upon Hull, cycling is an important way of getting to work.

4.24 Cycling has much less environmental impact than any other form of wheeled transport. The Eighteenth Report proposed that the target should be to increase cycle use from 2.5% of urban journeys to 10% in 2005, with further increases thereafter. A National Cycling Strategy was launched in July 1996,[28] drawn up in partnership by government Departments, local authorities, commercial organisations and voluntary bodies. It identified targets of doubling between 1996 and 2002 the trips made annually by cycle, and quadrupling them by 2012. These were regarded as challenging yet achievable targets, and are on a broadly similar scale to what was proposed in the Eighteenth Report.

4.25 Cycling has the advantage that it is cheaper than using a car. It can benefit health by reducing obesity and the incidence of coronary heart disease. At present however it carries a high risk of death or injury. Another target proposed by the Eighteenth Report was to reduce deaths of cyclists to not more than 2 per 100 million kilometres cycled by 2000. In fact mortality has increased from 186 deaths (4.1 per 100 million kilometres cycled) in 1993 to 203 deaths (4.7 per 100 million kilometres cycled) in 1996.[29]

4.26 For it to become safe and pleasant to use cycles on a much increased scale, the following conditions will have to be met:

reductions in the speed of other traffic in urban areas (6.27) and measures to reduce pollution from vehicles (already discussed in chapter 2);

provision of networks of quality cycle routes of a standard approximating to that found in many continental cities, with special facilities for cyclists at traffic lights and roundabouts (6.28);

provision by employers, colleges and schools of secure storage for cycles and showers for cyclists;

secure cycle parks at shopping centres, rail and bus stations, and other key points.

4.27 Action to implement the National Cycling Strategy falls mainly to local authorities. As conditions vary widely in different towns the Eighteenth Report recognised that local authorities would have to set their own targets for increased cycle use in their areas. Many local authorities have established cycle routes, but often these do not represent viable networks and have not been designed to a sufficiently high standard. Networks of cycle routes need to provide assurance about convenience and safety. People will not be encouraged to cycle more if cycle routes are established on the cheap. Use of quiet multi-purpose streets as part of cycle routes may be acceptable but cycle lanes along busy roads must be continuous and physically separated from other traffic. The 1,000-mile cycle network being established in London, for example, does not aim to provide for that. As well as providing cycle routes, local authorities should ensure there is secure storage in all appropriate locations, either by providing it themselves or by reaching agreement with building owners and operators, where possible in the context of giving planning permission.

4.28 Targets for increased cycle use should form a central part of the integrated transport plans which we describe later. Cycle routes should be designed to connect with public transport. Transport operators should be required by regulators to provide secure cycle parks at rail and bus stations. Rail operators should increase the facilities for carrying cycles on trains, which have been drastically reduced in recent years. Sustrans is playing an important role: in using National Lottery money to provide long-distance cycle routes, often using abandoned railway lines, it is also taking into account their potential for shorter journeys.

4.29 Central government has a vital role in monitoring implementation of the National Cycling Strategy, the targets being set by individual local authorities for increased cycle use and the standards of provision being achieved. It also has the responsibility of ensuring that local authorities can obtain the resources to provide comprehensive networks of cycle routes within a reasonable time, an aspect discussed in chapter 7. Model cycle networks should be developed in a few pilot cities to demonstrate in conjunction with campaigns on work and school journeys the true potential for transferring journeys from cars to cycles.

4.30 A further 1% of travel is by motorcycle, moped or scooter. The total distance travelled in that way is rather less than the distance travelled by cycle, and has halved since 1985.[30] Because two-wheeled vehicles can carry at most two people, energy consumption at average occupancy is higher than for a small car or most modes of public transport.[31] Noise from motorcycles can be intrusive and has been regulated by European Community (EC) Directives (3.7). Emissions from motorcycles have not hitherto been subject to statutory regulation, but are covered in a comprehensive EC type approval Directive due to take effect in 1999–2000.[32] This will allow motorcycles to emit much higher levels of carbon monoxide and hydrocarbons than a stage II petrol car, and mopeds to emit a higher combined total of hydrocarbons and nitrogen oxides than a stage II petrol car. Although motorcycles, mopeds and scooters take up less road space than cars, we have not received any information that would indicate that they would have an environmental advantage over cars in other respects.

Walking

4.31 Like cycling, walking is a pleasant form of exercise and popular for recreation. Unlike cycling, it can still be regarded as a major form of travel, used for 29% of journeys made (table 4.1), though only 3% of distance covered. Because many journeys on foot are very short there is some uncertainty about the statistics and it is difficult to set targets. Pedestrian fatalities are falling: the 1996 figure of 997 deaths (approximately 1.8 per 100,000 population)[33] offers the prospect of achieving the Eighteenth Report's proposed target of 1.5 per 100,000 population by 2000. It is unclear, however, to what extent this improvement in the death rate represents genuine improvements in safety and to what extent it might reflect the recent decline in walking (1.25). This decline has adverse implications for the safety and attractiveness of all types of urban area and the prosperity of businesses located there, and could thus generate a downward spiral further reducing the numbers of people moving about on foot.

4.32 The measures required to increase the number of journeys made on foot have many points of similarity with measures to increase the use of cycles. They include safe and convenient pedestrian access to railway and bus stations. The Pedestrians Policy Group (a lobbying group formed in 1996)

has suggested that local authorities should commission surveys to find out what proportion of journeys in their areas are on foot, and set targets and develop strategies to increase that figure.[34] In support of this they should allocate or bid for resources to implement such strategies; introduce a pedestrian priority audit to ensure all transport schemes improve conditions for pedestrians; and encourage the formation of local action groups to give pedestrians a strong voice.

4.33 Some local authorities have set targets, albeit modest ones, for increasing the proportion of journeys to work made on foot: from 13% to 14% in York, and from 16% to 18% by 2010 in Edinburgh. Alongside improved traffic management, a major feature of their policies is the creation of safe and attractive pedestrian routes. York plans a 120 km network linking the city centre, residential areas, local shops, schools and the surrounding countryside.[35] In Worcester the city council is collaborating with the health authority's health promotion unit to signpost and publicise 'routes to work' of up to 3 km between residential areas and the city centre.[36] Radial routes are a natural extension of the creation of pedestrian areas in town and city centres, something in which the UK has until recently lagged badly behind continental countries.

4.34 In July 1996 the Department of Transport (DOT) set up a steering group, chaired by a Minister, to look at the action needed to encourage walking. A discussion document was issued in December 1996 in order to find out more about problems which discourage walking and possible solutions.[37] Working groups are being established to prepare a national strategy for walking and a good practice guide for highway authorities, developers and others involved in designing and managing the built environment. We hope this work will be carried forward energetically.

Bus

4.35 The decline in use of public transport in Britain has been a decline in bus travel. This has roughly halved since the early 1950s (when it was more important than travel by car);[38] local buses now account for only 6% of journeys and 4% of distance travelled (table 4.1). The explanations usually given are the growth in car ownership (especially in the number of households with two or more cars) and changes in patterns of living and working. The plateau in bus and coach travel between 1993 and 1995 appears to mask a further decline in local travel offset by a small increase in coach travel.[39] Stabilising bus usage, let alone increasing it considerably as the Eighteenth Report advocated, will entail a sharp reversal of previous trends (1.27).

4.36 In London the use made of buses has been increasing recently: between 1985/86 and 1993/95 the distance a person travels by bus on average in the course of a year rose by 9% in London but fell by 16% in the rest of Britain.[41] There are also success stories on particular routes elsewhere.[42] The factors that account for success are discussed below. They point to a need for radical changes in policies towards the bus industry.

4.37 For more than ten years, government policy towards the bus industry was to privatise and, outside London, deregulate. The rationale was that facilitating competition between bus operators was the best way to make the industry more efficient and improve the service to customers. Regulation of safety and the mechanical maintenance of vehicles continues to be exercised by the Traffic Commissioners and by the Vehicle Inspectorate, an executive agency of the Department of the Environment, Transport and the Regions. However, there has not been any external control over the routes operated, the fares charged or the timetable, except where a route operates with a subsidy from the local authority. A few bus undertakings remain in local authority ownership but are required to operate at arm's length from the authority.[43]

4.38 Attracted by the cashflow and the low investment required (and in some cases by opportunities for disposal of assets such as depots), many firms entered the deregulated industry. Some were management or employee buy-outs. There have been many instances of bitter local competition, but these have mainly been short-lived. There have also been many complaints to the Office of Fair Trading about abuse of local monopolies. In most areas the position has now stabilised, with the market dominated by one or two large companies.[44] Nationally the bus industry has become concentrated in the hands of a few large firms.[45]

4.39 The legal framework is different in London: following privatisation of the London Regional Transport (LRT) bus undertaking, groups of services are franchised out by LRT on the basis of competitive tenders. There is no legal bar on operators providing other bus services in London, but their inability to participate in the travel card scheme run by LRT has in practice deterred them from providing scheduled services, although several tourist services operate in central London.

4.40 The main attractions of buses in environmental terms are that they require less road space per seat than cars and emit less carbon dioxide per seat. Economies of scale apply, in that buses become more profitable to operators when higher proportions of their seats are occupied. A marked feature of the period since deregulation is that, whereas bus travel has dropped sharply, the distance travelled by buses has increased sharply (by 26% between 1985/86 and 1995/96[46]). While this may to some extent reflect a greater use of smaller buses, perhaps at greater frequencies, an important factor has presumably been a fall in occupancy as a result of duplication of services. More buses have been competing for fewer passengers.

4.41 The impact of buses on air quality is a vital consideration: expressed as emissions per passenger-kilometre, this is also subject to economies of scale. The primary factor determining the impact of a bus on air quality is its age, and thus the emission limits its engine was designed to meet. Also relevant is the standard of maintenance. One outcome of deregulation which has been of particular concern to the Commission has been the very low level of investment in new buses.[47] Buses with polluting engines were kept in use for many years. Because vehicle mileage had increased, pollution became very noticeable in some town and city centres. In its Fifteenth Report the Commission recommended financial assistance to enable bus companies to purchase less polluting new buses or fit new engines to existing buses,[48] but it is only very recently that there has been any positive reaction from government (2.57).[49] Here again the position in London is different: LRT has been able to include in franchises requirements to purchase new and less polluting buses and use less polluting fuels.[50]

4.42 The lack of investment has contributed to the dowdy image of buses. There are other, more tangible respects in which buses have been uncompetitive with cars:

- journey time, which is determined by distance from a bus route, frequency of buses, punctuality and reliability, boarding times and quality of connections with other services, as well as by the speed of moving buses;
- comfort and security, not only while travelling on a bus but while waiting for one;
- perceived cost (1.39).

4.43 If customers are lost, a downward spiral may be created in which the operator has to increase fares in order to maintain profitability, and increases in fares lead to further losses of customers. There can be a further twist in the downward spiral if the operator reacts to losses of customers by reducing services, so making public transport less attractive and reducing usage still further. Service frequency can be a major factor in demand for bus travel.[51]

4.44 Buses should have a central place in an environmentally sustainable transport system. To achieve that, major improvements are needed in several respects. There must be a much stronger focus by operators on customers and on customer care, with staff trained in customer relations. Operators will have to undertake major investment in new buses offering a high standard of comfort and with low floors for easy boarding. These buses must as a minimum meet EC stage III standards for emissions (2.26). In urban areas they should preferably be fuelled by natural gas (2.69–2.71) or have hybrid propulsion which enables them to operate without emissions for part of the time. There must be enough of them to replace buses which are not of a satisfactory standard at present and meet increased demand. We have made the assumption that public transport operators will continue to be predominantly private sector companies, and that these will be able to draw on substantial private sector funds for investment, provided they can demonstrate that the investments will be profitable. It is reasonable to expect the required degree of initiative and commitment from the large and financially strong companies which now make up the British bus industry. There are signs that the industry is trying to improve its image and the service it provides. Some large orders have recently been placed for new buses.[52]

4.45 The role of local authorities is crucial. They provide significant financial support to bus services. This amounted to £0.9 billion in England in 1994/95, the largest component (£0.4 billion) for concessionary fare schemes for the elderly and disabled.[53] By comparison the subsidy the industry receives from central government in the form of a rebate on fuel duty has now been capped and was worth only £0.2 billion in England in 1996/97.[54]

4.46 Outside London, 15% of local bus mileage is subsidised by the local authority.[55] The cost of such subsidies was £0.2 billion in England in 1994/95. In conurbations most subsidies are for modifications to commercial routes in the form of either diversions or extended starting or finishing times.[56] In rural areas entire routes may be dependent on subsidy, and operators are now seeking subsidy on some services which they have previously operated commercially. Local authority subsidies to bus services have fallen by over 58% in real terms since deregulation.[57] This is largely explained by a fall of 45% in operators' costs[58] and by increases in fares.

4.47 Perhaps more important than direct subsidy is the role of local authorities in providing the infrastructure and traffic conditions that are necessary if bus services are to be made more attractive. This includes their responsibility for provision of bus stops and bus shelters, and in some cases bus stations or interchanges, and public information about bus services. Crucial to success will be traffic management measures to improve bus journey times, especially the designation of bus lanes and priority for buses at traffic lights. This type of measure is normally funded by the public sector through transport policies and programmes (7.19).

4.48 As part of its fundamental review of transport policy, the government has launched a review of buses in order to 'examine how buses can best play their part in an integrated transport policy, ... as a means of reducing congestion and pollution, particularly by attracting motorists from their cars.'[59] Among other things, this review will consider options for regulating the bus industry in terms of the improvements they would deliver in 'key areas such as passenger information and ticketing, service frequency and reliability, and greater stability in the market'.

4.49 In order to make buses an attractive alternative to car travel, we believe local authorities will have to play a more interventionist role than at present. Local authorities already exercise detailed control over bus services which they subsidise, but that represents only a small part of the total picture. The Eighteenth Report concluded that the effects of deregulation on bus services had been largely negative.[60] We have not received any information that would lead us to revise that judgement. Although conditions in London are not comparable in all respects, the Eighteenth Report concluded that it would be advantageous to extend the London system to the rest of the UK. That system recognises that, while there are advantages in subjecting the provision of bus services to periodic competition when franchises are let, there are also advantages in giving one operator an effective monopoly during the period of the franchise. There have been innovations in the route structure in London, but it has remained relatively stable, and this has greatly facilitated the provision of accurate information to customers, including real-time information on the location of buses.

4.50 If a system of franchising is generally adopted, and in the light of the requirements for investment in new buses and the many other demands for investment faced by local authorities, we see no particular merit in local authorities retaining ownership of the bus undertakings they still own.

4.51 Opinion among operators and local authorities favours the concept of a 'quality partnership' between the local authority and a designated operator, in which the operator agrees to meet certain criteria negotiated with the local authority and the local authority contributes infrastructure improvements and/or restraints on private traffic. Such an approach is inconsistent with the basic concept of competition between operators on which present legislation is based. At a practical level it would be necessary to prevent a competing company with lower costs undercutting the improved bus service which might have required considerable investment on the part of the private operator as well as the local authority. We believe therefore that, to be effective, the quality partnership approach will require legislation, and that local authorities certainly require stronger powers in other directions such as obtaining information about services. Given such legislation the quality partnership approach may be more appropriate than franchising in certain parts of the country, but we believe franchising on the London model is the right solution for major conurbations.

4.52 Within the structure of the kind we envisage, we see no reason why the private sector should not be able to expand considerably the provision of bus services. The effect of higher bus use, resulting from the overall package of policies we advocate, should remove the need for subsidies on a large proportion of those services which are subsidised at present. It is quite likely that the remaining need for subsidy would be confined to rural areas with a relatively sparse population, where this option could be assessed against alternative approaches such as post buses and community transport schemes.

Other urban transport systems

4.53 The London Underground accounts for about a sixth of passenger-kilometres travelled by rail in Britain and more passenger journeys than the former British Rail network.[61] Journeys on the Underground reached their historic peak in 1987–89, and in 1995/96 had climbed back to only 4% below the peak.[62] Demographic trends are expected to lead to a further increase in passenger demand over the next few years.[63] The system suffers from lack of capacity on sections of line and at stations in central London, and some stations have to be closed temporarily at times of peak demand.[64] There are also considerable problems in operating reliable services because of the age of much of the signalling system and rolling stock.[65] A way must clearly be found to obtain the resources required for investment. We hope that, as well as ensuring upgrading of the existing system, the arrangements arrived at will also make it possible to undertake some of the planned extensions, and contemplate linking of Underground and former British Rail tracks to provide more orbital routes for types of journey at present very poorly served by public transport.

4.54 Other urban rail systems account for less than 2% of rail travel in Britain,[66] but are playing an increasing role. The Glasgow Underground and the Tyne and Wear Metro (which is the largest system) have been joined by the Docklands Light Railway in east London and by a growing number of light rail systems which run in the street for all or part of the time. The systems in Manchester and Sheffield, which started in 1992 and 1994 respectively, are being evaluated. Systems are under construction in the West Midlands and in the Croydon area, and other proposals are being considered.

4.55 Light rail systems have often been advocated as the form of public transport which offers the best prospect of attracting people who would otherwise use their cars; they are more comfortable than buses, more glamorous, and (if they use a segregated track) faster and not affected by congestion. On the other hand, they have a very high initial cost, although they are also expected to have a long life. Such heavy investment can be justified only where a heavy traffic flow can be expected. Doubts have been cast on whether such systems are likely to be used to capacity and on whether the scale of investment involved can be justified in terms of either reduction in road congestion or any stimulus given to the redevelopment of inner city areas. The original line of the Manchester Metro, which is generally regarded as successful, replaced two rail services and therefore took over established traffic flows. The Sheffield Supertram has a high proportion of its first line on street, without priority at junctions, and appears to have been less successful because of the extent to which it is affected by traffic congestion. Future schemes may be much more promising if they can combine use of existing railway lines with street running in a city centre (as the Manchester and Croydon systems do).[67] Use of existing railway lines will be facilitated if a safety case can be established for dual use of tracks by light rail and normal trains. This already happens in Germany, and is a key feature recently approved by the Railway Inspectorate for the proposed Sunderland extension of the Tyne and Wear Metro.[68]

4.56 Guided buses are a halfway house between normal buses and light rail systems. They can achieve light rail's advantage of segregation from other road traffic. Experience to date from the Leeds Superbus suggests that such systems, properly thought out and operated in an enterprising manner, can be very successful. There are several different forms of guided bus, the capital costs of which vary considerably. The system proposed for Liverpool involves electric traction using overhead wires and guidance by magnetic coils within the road surface. Although less glamorous than light rail, guided bus systems are cheaper and more flexible. The buses can leave the guided track if desired. Provided they can offer sufficiently fast and uncongested journeys, they seem to have considerable potential.

4.57 It has been argued that only a revolutionary form of urban transport, providing rapid journeys on demand almost from door to door, can be attractive in competition with cars. In that belief designs

have been produced for computerised systems of small vehicles carrying only a few people at a time and running at short headways on overhead electrified guideways closely spaced within urban areas with numerous off-line stations. The PRT 2000 system in the Chicago area is due to come into operation in 1998/99. In the UK the ULTRA project is seeking funding for construction of a prototype, and subsequently a pilot loop, in central Bristol.[69] Whatever the theoretical advantages of such a system, they will not be realised until the system can be provided at full scale over an extensive area. That would require considerable investment, even though the construction cost per mile is said to be relatively low.

4.58 Policies to bring about greater use of public transport in urban areas should not be based on the assumption that traditional approaches and technologies will continue to be used. Their success is likely to depend on major innovations in both technology and marketing. One positive result of bus deregulation has been the introduction in some areas of smaller buses at more frequent intervals or serving more closely spaced routes, sometimes on a hail and ride basis. A variety of forms of urban public transport are now available, and should be considered as options when strategic decisions are being made. The Liverpool system mentioned above was chosen in a competition in which Merseyside Passenger Transport Authority specified the parameters of the system but not the technology.[70] That is an approach which should be followed more widely.

Rail

4.59 Although rail travel has remained at a broadly similar level since the early 1960s it now represents only 1% of journeys and 5% of distance travelled (table 4.1). It is slightly less important in Britain than in most European countries.[71] Rail travel is most important for journeys to and from work (especially in the London area) and on business (table 4.2). Both types of traffic fluctuate with the general state of the economy. There have been some signs recently that numbers of passengers on long-distance rail services between conurbations have been increasing to levels in excess of those predicted by previous models.[72]

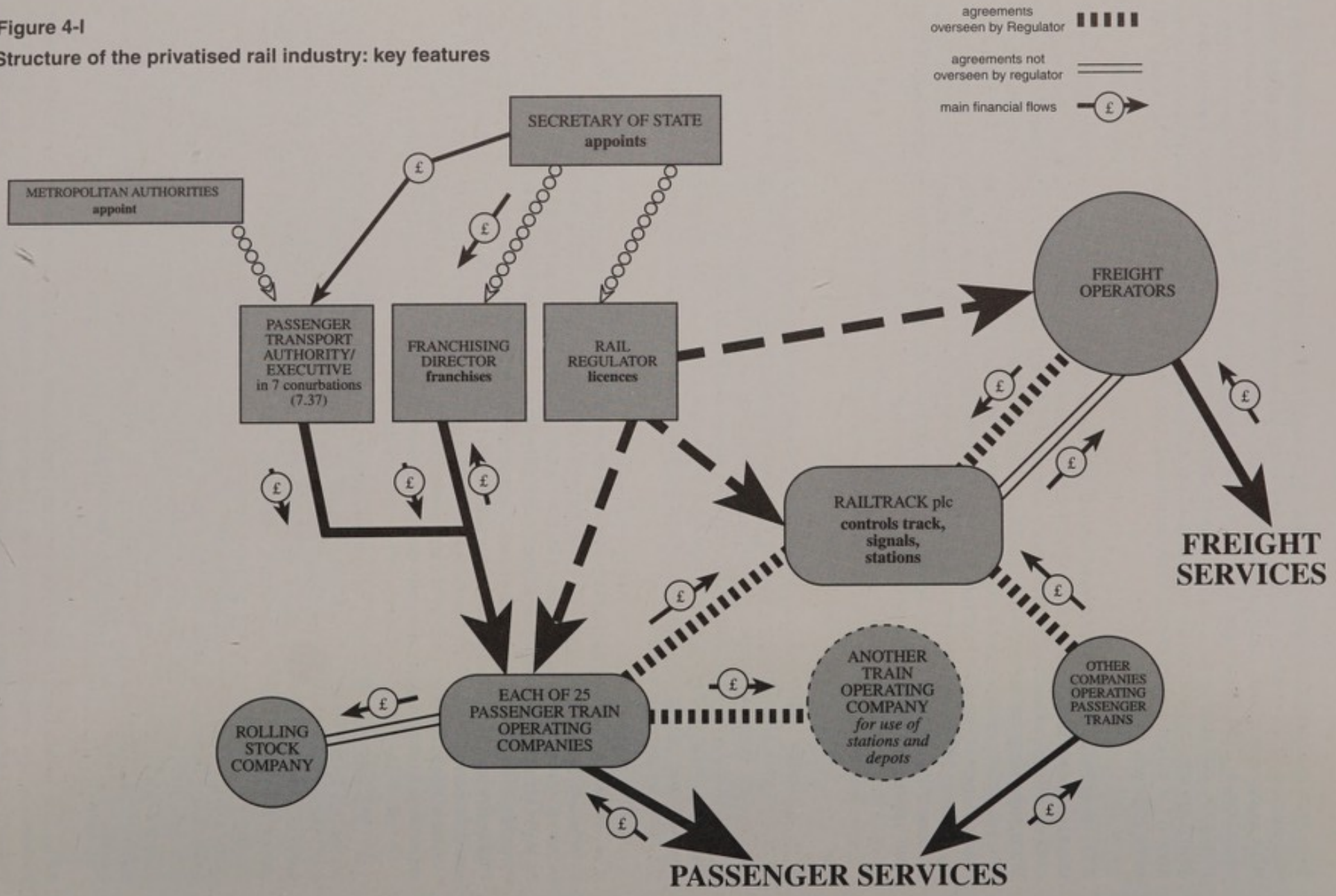
4.60 Since the Eighteenth Report was published, privatisation of passenger rail travel has been completed, and for the foreseeable future provides the context within which the place of the railways in an environmentally sustainable transport system has to be considered. The industry now has a complex structure, summarised in figure 4-I. Railtrack plc owns and controls track and signalling and owns stations. Separate companies operate regulated passenger services under franchises, using leased rolling stock, and in most cases receive subsidy. We have reviewed the prospects for increasing rail's share of personal travel on the basis of the system as it exists at present and of the information available about the intentions of the companies. Freight transport by rail, which is not franchised or subsidised, or regulated to the same extent as passenger services, is discussed in chapter 5.

4.61 The minimum obligation of a train operating company under its franchises is to maintain a prescribed level of service which is in general somewhat below that provided previously by British Rail. Bidders competed for franchises on the basis of the amount of subsidy they would require to operate such a service but in many cases committed themselves to maintaining or enhancing existing service levels and these commitments have been written into franchise agreements. The successful bidders are prepared to accept reducing amounts of subsidy over the period of a franchise (in most cases seven years, in some cases longer) or in some cases to make increasing payments to the Franchising Director. In order to make a profit, train operating companies are relying on their ability to reduce costs and on their success in increasing patronage. It is understood that the balance between planned cost reduction and revenue increase in each successful franchise bid is commercially confidential. There are also now competing rail services for some journeys, for example between London and Gatwick and London and Birmingham.

4.62 For certain types of fares, operators are constrained under their franchise agreements to restrict increases to the level of inflation or less. This provides a new safeguard for customers, who should also benefit from provisions in the franchises relating to quality of service (for example, time-keeping). Other types of fare however are left to the commercial judgement of operators.[73]

Figure 4-I

Structure of the privatised rail industry: key features



4.63 Although the train operating companies differ in operating under franchises and detailed regulation, they are similar to bus companies in having a strong cashflow and relatively small requirements for capital investment. Divesting track and rolling stock, and the long-term liabilities for stations, into separate companies greatly reduced the costs of entry to the passenger train industry. It is not surprising therefore that a large proportion of rail franchises have been obtained by bus companies.

4.64 Increased use of rail has the attraction that it makes more efficient use of existing infrastructure and, to the extent that it removes traffic from the roads, reduces congestion and averts pressure to take additional land for road building. If the railway line is electrified, there is also a clear advantage in terms of local air quality. Carbon dioxide emissions per seat are lower than for car travel, and also generally lower per passenger-kilometre at current occupancies (1.46 and box 1B). The environmental advantage of a train in this respect increases if more of its seats are occupied.

4.65 As with buses, the key respects in which rail services need to be competitive with cars are journey time, comfort and security, and cost. Trains have the advantage that they generally travel at higher speeds than cars; and, where roads are subject to congestion, they also have a major potential advantage in reliability. However, journey times are also affected by frequency of services. Use of another mode is generally required to reach a station (see table 4.3).[74] The competitiveness of rail therefore depends crucially on how effectively it interconnects with other modes. We return to this point later.

4.66 The duties placed on the Rail Regulator and the Secretary of State include exercising their functions in the manner which each considers best calculated to:

> promote the use of the railway network in Great Britain for the carriage of passengers and goods, and the development of the network, to the greatest extent that is considered economically practicable;
>
> promote efficiency and economy on the part of service providers and competition in the provision of railway services;[75]
>
> promote measures designed to facilitate the making by passengers of journeys which involve use of the services of more than one passenger service operator;
>
> enable persons providing railway services to plan the future of their businesses with a reasonable degree of assurance.

The Franchising Director is required to fulfil objectives given to him from time to time by the Secretary of State.[76]

4.67 Railtrack's primary obligations are to its shareholders to trade profitably; and to the various operating companies under regulated access agreements to maintain and operate the network to a standard that permits them to meet their obligations. It appears to be generally agreed that, because inadequate funding was available under nationalisation, there is a considerable backlog in the investment required to renew the rail infrastructure periodically and ensure that it continues to provide its existing capacity. Railtrack is required to publish annually a Network Management Statement setting out its investment plans. Its latest Statement, published in February 1997 suggests that most of the planned expenditure represents maintenance and renewal. This is funded in part from its income from property assets but primarily from the access charges paid by passenger and freight companies. The Rail Regulator took investment requirements into account in determining the level of charges to be paid by franchised operators in the period to 2001.[77] He has recently agreed a modification to Railtrack's licence which is intended to increase public interest accountability for delivery of its investment obligations and of improved service quality and network capability.

4.68 We have been particularly interested in the extent to which Railtrack's investment programme is likely to increase the capacity of the railway system and so facilitate the large shift we would like to see from road to rail. In order to fund investment for enhancement of the network Railtrack must normally obtain the agreement of operating companies to pay additional access charges. The only major enhancement project at present in Railtrack's programme, the Thameslink 2000 project for the

north-south line across London, was inherited from British Rail. Major expenditure is required on the West Coast Main Line from London to Glasgow, but it has not yet been agreed to what extent that will involve enhancement. Railtrack envisages that capacity can be increased considerably without major new construction by installing a much more flexible signalling system: transmission-based signalling. As this is activated by the trains themselves it does not require the track to be divided into fixed sections. Railtrack has drawn up plans for the progressive installation of transmission-based signalling which extend to 2010.[78] By that date it should be in operation on the major routes between cities. However it would not have been installed even by then on most of the lines in the south-east and the north-west of England, which are some of the most heavily loaded parts of the railway system. There must be some doubt whether transmission-based signalling is suitable for the complex rail networks which exist in those areas, or at least about whether its installation there would bring major benefits in capacity.

4.69 The operating companies which seem most ready to contemplate heavy capital investment, either by Railtrack or on their own account, are those with the franchises for the main routes between conurbations, which seem to offer the best prospects for profitability. Capital expenditure announced by other franchised companies seems often to be confined to a modest expenditure on renovating the smaller stations they themselves operate and renovating (rather than restoring) rolling stock. In neither case is it likely to achieve standards that would be attractive to large numbers of car users. There is a danger that, because of the relatively short terms of most franchises with no guarantee that they would be renewed, operating companies will not find it profitable to undertake the investment that would be needed to make a real impact in attracting more people to use the railways: companies could therefore be tempted to minimise long-term investment and, towards the end of the franchise period, maximise net revenue. Where Railtrack requires payment of additional track access charges over a period that extends beyond the end of a franchise, there is provision in the legislation for the Franchising Director to give an undertaking about the way he will exercise his functions in the future, and he has given such an undertaking in relation to the Thameslink 2000 project.[79] In the case of most train operating companies additional investment may not be forthcoming unless the length of franchises is extended.

4.70 Many train operating companies are showing enterprise and a greater commitment to customers. They have an immediate incentive to increase the numbers of passengers carried where they can do so profitably within the capacity of the existing system. On many lines there is spare capacity, or will be if transmission-based signalling can be installed. Other lines are much nearer to capacity, especially at peak times. We are concerned about the difficulty of obtaining agreement on, and funding, projects to enhance the network. Failure to obtain the agreement of all parties involved could be a severe obstacle to the increased use of rail for passenger travel.

4.71 The Labour Manifesto said it was 'an overriding goal' to increase the passengers and freight carried by rail. It mentioned in particular:

> establishing more effective and accountable regulation by the Rail Regulator;
>
> ensuring that the public subsidy serves the public interest;
>
> establishing a new rail authority, combining functions previously carried out by the Franchising Director and DOT, 'to provide a clear, coherent and strategic programme for the development of the railways so that passenger expectations are met'.[80]

Pending publication of specific proposals for changes, we have assessed the system as it exists at present and existing plans for investment. There is a need for a much higher level of investment than so far planned, both in rolling stock and in enhancement of the infrastructure. Enhancement should generally take the form of finding ways to use existing infrastructure more efficiently rather than building new rail lines on new alignments.

Quality of the public transport system

4.72 Key parameters identified above for the attractiveness of buses and trains were journey time, comfort and security, and cost. Over and above these factors, cars have great inherent advantages in

convenience and flexibility. A car driver, and his or her passengers, can make a direct (or, if they so choose, indirect) journey under their own control from any place to any other place. They do not have to get out of the car, although they can if they want to. Attempts are being made to develop new forms of transport that would come close to replicating such features within an urban area (4.57), but public transport will never be able to replicate them completely. Nevertheless, if people are to be attracted to make greater use of public transport, the gap in these respects between journeys by car and journeys by alternative modes must be narrowed considerably, so that alternative ways of undertaking journeys begin to show overall advantages in a much larger proportion of cases. The only way of achieving that is to assess the role of each mode of public transport and of cycling and walking, and to plan their development, not in isolation, but as parts of an integrated system of transport. An integrated system will offer considerable advantages to users, not only in terms of convenience and flexibility, but also in terms of journey time, comfort and security, and the overall cost of a journey.

4.73 The essential requirements for an integrated system apply both within a particular mode of public transport and between modes. They are:

a. connecting services. Bus and rail routes must be timetabled in such a way that connections within and between them can be made without delay. There must either be a guarantee that cancellation or lateness of one service will not leave customers stranded or generous compensation in such an eventuality. Connecting services must connect. Taxis should be seen as an integral part of the system, so that it will be possible, for example, to pre-book a taxi when booking a rail ticket;

b. physical provision for connections. It must be possible for passengers to change from one route to another, or one mode to another, with ease, and in safety and comfort. This entails being able to wait inside railway stations, or at least in a comfortable and well-lit shelter, for connecting buses; providing secure cycle parks and car parks at all railway stations and at bus terminals; and making provision for cycles to be taken on trains. It also entails clear signing, and wherever possible eliminating stairs and awkward changes of level. A number of railway and bus stations will need to be reconstructed to make them more convenient and attractive interchanges;

c. clear, up-to-date and easily accessible information about timetables and fares. Separate rail and bus timetables are published for the whole of Britain; there is a national telephone information service for rail, and the Rail Regulator is seeking to ensure that this offers a high quality of customer service. Some local authorities publish timetables of all public transport services in their areas. LRT and the passenger transport executives (7.37) provide telephone information services. The essential need is for comprehensive and up-to-date information covering all modes to be available at the place and time when someone is considering making a journey by public transport, and during the course of that journey. Telephone is the only method by which most of the population can obtain such an information service at home or work at present. In the fairly near future it ought to be provided on the Internet, which can also offer the facility of on-the-spot booking;

d. through ticketing. It ought to be possible to buy a single ticket at the start covering the whole of a journey, even if this involves bus or rail routes provided by different operators, or a combination of bus and rail, or involves using a taxi (see above). This is not only a matter of convenience; having to buy several tickets can bring significant cost penalties.

4.74 Connections within and between public transport modes have recently been studied by a sub-group of the UK Round Table on Sustainable Development.[81] It recognised that 'action to promote the seamless journey will not be sufficient on its own to secure a major shift away from car ... use.' It nevertheless concluded that this is an important factor in the choice between public and private transport, and that 'the existence of genuine and perceived barriers to transfer within and between modes is an important and relatively neglected issue' on which action is urgently needed. Table 4.3 (derived from the group's report) shows the extent to which different modes are used in combination at present. The group believed that the absence of significant transfers between certain modes does not imply a lack of potential for much more extensive transfers within an integrated transport system, but is more likely to reflect the practical difficulties of making such connections under current

conditions. London is the part of Britain which comes closest at present to meeting the requirements for an integrated public transport system as set out above. It can be seen from the figures given in table 4.3 for the London Underground that transfers between routes and modes are much more extensive in London than in the rest of Britain.

Table 4.3
Interchange between and within transport modes

percentages rounded to the nearest whole number

	proportion of journeys using mode which involve another stage in same or other mode			
mode used for other stage	Underground	rail	bus	car/van
Underground	39	21	2	0[1]
rail	29	12	3	1
bus	21	19	11	0[1]
car/van	17	29	2	n/a

'Underground' is the London Underground, 'rail' is the former British Rail network.
Columns can sum to more than 100 because a journey can involve more than two stages.

1. Less than 0.3%.

4.75 An integrated public transport system must include special provision for people with reduced mobility, for example in the form of dial-a-ride services. Ordinary buses, coaches, light rail systems and trains should be made much more accessible; it should be possible for people with reduced mobility to board trains and trams without a step, and buses should be designed with low floors (4.44). Clearer signing and improved lay-out at interchanges (4.73) will be particularly important for them, and should have specific regard for their needs.

4.76 Deregulation of bus services has removed procedures by which public authorities previously sought to achieve integration, not only between different bus routes but between different modes.[82] Tyneside provides a vivid example. The Tyne and Wear Metro originally operated in an integrated way with feeder bus services. This protected its profitability and service frequency, and at the same time reduced congestion and pollution in the centre of Newcastle-upon-Tyne. Following bus deregulation the Passenger Transport Executive (now called Nexus), which operates the Metro, can still exercise some influence over the pattern of bus routes in the area, through the selective provision of subsidy and in other ways; but it can no longer prevent operators running into the centre of Newcastle-upon-Tyne, in competition with the Metro, in preference to serving and terminating at Metro stations.[83] In the Croydon area, in contrast, the franchising system which applies to bus services in the London area will make it possible to protect the new Croydon Tramlink from direct competition from buses; this is an intrinsic part of the financial case for the project.[84]

4.77 In principle, integration could be achieved by the private sector without government intervention if the same company operated several modes of transport in the same area. As already noted, a number of rail franchises have been granted to bus operators, although not normally in areas in which they have major networks of bus services. Two bus operators are reported to have expressed interest in purchasing the Tyne and Wear Metro (although there are no plans by the passenger transport authority to sell it). Concerns have been expressed that rail operators which are also bus operators might seek to replace their rail services with bus services. Some of the train operating companies have started feeder bus services. Another risk might be that widespread provision of such feeder services by companies operating the main rail routes would compete directly with rail services operated by other companies and thus undermine the rail network. The recent reference to the Monopolies and Mergers Commission of the acquisition of the Scotrail franchise by the coach and bus operator National Express suggests that any attempt by the private sector to secure integration across modes could be prohibited as anti-competitive. We believe that would be mistaken because, for reasons we have indicated, we do not regard public transport as an activity where it is appropriate

to promote, and rely upon, competition to ensure an efficient and attractive service to customers. There are nevertheless issues to be resolved about the regulation of a company which operates more than one mode of transport in the same area, and about the availability of investment to maintain, and where appropriate extend, services in both modes.

4.78 The continued functioning of the rail network as a co-ordinated system is safeguarded through one of the statutory duties placed on the Rail Regulator (4.66). This is appropriately exercised at national level. It has been suggested that a single regulator should be established for the rail and bus industries.[85] While there may be a good case for that, we do not believe that the functions of such a regulator in relation to the bus industry ought to extend beyond those functions exercised at present by the Traffic Commissioners and (to the extent that this remains relevant within a new statutory framework) regulation of competition. A regulator at national level would not provide an effective or suitable instrument for creating an integrated transport system. We believe the primary focus for creation of an integrated transport system covering all modes of transport ought to be at local level, though with appropriate recognition of the regional dimension. We explain in chapter 7 why we hold that view, and what procedures need to be put in place in order to create integrated transport systems. One change is certainly required in the legislation at national level: whether there is a single regulator in future or there continues to be a separate regulator for the rail industry, the present statutory duties should be extended to include facilitating journeys that cover more than one mode.

4.79 There is scope for increasing considerably the use made of public transport, as well as increasing the extent to which people get about by cycling and walking. We regard creation of an integrated transport system covering, not only all forms of public transport, but other modes as well, as an essential pre-condition for that. At the moment the legislation and institutional arrangements to bring that about are lacking especially outside London. The other vital element in the package is traffic management, which we discuss in chapter 6.

Chapter 5

REDUCING THE IMPACT OF FREIGHT MOVEMENT

What is being done, and what more could be done, to reduce the adverse impacts of freight traffic on the roads? One aspect is the scope for improving efficiency and reducing the distances over which some goods are moved. Another aspect is the scope for transferring freight from road to rail for all or part of its journey. The heaviest lorries should be permitted only on suitable roads.

5.1 The pattern of growth of freight transport (1.29–1.31) and the justification for setting targets for transferring a greater proportion of freight to environmentally less damaging modes (4.1) have already been discussed. The assumption in the National Road Traffic Forecasts, not so far modified, is that there will be a further increase in the proportion of freight transported by road. That would be most undesirable in environmental terms given the clear advantage of rail and water transport over road in terms of pollutants emitted, especially the greenhouse gas carbon dioxide (1.45).

5.2 A central problem in moving towards a less environmentally damaging freight operation is the low price of road transport compared with rail. We believe that ensuring that heavy goods vehicles (HGVs) bear their environmental cost at the margin will be an important factor in achieving the requisite modal shift. Increasing user costs to reflect the costs they impose on the public sector and the environmental and other social costs of road freight will exert pressure towards greater efficiency in the use of transport by industry. The fact that the relative cost of road freight transport in general has decreased, and the difference in the cost of a long journey and a short one in particular, is cited as an underlying cause of the growth of lorry traffic.[1] The effect of an increase in transport costs will vary considerably between industries and between individual firms, as a consequence of large variations in the proportion of overall costs represented by transport. Transport costs can account for as much as 8% of the final price of consumer goods.[2] In such cases a substantial increase in the cost of freight transport could have a significant impact. On the other hand there is a view that increasing the cost of road freight will be unlikely to achieve much on its own especially where transport costs are only a very small proportion of total costs and often 'greater importance is attached to maintaining a competitive level of customer service than to minimising road transport costs.'[3] Making road freight vehicles pay the environmental and public costs of road usage must form part of a package of measures if a significant modal shift is to be achieved.

5.3 The Eighteenth Report concluded that HGVs in particular were paying substantially less in road taxes (fuel duty and vehicle excise duty (VED)) than the appropriate share of infrastructure costs and environmental and social costs to which they give rise.[4] HGVs have a much more damaging impact than light vans and cars. We are aware of the important practical difficulty in increasing the cost of road freight transport through higher VED. The main problem is the potential effect on the competitiveness of UK hauliers of VED significantly higher than that paid (in their own countries) by vehicles registered elsewhere in Europe. A larger differential would put UK firms at a competitive disadvantage both at home and abroad, particularly since duty on diesel is also higher in the UK than elsewhere in Europe. Possible ways of overcoming that difficulty, for example by introduction of a *vignette*, are discussed in chapter 6.

Reducing freight transport intensity

5.4 Action should be taken to make better use of vehicles and to reduce the distances over which goods need to be moved. The answer lies in part in the way industry organises its activities, for example, in the location and operation of distribution centres and the greater efficiency in logistics planning and loading of goods vehicles. There are various ways in which vehicles can be better utilised to reduce empty and part-laden lorry journeys.[5] More efficient vehicle utilisation can have economic

benefits for the companies concerned as well as wider environmental benefits. In responding to this review Marks and Spencer plc has said that for the lorry fleets which it uses the 'distribution schedules are scientifically planned to minimise mileage and fuel consumption and atmospheric pollution is further reduced by the opportunity taken to avoid "rush hour" deliveries and traffic congestion through the increasing use of "out of hours" deliveries to stores.'[6] A report for the Institute of Grocery Distribution draws attention to the growing awareness of the environmental problems presented by road transport and how the industry can address these by a variety of responses including better vehicle routeing and scheduling (aided by computer packages) to reduce mileage travelled and trips made; the use of combined deliveries from multiple suppliers to Retailer Distribution Centres; and the provision of non-liveried vehicles to pool deliveries and reduce the number of vehicles needed.[7] While there has already been a reduction in the proportion of goods vehicles running empty, it has been suggested that 'future increases in the real cost of road transport, stemming primarily from higher fuel taxes and the introduction of road tolls, will give firms a greater incentive to rationalize the pattern of vehicle movement.'[8]

5.5 The location of manufacturing and retail operations in relation to the supply of raw materials and 'intermediate' products and goods is also relevant. One reason for the increase in the average distance of freight journeys is cited as 'the gradual switch from local to national and then international sourcing'.[9] Various commentators have remarked on the long distances over which goods are transported during the manufacturing and retailing processes. For example, in its Food Miles project, the SAFE Alliance points out that 'the transport of foods is responsible for over a quarter of the distance travelled by heavy goods vehicles in the UK, more than for any other major commodity group.' The SAFE Alliance also claims that 'the same amount of food is travelling 50% further around the UK by lorries than fifteen years ago – supermarkets' centralised distribution systems and just-in-time deliveries are major culprits.'[10]

5.6 The transport intensity of freight movement could be reduced if manufacturers and retailers began to reverse this trend and made greater use of local supplies. Sourcing supplies and selling goods closer to home could be one aspect of a strategy to reduce transport demand and the adverse environmental impact of freight transport.[11] The SAFE Alliance has been encouraging action by individuals, farmers and growers, food retailers and processors, local authorities and national government to promote local sources of food supplies and to reduce the distances over which food is transported. It notes some change in policy by some major supermarket chains towards more local sourcing since the Food Miles campaign was launched in 1994. Initiatives which reduce the distances over which goods are transported are to be commended and we would like to see their wider adoption.

Transferring freight movements from road to rail

5.7 The other way of reducing freight traffic on the roads is to transfer loads to other modes for all or part of their journey. One of the targets proposed in the Eighteenth Report (target D3, see appendix A) was for increasing the proportion of freight carried by water, mostly by coastal shipping. The scope for a substantial switch of freight to UK waterways is largely dependent upon the availability of specific cargoes and locational opportunities.[12] This target has turned out to be particularly ambitious because of the decline in some of the main waterborne cargoes and because water transport and rail compete with each other to a large extent. The latest analyses (1.45) suggest that water transport does not have any significant advantage over rail in environmental terms. Nonetheless, we consider that efforts should continue to maintain and increase the use of inland and coastal waters for freight.

5.8 The prospects for achieving the proposed target for transferring freight to rail (target D2, see appendix A) are much better. This will mean making rail freight transport much more attractive and competitive for a wider range of goods and facilitating the interchange of goods from road to rail. The recommended targets for increased carriage of freight by rail represent a substantial increase in traffic but the capacity for such an expansion within the present rail network is considered by both Railtrack and the freight operator, English Welsh & Scottish Railway (EWS), to be sufficient, with a moderate increase in passenger travel, providing improvements to bottlenecks and key arterial routes are undertaken as necessary. We note that the Rail Freight Group has argued that it would be feasible

to increase the proportion of freight transport by rail to up to half over a twenty-year period, broadly equivalent to the proportion of freight transport in journeys which are of more than 200 km.[13]

5.9 The significant change since the Eighteenth Report is that over the last eighteen months the majority of British Rail (BR) freight operations have been privatised. At the time of this review Railfreight Distribution (RfD), the international part of the BR freight operation, had still to be sold (the sale is dependent on clearance by the European Commission). It is too early to judge the effect of privatisation on rail's share of the freight market but there are some hopeful signs and there appears to be greater optimism about the prospect for increasing rail's share of the sector.

5.10 Innovative management under privatisation may be helpful in moving towards the Commission's targets. All three of the domestic bulk freight companies plus Rail express systems (which carries the Royal Mail) have been sold to EWS. EWS is also the prospective purchaser for RfD. EWS' parent company has made dramatic improvements to the freight operations it acquired in the USA and New Zealand and is optimistic about the potential to expand the proportion of freight transported by rail although it also sees a number of possible obstacles. EWS has the objective of tripling rail freight's market share within ten years. The company is looking for substantial increases in new markets and intermodal business and, to a lesser extent, in its existing markets. Its objective is underpinned by investment commitments, for example to spending £300 million on 250 new locomotives and the purchase of at least 500 new wagons a year.[14] Likewise, carriage of deep sea containers by rail seems to be increasing since the management buy-out by Freightliner of the operation handling deep sea container traffic to and from ports such as Felixstowe.

5.11 Railtrack also believes that there are good opportunities to expand the scale of the rail freight operation within the existing infrastructure and suggests that rail can have a significant advantage over road for certain journeys in terms of reliability (it quotes an average figure of seven minutes delay over a four-hour journey) and avoiding the cost of being held up on congested roads. Railtrack is committed to having more, higher speed paths.[15] We note Railtrack's recent plans to promote freight showing a more progressive approach to developing the freight operation on the railways including interest in developing a piggyback route between the Channel Tunnel, London and Scotland.[16] The Freight Transport Association also sees scope for developing the potential of rail following privatisation, especially in dealing with 'less-than-trainload' quantities and has referred to the possibilities for new partnerships to be created 'between service providers and companies with skills and experience in the transport market'.[17]

5.12 Overall the climate for increasing rail's share of freight transport seems to be good and certainly better than in 1994. Success will depend on a number of factors including:

the ability to provide a customer-friendly, customer-focused and flexible service;

adequate investment in rolling stock, locomotives and certain parts of the infrastructure;

good interchange facilities with other modes;

co-operation with the operators of other modes so that journeys are 'seamless';

competitive pricing;

brokering of freight capacity to low-volume customers.

5.13 Possible obstacles to success include:

the lack of an adequate network of interchange facilities and intermodal terminals;

lack of investment in the rail infrastructure;

the cost differential between road and rail freight;

the competitive threat posed by 44-tonne lorries if they are allowed;

competition with passenger services for slots.

5.14 A key factor in achieving the targets proposed in the Eighteenth Report for increasing the proportion of freight to be carried by rail is improved integration with road transport since there will almost always be some part of the journey which has to be undertaken by road. Better integration between road and rail both in terms of physical connections but also in the sense of working in closer partnership is necessary if rail is to play a fuller part in the transport of goods. It seems possible that following rail privatisation the prospects are better than before.

5.15 Making the physical connection between rail and road (and also shipping) means having good interchange facilities from which freight can be transferred between modes. A number of documents received for the review stress the need for these. A recent report by a sub-group of the UK Round Table on Sustainable Development highlights the importance of the provision of intermodal freight facilities if the restructured rail freight industry is to be successful in securing a shift of freight carriage from road to rail.[18] This report also refers to the potential hazards of interchange such as delay (an average of two hours per interchange), risk of loss and increased costs.[19] In the case studies in a manual of European best practice in transport planning, there is reference to the importance of 'combined movement' of freight 'with through carriage of containers using rail for long distances and lorry for local movement' calling for specialised rail terminals suitably placed for access.[20] Case studies in the manual refer to the policies in some other European countries (the Netherlands for instance) for ensuring that there is a pattern of appropriate terminals across the country. In its response to the 1996 Transport Green Paper, the Civic Trust, criticised the then government's 'defeatist' analysis of the scope for changes in mode of freight movement and referred, *inter alia*, to the importance of safeguarding 'key sites suitable for rail freight use on or adjoining the rail network'.[21]

5.16 The development of a network of terminals which is crucial to enhancing rail's share of freight appears to be being frustrated by a number of factors. Inadequate co-ordination means for instance that some areas have several terminals, capable of handling international freight through the Channel Tunnel, and others none.[22,23] There has in the past been criticism of Railtrack for failing to retain disused freight depots which would have provided suitable sites for terminals, although we understand its policy on this has now changed.[24] We believe that Railtrack should be discouraged from disposing of any more disused goods sidings/depots and welcome the change in its policy. Planning authorities need to ensure that suitable sites for terminals and depots are safeguarded and that development of appropriate sites is not frustrated by lack of adequate co-ordination between land use planning and transport planning.

5.17 Freight Facilities Grants are designed to meet part of the capital costs of providing rail and inland waterway freight facilities. The grant can go towards such items as rail sidings, rolling stock, containers and swapbodies, warehousing and loading equipment. Grant is now also available towards track access charges. Such grants could play a greater role than they have done in the past in promoting a shift to rail.[25] The Eighteenth Report recommended that the government should keep the grant schemes under review, and if necessary modify them and make extra resources available to stimulate the switching of freight from road to rail.

5.18 The resources available for the grants have increased and there have been some improvements in their structure but the take-up has consistently lagged behind provision. A National Audit Office (NAO) report identified a massive underspend in the allocation for these grants (between April 1985 and March 1996 the Department of Transport (DOT) paid grants totalling £32 million out of an allocation of £70 million).[26] NAO suggested that there were several factors leading to the low take-up of the grant including 'the perception, amongst companies moving freight and industry more widely, that rail freight transport was inflexible and inherently less attractive than road transport' (although NAO suggests that with the new climate following privatisation this may change), and that not enough was being done by DOT to encourage take-up of grant and to speed up the processing of applications. The take-up of these grants must be improved as part of the package of measures needed to encourage transfer of goods to rail and water. We are encouraged to learn that the Department of the Environment, Transport and the Regions has plans to re-launch the grant regime and that this will include improved marketing.[27]

5.19 Developing the potential for piggyback operations (the carriage of lorry trailers on rail wagons) is another important element in developing the freight potential of rail. At the moment, the loading gauge in the UK is too restrictive to allow carriage of full-height trailers in piggyback operations. The Piggyback Consortium is examining the possibilities of introducing this traffic to the UK. Key routes (the route from the Channel Tunnel to London and Scotland would be one such) would need gauge enhancement works to facilitate piggyback operations between the UK and mainland Europe. If such investment is justified on economic and environmental grounds, we consider that the government should take the initiative to promote it and to help finance it.

5.20 The Channel Tunnel has improved the prospects for developing new rail freight services. It offers the potential for through services over the long distances for which rail is fully competitive. As the transfer of freight from road to rail brings such clear benefits in environmental terms, through freight services should be given priority over other traffic if any issue arises at a future date about the best use of the tunnel's capacity.

5.21 Although the environmental and social benefits of transferring freight traffic from road to rail have been stressed and the prospects for this now seem to be improving, it should not be forgotten that increasing the amount of freight travelling by rail may also have an adverse environmental impact in terms of noise, especially if this means more trains travelling through residential areas particularly at night. The proposal by Central Railways in 1996 for a new rail freight line which would have passed through residential areas was opposed, and rejected by Parliament, for this reason. The development of quieter trains which is now beginning to take place (3.21) is welcomed as a step which may help to make further development of rail freight transport more acceptable.

Heavier lorries and break loads

5.22 Since 1994 certain six-axle vehicles have been allowed to operate in the UK at up to 44 tonnes when carrying containers or swapbodies to or from railheads in combined road/rail operations. In March 1997 permission was extended to lorries engaged in piggyback road/rail operations.[28] These measures will give a welcome boost to increasing the market share of rail freight. We see no reason to depart from the Commission's previous position on the introduction of heavier lorries, that generally 'the trend towards heavier and heavier goods vehicles is inconsistent with the objective of reducing the dominance of lorries in order to improve the quality of life' and that 'it is desirable on environmental grounds that the heaviest lorries should be permitted only on suitable roads.'[29]

5.23 Likewise we maintain our previous position on bridge strengthening, 'that the programme of strengthening bridges to carry 40-tonne lorries should be scaled down to the minimum necessary to provide a basic network giving such lorries access to main distribution centres.'[30] Therefore, we do not agree that this programme should be accorded priority for investment despite the recommendations of the House of Commons Select Committee on Transport to this effect.[31] While, as previously stated, we accept the need for the strengthening of some bridges to provide a basic network, we do not see the need for a more extensive programme. Under a restricted programme, priority should be given to routes which will encourage lorries not to pass through areas where their presence would be particularly obtrusive, such as town centres and residential areas, or to bridges where some further benefit could be gained from the engineering works necessitated by strengthening, for example, by enabling bridges on key routes to accommodate piggyback traffic. We believe that where bridge strengthening is required to take heavier lorries, their operators should make a greater contribution towards the cost of this than that from their present contribution through general taxation.

5.24 In our previous report we commended the practice, in certain situations, of breaking loads down into smaller vehicles for part of the journey. While there are some environmental arguments against this we also saw some potential benefits. We believe that still not enough has been done to explore the development of this type of operation and commend its further consideration, particularly where it would be possible to run the smaller vehicles on alternative and less polluting fuels.

Conclusions

5.25 Reducing the environmental impact of freight movement is an essential part of moving towards an environmentally sustainable transport system. This can in part be done by reducing the distances

over which freight has to be transported through better planning by the industry and local sourcing of supplies. Moves towards internalising the external costs imposed by road freight transport will be a stimulus in that direction. The other aspect is ensuring that a higher proportion of the necessary freight transport is by rail. This requires steps to improve the attractiveness of rail, including facilities for interchange with other modes. Increasing the cost of road transport should also make rail more attractive. It is encouraging that an integrated approach is increasingly being adopted towards logistics, with road and rail regarded as complementary modes and hauliers showing a growing interest in using rail for long journeys. We hope that both government and the industries involved will take all necessary steps to ensure that rail's potential is fully realised.

Chapter 6

MAKING BEST USE OF ROADS

The environmental and social costs associated with the transport system can be reduced if better use is made of the road network. To achieve that, such costs will have to be internalised to a greater extent than at present. Company cars should no longer receive favourable tax treatment. Tolling for use of motorways might well have disadvantages that outweigh the benefits. In urban areas the policies needed to create integrated transport systems will reduce the capacity of the road network for private vehicles. Charging for use of road space will probably be an essential component of such policies in some urban areas, as will controls over private parking.

6.1 Among the conclusions reached in chapter 2 (2.99–2.103) were that measures such as traffic management schemes will play an important part in reducing carbon dioxide emissions, and that an essential element in creating an environmentally sustainable transport system will be policies to encourage a switch of personal travel and freight transport to modes which are less damaging to the environment. The last two chapters have discussed ways of encouraging such a switch by increasing the attractiveness and capacity of modes which offer an alternative to use of cars and lorries. In order to achieve any significant switch, however, policies towards private road transport must also be coherent and consistent, and reinforce the effects of policies adopted towards other modes.

6.2 It was pointed out at the beginning of this report (1.48) that 'To the extent that environmental and social costs are not brought to bear on users' travel decisions ..., road transport ... will tend to be both more extensive and more damaging.' Internalisation of costs is a prerequisite for a socially efficient transport system: if misleading price signals are corrected, the result should be a more efficient use of resources (1.54). This is especially important in relation to a key aspect of the policy objectives identified in the Eighteenth Report (see appendix A), which is to make the best use of existing infrastructure. In this chapter we consider how the most efficient use can be made of the road network. We pay particular attention to the case for introducing measures that would internalise costs to a greater extent than at present, but we also discuss the management and financing of the road network, including the scope for using technology to increase the capacity of existing carriageways.

6.3 The specific taxes paid nationally by road users are the annual vehicle excise duty (VED) and duty on fuel. It has been a longstanding government policy to ensure that the total revenue from these two taxes 'should at least cover the full economic costs of road provision and road use'.[1] The 1996 Transport Green Paper confirmed that the government now interpreted 'economic costs' for this purpose as including those environmental costs for which a money value can be estimated.[2] As the total revenue exceeds the costs of providing and maintaining roads, the Eighteenth Report considered whether the remaining amount could be regarded as offsetting those environmental costs for which it estimated money values, but emphasised that this comparison does not take into account some important environmental costs for which it had not been possible to estimate a money value, particularly those imposed by construction of transport infrastructure.[3] Moreover many of the assumptions underlying the estimates made of money values are subject to considerable uncertainty; a recent estimate of the health costs of air pollution is much higher than that used in the Eighteenth Report (1.51).

6.4 The present government has extended the commitment by the previous government to increase fuel duty annually in real terms. This policy is bringing about a closer relationship between the full costs of transport and the benefits transport yields, although the primary motivation is to contribute towards achieving targets for reductions in carbon dioxide emissions (1.55). Modelling studies indicate

that increases in fuel duty are the most effective economic instrument available for reducing fuel consumption.[4] Other studies have shown that increases in fuel prices could be effective in reducing the overall level of road traffic: a doubling of fuel prices in real terms by 2006 has been estimated to reduce traffic in that year to 22–28% below forecast levels.[5] For comparison reductions in public transport fares would in themselves have only a small effect: it has been estimated that halving public transport fares in real terms would reduce traffic in 2006 by only 2–3%.[6] A doubling of fuel prices is a much larger increase than the government plans, and on the scale of the increase advocated in the Eighteenth Report (2.45). It is doubtful in any event that fuel price increases will in practice have a large effect on traffic in the medium term: the implied increase in costs will be neutralised to an extent by the changes in vehicle design and consumer preference the prospect of such an increase induces, which may be reinforced by legislation (2.84, 2.88).

6.5 With the aim of achieving a greater degree of internalisation we advocate elsewhere in this report variations in the rate of fuel duty to reflect the environmental impact of different fuels (2.64–2.65, 2.71) and variations in the rate of VED to reflect differences in the environmental impact of vehicles of different ages and designs (2.84). These variations were not intended to affect the total amount paid by road users in specific taxes, and it would not be expected that they would reduce traffic levels.

6.6 Even with the measures to secure internalisation canvassed up to this point, there will be increasing congestion of the road network if traffic continues to grow on broadly the scale indicated by the National Road Traffic Forecasts (1.26–1.28). Congestion is to a degree self-regulating, but the feedback processes involved will not lead to an efficient outcome in economic terms unless the costs of the delays caused are borne by those who cause them.[7] In principle therefore making a charge to road users which reflects the costs they impose on each other by causing congestion (1.47) can bring about a more efficient use of a road network which is subject to congestion.[8] The effect of the charge is to deter users from making additional trips which, because of their location and timing, would impose increased delay costs in excess of the net private benefits the additional trips would confer for them. Taking that into account, we discuss below the policies that have been pursued in relation to the trunk road network and the urban road network. Before doing that, we look at one aspect of the present tax system which considerably reduces the extent to which the costs of car use are brought to bear on decisions by car drivers.

Company cars

6.7 The dominance of company cars in the UK market for new cars has already been mentioned, and support given to an amendment to the tax rules which would encourage the purchase under this heading of cars with lower fuel consumption (2.58). While company cars are only 8–10% of cars registered in the UK, their annual mileage is on average two and a half times that of other cars, and they therefore make up about 20% of car traffic. There is some evidence that people commuting in a company car travel further on average than people of similar socio-economic status commuting in their own car; that those who receive free fuel from the company commute even longer distances; and that drivers of company cars make almost no use of rail for business journeys of more than 50 miles. Because less tax is paid if business mileage in the course of a year exceeds certain thresholds, the present rules have been estimated to result in an additional 1 billion miles being driven each year.[9]

6.8 No action has been taken in response to the recommendation in the Eighteenth Report that the tax rules for company cars should be modified to remove incentives to environmentally damaging behaviour.[10] About half the drivers of company cars receive some benefit in the form of free fuel. They are taxed on this benefit at a flat rate which takes no account of mileage or the actual amount of fuel used and in effect cushions the user from the effect of fuel duty increases. Company car drivers also have an incentive under the present rules to exceed one or other of the thresholds for mileage travelled annually on business. A recent report has proposed that the present thresholds for business mileage should be replaced by a tax which relates to private mileage; and that the tax on free fuel should either relate to the actual cost of fuel purchased by the employer for the employee's private use or be levied at so many pence per private mile.[11] We believe this issue should receive early attention in order to remove the present distortions.[12]

The trunk road network

6.9 Trunk roads, which include nearly all motorways, make up less than 4% of the road network in England but carry over 30% of traffic.[13] The 'roads programme' which has featured prominently in public debate is the programme of investment in these roads. The justification for retaining a government-sponsored national system of trunk roads was questioned in the Eighteenth Report,[14] but a review of recent developments can most conveniently focus on the management and financial systems that have existed hitherto. In 1995/96 trunk roads accounted for nearly 60% of public spending on construction, improvement and structural maintenance of roads in Britain.

6.10 Between 1986 and 1996 the motorway network in England increased in length by 7%. As already noted, policy in recent years has moved steadily away from the construction of new roads on new alignments (1.8). Public spending on trunk roads in England has fallen by 27% in cash terms between 1994/95 and 1997/98, from more than £2 billion a year to less than £1.5 billion a year.[15] However, the fall in publicly financed investment has been offset by a programme of privately financed roads.[16] Of 12 schemes specially reviewed in June and July 1997 because urgent decisions were pending a majority were privately financed.[17]

6.11 The Eighteenth Report recommended that expenditure on the trunk road network should in future be confined to maintenance and the construction of local by-passes yielding substantial environmental and social benefits to the area bypassed, except where construction or widening of a motorway or other trunk road represented the best practicable environmental option (BPEO) for meeting access needs.[18] There has been some concern subsequently that, within the reduced total of public spending, proper standards of maintenance are not being achieved. Spending on structural maintenance of trunk roads in Britain fell by 28.5% in cash terms between 1994/95 and 1996/97, possibly because it took longer to reduce spending on new construction and improvement as total provision was reduced. However the 1994/95 level has been almost restored in cash terms in the plans for 1998/99 and 1999/2000.[19]

6.12 The Highways Agency which now manages trunk roads in England, has been applying a strategic approach to particular routes by considering options, taking into account local as well as national objectives, taking into account the interests of all road users and those affected by roads, and considering environmental issues.[20] This approach did not extend to identifying the BPEO in each case, for example through the kind of review of options which the Eighteenth Report recommended when proposals for construction or improvement of a long-distance route are being considered.[21]

6.13 As part of the current strategic roads review (1.19), the government has published projections showing the proportion of the trunk road network affected by congestion at peak hours and at times outside peak hours increasing from 5% in 1996 to 25% in 2016. As the Eighteenth Report showed, however, capacity would have certainly increased much more slowly than forecast increases in traffic. Indeed, capacity would have increased more slowly than forecast increases in traffic even with the pre-1994 trunk road programme, or a still larger programme.[22] It is inescapable that in future more roads will be operating at or near their maximum capacity for longer periods. There has been an increasing emphasis on making the maximum use of the capacity of the existing road network. One method of doing that is to remove bottlenecks through minor construction work in the form of junction improvements, widening, dualling or changes in alignment. Another method is to avert congestion through improved management of traffic flows. The capacity of a road is highest over a period if vehicles are travelling at a moderate and uniform speed. More effective enforcement of speed limits through use of automatic cameras could therefore help to avert congestion as well as improving safety and reducing emissions (2.48, 2.86). Trials have been carried out on the M25 to investigate the effects of varying the speed limit automatically according to the volume of traffic; there has been some benefit in terms of reduced congestion but less than had been predicted.

6.14 A future development that could increase the capacity of the existing network is the introduction of 'automated highway' systems in which vehicles travelling on motorways would be controlled electronically rather than by the driver. It is likely to be a considerable time before such systems are perfected and become general. However some manufacturers of luxury cars have now taken a step towards them by introducing automatic cruise control, which regulates a car's distance

from the vehicle in front. The technical characteristics of electronic systems will have to be compatible across Europe.

6.15 Drivers themselves seek to avoid congestion by changing the routes and times of their journeys. In principle, improved information facilitates that but can in some circumstances lead to unacceptable levels of traffic on alternative routes. A new driver information system on motorways and trunk roads between Birmingham, Nottingham and London includes over 70 variable message signs giving information about accidents, delays, and sometimes advice on which route to take. In-car systems providing subscribers with real-time information on congestion are spreading: the Trafficmaster and Freeway systems, licensed by DOT, now cover all motorways and many all-purpose trunk roads.

Motorway tolling

6.16 The previous government said that it was minded to introduce tolling on British motorways and set up trials of the systems required. Electronic charging of moving vehicles is considered to be more practical than the traditional toll booth for roads with high volumes of traffic. There are two possible objectives for tolling. The traditional purpose, familiar at crossings of river estuaries in the UK and on inter-urban roads in other countries, has been to recoup the cost of building and maintaining infrastructure. The alternative principle of making a charge in order to regulate the volume of traffic has recently been accepted on highways in California, after much controversy.[23]

6.17 The results of trials in Britain are not yet available. Similar trials in Germany showed that there were problems with the systems required for enforcement. Another problem with all electronic tolling systems is that they must be able to dealing with vehicles which do not have the appropriate equipment for registering a charge. The slow progress both in Germany and in Britain appears to have been the result in part of these technical difficulties and in part of doubts about public acceptability.

6.18 The Eighteenth Report opposed the introduction of tolls on British motorways, unless in the context of a general system of charging over all roads, or as a stage in such a development. This was because of concern that motorway tolls are likely to result in diversion to unsuitable non-tolled roads, with a consequential increased social cost in accidents and environmental damage that would offset any traffic management or congestion reduction gains on the motorways.[24] Any introduction of tolls on motorways ought certainly to be accompanied by measures to avoid or minimise any such undesirable diversion to alternative all-purpose routes, and in particular to protect roads which are especially environmentally sensitive. This might be achieved though access and size restrictions or lorry bans on the main alternative routes.

6.19 Work on congestion costs suggests that the marginal extra cost of congestion on motorways is generally much smaller than in urban areas, with a correspondingly lower potential benefit from tolling.[25] Motorways are usually the most efficient, safest, and environmentally and socially least damaging roads for vehicles. It remains our view that it is as a general rule inappropriate to divert long-distance traffic from motorways, particularly in the case of goods vehicles. On particularly congested stretches of motorway, tolling could in principle produce significant economic gains by reducing congestion, and such gains might be on a sufficient scale to outweigh any environmental damage caused through increased use of alternative routes. From the practical point of view however it would be difficult to ensure that all the vehicles using such stretches were fitted with the correct electronic equipment for tolling. On many of the regularly congested stretches of motorways and trunk roads most traffic is travelling short distances. It may be more effective in such circumstances to give priority to longer-distance traffic by restricting access to the road, either permanently or at certain times of day.[26]

6.20 Levying tolls for use of new privately financed motorways would simplify and facilitate the use of private finance to construct new roads. Plans are at an advanced stage for what would be the first tolled motorway in the UK, the Birmingham Northern Relief Road. In the absence of general powers to levy tolls, the consortia building other privately financed roads will be remunerated by 'shadow tolls' paid by the government on the basis of the amount of traffic using a road. The need to make such payments will have a significant, albeit delayed, effect in reducing the resources available for public transport within the government's overall transport programme. It has also been argued that

this arrangement provides a dangerous stimulus to traffic growth because the consortium operating the road has a financial incentive to maximise the number of vehicles using the road whereas those vehicles do not have to pay anything in order to use it. One way in which a consortium might seek to increase the traffic using a road would be to apply for planning permission for major developments along its route. A cap has been incorporated in the agreements so that, if traffic rises beyond a certain level, the operating company will be exposed to extra maintenance costs without receiving any extra payment.

A *vignette* system for heavy goods vehicles

6.21 For one category of vehicles, heavy goods vehicles (HGVs), the Eighteenth Report concluded that the amounts paid in VED and fuel duty are substantially less than the infrastructure and environmental costs imposed (5.3). Increases in fuel duty will produce a greater degree of internalisation. However the rates at which VED is paid for HGVs, although much higher then the rate for cars, is not sufficient to cover even the damage HGVs cause to roads. That particular shortfall could be made up under a system of tolling for motorway use in which rates of charge reflected the damage caused to roads by particular classes of vehicle. As we do not favour a general system of motorway tolling we have looked for an alternative method of making up the shortfall in charges paid for HGVs.

6.22 In a group of European Union (EU) Member States larger HGVs must have a *vignette* in order to use the motorway network.[27] A *vignette*, or user charge, is a permit for a specified period, displayed on the windscreen, for which a fixed payment is made. The requirement applies to all vehicles of more than 12 tonnes maximum permitted weight, irrespective of the country in which they are registered; this avoids the objection to an increase in VED in a particular country that it would disadvantage hauliers whose vehicles are registered in that country. Under European Community (EC) law the only vehicles that can be required to have a *vignette* for use of roads other than motorways are vehicles registered in the country in which the road is situated; in those circumstances a *vignette* becomes in effect another form of VED. The weakness of a *vignette* is that, as in the case of VED, the amount paid is not proportional to the use made of the road or motorway network.

6.23 As it has so far proved impracticable to obtain EU-wide increases in VED on the scale envisaged in the Eighteenth Report,[28] we believe a *vignette* should be introduced for use of British motorways by HGVs of more than 12 tonnes. Further study is needed to determine whether the charge should be related to a vehicle's size, weight or axle weight. The charges levied should be sufficiently large that they would at least cover the whole of the infrastructure costs imposed by the use made of the motorway network by a particular category of vehicles.

6.24 Although the requirement to obtain a *vignette* would deter some HGVs from using motorways, we do not believe it would in general lead to significant or noticeable diversions to other, less suitable roads. That is because a *vignette* would represent a flat-rate payment for any use made of any part of the motorway network. HGVs which use motorways regularly would have an annual *vignette*; occasional users would often be making long journeys for which it would be worthwhile to obtain a *vignette* on a daily basis. If local problems arose from diversion of traffic, that would probably indicate that a stretch of motorway had previously been heavily used by HGVs making local journeys. It might be necessary to take special measures in some cases, for example by banning HGVs from alternative routes or exempting certain specified stretches of motorway from the *vignette* system.

The urban road network

6.25 The urban road network is made up in part of those stretches of trunk road managed by the Highways Agency which run through urban areas but predominantly of roads managed by local authorities. Even when the roads programme was being greatly expanded, it was recognised that there were 'severe limits to the amount of road space that can be provided ... in urban areas'.[29] Short lengths of new road constructed by local authorities may be an integral part of urban regeneration schemes. To an even greater extent than with motorways, however, the emphasis in urban areas must be on making the best use of the existing road network.

6.26 The urban road network is used not only by cars and goods vehicles but by walkers, cyclists, buses and, in some areas, light rail. The respective priority to be assigned to each class of user is therefore a major policy issue. A major part of creating an integrated transport system is to change the allocation of the existing road space in urban areas through pedestrianisation, construction of physically separated cycle ways and the designation of part of the carriageway on main roads for buses or light rail. As a consequence, the amount of road space available for cars and goods vehicles will be reduced. Given proper management, that will increase the capacity of the road network to transport people, because buses take up less road space than cars per person carried. As a result of the decline in use of buses, the number of people travelling on inner London roads is now lower than in the 1950s but there has been a reduction in average speeds over the last 30 years.[30]

6.27 One of the essential conditions for safe cycling and walking is to limit the speed of traffic. Many local authorities are carrying out traffic-calming schemes involving physical modifications to roads. The Eighteenth Report supported wider use of low overall speed limits (20 miles per hour or less).[31] Neither approach necessarily reduces the capacity of a road to a marked degree, but there may well be an indirect effect in traffic volume because drivers adopt alternative routes.

6.28 A crucial factor in the attractiveness of alternative modes of transport is the priority they receive at junctions. Walking will not be attractive unless there are sufficiently long and frequent pedestrian phases at traffic lights. Segregated cycle ways will not ensure the safety of cyclists if they have to cross junctions with roads carrying motor traffic, especially if they do not receive priority in the form of cyclist phases at traffic lights. Buses and light rail will not be attractive unless they offer an overall journey time which is at very least competitive with, and preferably significantly faster than, the same journey undertaken by car; to achieve this they need to override traffic light phases, either automatically as they approach or when activated by the driver.

6.29 Many local authorities are adopting clear policies which give alternative modes of travel priority on urban roads. A well-established system in Zurich operates the traffic lights in such a way as to control the number of cars in the city at any given time, with the objective of ensuring there is adequate space on the roads for buses, trams, pedestrians and cyclists.[32] In the UK York has adopted a formal hierarchy in making transport and land use planning decisions. The needs of pedestrians are considered first, the needs of people with mobility problems, then in turn the needs of cyclists, users of public transport, and commercial and business users; only after that is consideration given to the needs of shoppers, tourists and commuters travelling by car or coach.[33] Edinburgh subjects all traffic management schemes and schemes for improvement or major maintenance of roads to a pedestrian priority audit with the aim of creating a quality streetscape and increasing the amount of space available to pedestrians.[34]

Urban road pricing

6.30 So far in this report, discussion has focused on the environmental and other social costs imposed by road transport in aggregate and on forms of tax or charge that are uniform across the country. In reality, the effects of an individual journey or movement of freight vary not only with the type of vehicle but also with the type and location of the road on which it is being used, the traffic conditions at the time, the weather, and other factors. The Eighteenth Report recognised that ultimately internalisation of costs ought to reflect such variations, that in the long run electronic charging systems might be developed that could set a rate of charge for an individual vehicle making a particular journey, and that such a possibility was worth pursuing. It also concluded, however, that large-scale electronic systems of this nature would not be practicable for some time; and that, even when they are available, it will remain impracticable to determine uniquely (and in advance) the level of charge appropriate to a particular journey by a particular vehicle on the basis of the environmental effects produced.[35]

6.31 Environmental costs, congestion costs and other social costs are all generally higher on the urban road network than on other types of road. The Eighteenth Report saw charging for the use of roads within specified areas as a way of supplementing general taxes and charges such as fuel duty by giving a broad indication that environmental and other social costs are especially high within those areas.[36] It also provides a way of increasing the efficiency with which the road network is used[37] and

can serve other purposes as well.[38] The charging systems which have the greatest potential to reflect variations in the external costs of particular journeys are those in which the charge for use of the roads within a specified area is related to the distance a vehicle travels within that area.[39] In some proposed schemes the charge would be increased if the speed of the vehicle falls, because this is regarded as indicating increased congestion. In other simpler schemes a charge would be made for time spent by a vehicle in the specified area or for use of a vehicle within that area (*area licensing*) or for crossing the boundary of the area (*cordon charging*).

6.32 In 1995 the findings were published of a major study of how congestion charging might be applied in London.[40] There have also been studies of Bristol, Cambridge and Edinburgh. These studies have considered alternative systems for charging, the availability of suitable technology, options for implementation, the likely impact on travel patterns, and distributional issues. It was estimated that a charge of £8 for each journey in central London would reduce traffic there by 17% and raise £400 million a year. The studies of Cambridge and York suggest that a reduction in traffic of 15% would be achievable.[41] Although the schemes studied were designed to reduce congestion, they would also have beneficial effects on the environment, in particular on air quality, partly because there would be less traffic and partly because it would flow more smoothly. In the case of Central London, the best option was found to increase average speed from 16 mph to 22 mph, reduce accidents by 5% and reduce emissions of regulated pollutants by 10–20%.[42]

6.33 The benefits from road pricing would of course be localised. It has been estimated that comprehensive systems of road pricing in London and the major conurbations would reduce road traffic nationally by only about 1%,[43] less than the increase in traffic nationally in a single year. Moreover the introduction of road pricing in one area will tend to displace traffic onto surrounding roads so that some of the benefits will be offset by increased environmental and social costs imposed elsewhere. However problems of that nature can be minimised in well-designed schemes. Road pricing appears to be a valuable instrument for reducing congestion and traffic levels in individual cities or towns.

6.34 It seems likely that the case for introducing road pricing would have to be based on the overall benefits produced for a particular urban area, as part of an integrated transport plan, rather than narrowly on the benefits in reduced congestion. The London study found the gains to drivers in central London from the introduction of road pricing would amount to only 36% of the revenue raised from them through charges.[44]

6.35 Experience of road pricing in other countries was summarised briefly in the Eighteenth Report.[45] Progress since then seems to have been relatively slow. A simple cordon scheme is being introduced in Stockholm. A proposed scheme in the Gothenburg area, designed to raise money for road improvements and some investment in public transport, has had to be rethought after lengthy negotiations with the municipalities about several variants failed to secure agreement.[46] In the UK Edinburgh is contemplating seeking powers to introduce a scheme[47] and experiments are being carried out on one route into Leicester.[48]

6.36 The 1996 Transport Green Paper said that research had confirmed that 'price signals are a highly efficient way of influencing the demand for transport,' and that the government would be discussing with the local authority associations the case for taking powers for local authorities to implement experimental schemes.[49] We endorse the view taken in the Eighteenth Report that the introduction of road pricing should be a matter for local decision.[50] We consider that local authorities should be given the necessary powers at the earliest opportunity. We emphasise that decisions to introduce such schemes should be take only after a full evaluation of the environmental effects and as an integral part of an integrated transport plan for the area affected.

6.37 Although the introduction of road pricing should be a matter for local decision, the technical standards for the design and operation of electronic equipment installed for that purpose at the roadside and in vehicles ought to be common across Europe. In a joint statement in January 1995 (appendix F) the Commission and the German Council of Environmental Advisors called on national governments and the European Commission to give high priority to the development and implementation of such standards.

Control of parking

6.38 The amount of parking space available in an area, whether on-street or off-street, is an important dimension of the road network. Restricting the supply of parking spaces and/or raising their cost to the user can be a relatively simple and very effective method of deterring people from using private transport and encouraging them to use other modes (often in the form of park and ride schemes). If traffic management is poor, however, a significant proportion of traffic may consist of vehicles looking for parking places. Moreover controls on parking do not have any effect on through traffic.

6.39 For controls over parking to be fully effective, there will have to be some new form of control over existing private non-residential parking. National legislation for the levying of charges on the owners of parking spaces, perhaps as part of the council tax system, could alleviate fears local authorities might have about their competitive position in relation to neighbouring authorities. In the absence of national arrangements, controls over existing private parking should be set within comprehensive regional strategies for parking, as advocated in the Eighteenth Report.[51]

6.40 Another approach is to focus on the benefit that a free parking space represents for an employee. Availability of a parking space seems to be a major factor in decisions on whether to travel to work by car. Provision of free parking space was regarded in the past as a taxable benefit in kind; but the Inland Revenue stopped collecting tax on it because of practical difficulties. Here too therefore, as in the case of company cars, the present tax system encourages excessive use of cars. That is particularly perverse because of the Inland Revenue's insistence on taxing assistance given by employers towards the cost of travelling to work by public transport. This discrepancy has impeded efforts by BAA plc to persuade employees at Heathrow to travel to work by public transport rather than by car.[52]

Controlling the growth of road traffic

6.41 While this review was in progress a Road Traffic Reduction Bill was introduced in Parliament which would have required the government to set national targets for road traffic. After negotiations with the government of the day, it was amended to require local authorities to review the situations in their areas and, if they considered it appropriate, set a target either for a reduction in the existing level of traffic or for a reduction in the expected growth of traffic. In that form it received royal assent in March 1997. A Private Members Bill similar to the original Bill will be introduced in the current session of Parliament; the present government has not indicated what attitude it will take.

6.42 Although the origins of the Eighteenth Report lay in concern about the growth of road traffic, the targets it proposed did not include a target for the overall level of road traffic. In seeking to reconcile people's desires to make journeys and the need to protect the environment, we believe it is right to concentrate on reducing the harmful effects of the transport system through the types of measure discussed in previous chapters, rather than seeking to impose an arbitrary limit on a national total which conceals the complex reality. Some of the targets proposed in the Eighteenth Report, particularly those for increased use of other modes, imply a significant reduction in the forecast growth of road traffic,[53] but that was not their primary purpose. We continue to believe that targets for the reduction of road traffic must have a clear and specific justification in terms of the environmental benefits they are expected to achieve, and must represent the preferred and most effective method of achieving those objectives.

Chapter 7

PLANNING FOR AN INTEGRATED TRANSPORT SYSTEM

The way housing demand is met has considerable implications for future transport patterns. There have been significant developments in legislation, administrative procedures and central government policies which affect the interactions between land use and transport. The policies followed by local authorities will be of crucial importance. Further modifications are required in legislation and procedures before local authorities will be able to produce and implement effective plans which cover both all modes of transport and the integration of transport, land use and air quality.

7.1 The creation of the Department of the Environment, Transport and the Regions (DETR) in June 1997 can be regarded as a recognition of the need to establish a much closer relationship between transport and land use policies. The Eighteenth Report described that as 'the central objective of a sustainable transport policy'.[1] There is now general acceptance of the 'need for a full consideration, at all levels of decision making, both of the land use implications of transport infrastructure provision, and of the travel and consequent environmental implications of land use policies.'[2] There has also been a growing realisation of the important links transport and land use policies in turn have with achieving acceptable air quality, reducing carbon dioxide emissions and reducing exposure to noise.

7.2 This chapter first reviews recent trends in land use, how land use and transport policies affect rural areas, and the implications of the projected increase in the number of households for the scale and location of future urban development. It then looks at the present framework for planning land use, transport and air quality. We assess the effectiveness of measures taken in recent years to improve co-ordination. We consider whether the existing machinery is capable of delivering the integrated approach that will increasingly be required in order to carry forward a co-ordinated strategy for transport and land use, contribute to achieving air quality objectives (2.95) and targets for reductions in carbon dioxide emissions (2.85–2.88) and exposure to noise (chapter 3), make alternatives to private road transport much more attractive for personal travel (chapter 4) and freight (chapter 5), and increase the efficiency with which the road network is used (chapter 6). We identify the respects in which modifications are needed, both at local level and at regional level. Finally we consider how the creation of an integrated transport system should be financed.

Key land use issues

Broad trends

7.3 Trends in urbanisation were reviewed in the Commission's Nineteenth Report on sustainable use of soil.[3] In 1990 urban and suburban areas took up 7% of Britain and 10% of England.[4] More than a third of the present urban area of England has been transferred to urban uses since 1945.[5] Most of that has been laid out in ways which presuppose, and thus to a degree pre-determine, that most travel will be by car.

7.4 Even in older urban areas the growth of car ownership over the last half century has given most of the population great flexibility in choosing where they live, work, shop and relax. The resulting dispersal of activities which had formerly been grouped together in a particular locality has been another major factor in increasing the distances people travel. One of the sustainability indicators suggested for the UK is the length of regular journeys. Over the last 20 years the average length of journeys to and from work has increased by about 40%, the average length of shopping journeys by 35%, and the average length of journeys taking children to and from school by 40%.[6]

7.5 The main cause of the increase in the length of shopping trips is the trend revealed by another suggested sustainability indicator, the amount of out-of-town retail floorspace.[7] That is part of a wider trend which over the last quarter of a century has seen many activities, extending from retailing to hospitals, increasingly concentrated in out-of-town locations[8] or at least outside traditional town centres. The amount of out-of-town retail floorspace opened each year fell after 1990 because of the recession; and the number of planning permissions given fell after 1993 because of new guidance to planning authorities to take into account the impact of proposed out-of-town developments on village and town centre shops.[9] It is possible however that, even without this change in planning policy, a saturation point would soon have been approached, given the large proportion of retail trade already taken by out-of-town stores.[10] The growth sector in out-of-town development is now large-scale leisure complexes such as multiplex cinemas.[11]

7.6 Providers concentrate their facilities in order to reduce their own costs, but in so doing impose costs on users, who now have to make longer journeys. The locations chosen are easier to reach by car, and provide larger car parks, but are often not readily accessible in any other way.[12] Even if users find that the additional costs to them are offset by the higher quality of the facilities, there are also environmental and other social costs imposed on the community as a result of greater distances travelled by private road transport, and in the longer term the further impetus given to car dependence.

Rural areas

7.7 Over the last quarter of a century it is in the rural areas of England[13] that population has grown, in contrast to many other parts of Europe where the rural population is still declining. An increase in the population of England of 5.4% between 1971 and 1995, was made up of 21% growth in rural areas and 0.5% growth elsewhere.[14] Economic activity and employment are also growing more quickly in rural areas than in major towns.[15] In rural areas people have to travel greater distances to work, schools, shops and leisure facilities, especially as many village shops and schools have closed. There is little public transport and many journeys are too long for it to be convenient to walk or cycle.

7.8 It has been argued that, because people living in such areas are more dependent on their cars, increases in the cost of car use, for example increases in fuel duty, bear unfairly on them. These arguments have been urged even more strongly in relation to other parts of the UK.[16] In Great Britain the proportion of households with a car is higher in rural areas than in urban areas, both in the population as a whole and among low income households; this seems to confirm that a car is more often a necessity in rural areas, and that some households with low incomes might suffer hardship if the cost of running a car increased substantially. Even in rural areas cars do not provide accessibility for everyone, as 19% of rural households in Great Britain do not own one.[17]

7.9 We accept that the impacts of new policies and new fiscal measures on people living in rural areas require special consideration. We believe there ought to be specific policies to deal with the transport problems of rural areas based on the following measures:

- improved provision of subsidised public transport where that can be justified in terms of the number of users;
- innovative approaches such as community buses or taxis where a conventional bus service would not be viable;
- increasing the extent to which essential services such as food stores, primary schools and post offices are available in villages;
- promoting the options of working from home or from telecottages[18] in villages in order to remove the need for long daily journeys to work.

Planning for growth in population and households

7.10 The population of the UK is expected to show only modest growth over the next quarter of a century, and stabilise by 2030.[19] However the number of households is projected to increase by almost a quarter between 1991 and 2016.[20] As a result of longer life expectancy and social trends about 80% of the extra households are expected to consist of one person. Population growth is again projected

to be more rapid in rural areas of England:14% between 1991 and 2011, with an increase of 25% in the number of households.[21]

7.11 There has been considerable debate about how and where the projected increase in households should be accommodated. The 1995 Rural White Paper foresaw a need to construct up to 2 million new homes in rural areas of England.[22] In recent years there has been increasing emphasis on re-use of previously developed land as a way of safeguarding undeveloped land, assisting urban regeneration, reducing the need to travel and facilitating the provision of additional social housing. During the 1990s the rate at which green-field land has been converted to urban uses, mainly housing, has been lower than the rate between 1984 and 1990, which was in turn lower than the rate in the 1960s.[23] In June 1995 the government set the target that at least 50% of new housing in England should be constructed on previously used sites in the period to 2005,[24] and in 1996 that target was being met on average.[25] We welcomed the suggestion made by the Department of the Environment (DOE) in November 1996 that there should an aspirational target of at least 60%,[26] and thought an even higher figure should be considered.[27] Detailed studies will be needed to allocate the overall target between regions, and there should be similarly challenging targets for Scotland, Wales and Northern Ireland.[28]

7.12 As the Green Paper on Household Growth pointed out, ambitious targets like this are unlikely to be achieved unless the quality of life in urban areas is enhanced so that people are more likely to choose to live there. Reducing the present dominance of heavy traffic in many areas, and the air pollution and noise it causes, are vital dimensions of that.[29]

7.13 Whatever the eventual balance between green-field and brown-field land, it is clear from the projections that large-scale development will take place over the next quarter of a century in order to meet future demand for homes. The crucial consideration is that, wherever development takes place, it should be in a form that discourages car dependence. This means that housing should be mingled with shops, offices, schools and leisure facilities. Shops, schools and post offices should be within walking distance of most homes, and the design should encourage people to make journeys by foot, by cycle or by public transport. The way in which development is planned will be crucial to future demand for travel and the way in which it is met. In the case of large developments, especially any large developments permitted on green-field sites, it may be appropriate for the planning authority to require the developer to install a guided bus or light rail system. Offset against the cost of such facilities would be reductions in the provision needed for car parking and circulation. The challenge posed by the projected increase in the number of households requires much more by way of central government action than simply stipulating the amounts of housing land to be provided by individual local planning authorities. A more pro-active role will be essential both to facilitate the maximum use of previously developed land and to ensure that all new development achieves a sustainable integration between land use and transport.

7.14 Land use policies can in principle reduce the need for travel, and the extent to which people are dependent on travel by car, by locating different activities within walking distance of each other or where they can be reached conveniently by cycle or bus. However such policies will not have a major effect unless they are pursued consistently for a number of decades. Moreover there is unlikely to be much impact on the length of the journeys people actually make, or the mode they actually use, unless land use policies form part of a coherent package which also incorporates appropriate transport policies.

Promoting urban regeneration

7.15 We have previously expressed concern that the policies for urban regeneration so far in place will not ensure that the amount of brown-field land brought up to a standard suitable for housing is sufficient to meet the targets that have been set. The Household Growth Green Paper did not address this problem adequately. The previous government rejected some key recommendations of the Nineteenth Report, in particular the recommendation that development agencies should collaborate with local authorities to promote land banks of remediated sites.[30] The Round Table on Sustainable Development has endorsed the view that local authorities should play a more pro-active role in strategies for urban revitalisation, and also proposed that Urban White Papers should be prepared for each part of the UK, and that economic instruments should be used to make green-field sites less

attractive for developers in comparison with brown-field sites.[31] We hope serious consideration will be given to these proposals.

The present planning framework

7.16 The present procedures at each level of government for planning roads and transport, land use and air quality are summarised in table 7.1. We discuss the procedures in each field briefly below and the present arrangements for co-ordination between them. For clarity, the table shows the procedures in England. The present procedures in Scotland and Wales are similar in essential respects, except that all local authorities in those countries are now unitary authorities.

Land use planning

7.17 The land use planning system has a long time-horizon, in that regional planning guidance and local authority structure plans look 15–20 years ahead. Although the intention has been that structure plans should be reviewed at approximately five-year intervals, there has been some slippage, which DOE has sought to redress. In 1992 it was decided that there should also be local plans for the whole of England, rather than at the local authority's discretion. In some districts plans have been produced and reviewed; other districts have yet to agree a first plan.

7.18 Policies for land use planning may take a long time to produce their effect. If they are to make a full contribution to the creation of an environmentally sustainable transport system, the transport implications of development must be fully understood and addressed at all levels of the system from national and regional planning guidance through structure plans and local and unitary development plans to the granting and enforcement of individual permissions. In recent years greater legal significance has been attached to the provisions of development plans. However the land use planning system remains essentially reactive, in that decisions are taken in response to applications for development or for change of use.

Transport planning

7.19 The present procedures for planning transport systems and infrastructure have three main strands:

- the planning of trunk roads, for which the Highways Agency is responsible;
- planning by transport operators (Railtrack, train operating companies, other rail operators, bus operators, London Regional Transport), which has been discussed in chapter 4;
- transport policies and programmes (TPPs) which local highways authorities (in England, county councils, unitary authorities, metropolitan district councils and London boroughs) draw up and submit annually to central government as bids for capital funding.

7.20 The division of the road network between trunk roads managed by the Highways Agency and other roads managed by the highways authority complicates considerably both planning of the transport system and integration of transport and land use, as the Eighteenth Report pointed out. Hitherto the trunk road programme has been drawn up and reviewed centrally. The proposed line of a new trunk road or plans for improving an existing one have been presented to local planning authorities as matters to be taken into account in drawing up their strategic plans but not as the subject of consultation or comment. Trunk roads are outside the normal procedures for planning consent.

7.21 In February 1997 DOT and DOE sought views on proposals for new arrangements for formal consultation.[32] Prior to preparing its advice to the Secretary of State in the process of preparing regional planning guidance, the regional planning conference, made up of the authorities in each region, would ask the Highways Agency for a report on the future state of the trunk road network in their region. That report and the views of local authorities on it could then be incorporated in the advice given to the Secretary of State.

Table 7.1
Present planning procedures

	land use	roads and traffic	public transport	air quality
national policy statements	Planning Policy Guidance notes (including no. 13 on transport), Circulars	National Road Traffic Forecasts, statements of national roads policy, trunk road investment programme	annual guidance on Transport Policies and Programme submissions, Railtrack network management statement (10 years ahead)	National Air Quality Strategy (objectives for 2005)
region	Regional Planning Guidance notes (15–20 years ahead)	Government Office for the Region assesses TPP submissions and makes recommendations to DETR	London Regional Transport in Greater London	
county council	county structure plan (or, in unitary authorities, a Unitary Development Plan part I) showing general policies for development (15–20 years ahead, typically reviewed every 5 years); structure plan shows proposals for new roads, or other major transport infrastructure, in diagrammatic form	annual bids for central government funds for capital expenditures through the TPP process package approach encourages authorities to plan transport in the round, looking at all modes together; guidance encourages authorities to establish a long-term strategy for transport planning, reflect the policies in development plans and take account of trunk roads projects		statutory consultee for air quality action plans
district council	local plan (or, in unitary authorities, UDP part II) reviewed as necessary, showing specific local road proposals in detail			two assessments of air quality before 2005 (proposed). air quality action plan (if NAQS objectives are not likely to be met by 2005)

Unitary authorities, metropolitan district councils and London boroughs combine the functions shown here for county councils and district councils. Air quality management provisions of Environment Act 1995 described above are not yet in force.

7.22 The second volume of the consultation paper for the strategic roads review (1.19) discusses the trunk road network in each region in terms of route hierarchy, present traffic levels, network management issues, pressures on the trunk road network from major planning developments, road schemes under construction and road schemes in preparation. The output of this consultation exercise is expected 'to consist in the main of two parts:

> a forward programme of high priority projects which will definitely be taken forward
>
> setting in hand work to develop strategies for specific corridors or transport problems out of which investment programmes will emerge in the longer term. In the interim options will be kept open.'

Those responding to the consultation are invited to consider solutions to problems which do not involve new road building, as well as advocating particular road schemes, but little information is provided about such alternatives, and none about other modes.

7.23 TPP bids cover capital expenditure by local authorities in the forthcoming financial year on those roads for which they are responsible and on public transport. For projects costing more than £2 million which it approves, central government provides transport supplementary grant to meet half the cost. The authority borrows to fund the other half of the cost; and can undertake further borrowing for transport purposes up to a credit limit which central government sets. A separate grant ('section 56 grant') is given for approved public transport schemes costing more than £5 million (for example, light rail lines). TPPs were intended to provide the machinery for comprehensive transport planning at local level. For the 1994/95 round ring-fenced funding was introduced for coherent packages of mutually supportive measures covering different forms of transport, with the aim of discouraging local authorities from placing too much emphasis on road-based solutions to transport problems. The guidance for the 1997/98 round[33] required that 'Bids ... demonstrate suitable land use policies and show that full consideration has been given to the potential for public transport, walking, cycling and improved traffic management.' Local authorities were exhorted to produce strategies 'for reducing car dependency, promoting quality alternatives and better management of existing roads'. It has been suggested however that local authorities often fail to demonstrate how the programmes for which they are bidding relate to the policies they have listed in their TPP.[34]

7.24 There is concern that in practice TPPs continue to be dominated by spending on roads. In part this might reflect increasing competition for a reducing pot of money: transport supplementary grant has been reduced in cash terms from £431 million in 1993/94 to £195 million in 1997/98, and is planned to be only £120 million in 1999/2000.[35] In bids submitted for the 1996/97 round 70% of the funds sought were for roads and parking. A recent report by the Audit Commission concluded that 'In many local authorities the emphasis is still on roads and cars, and relatively few authorities have adopted vigorous restraint measures.... Many of the proposals reflect a traditional road-building approach which no longer attracts government support.'[36] However spending on roads has loomed even larger in DOT's decisions than in the bids received, accounting for 74% of grant for 1995/96 and 1996/97 and 83% for 1997/98. Multimodal packages received only 15% of grant both in 1995/96 and 1996/97.[37]

Integration of transport and land use

7.25 The need for integration between transport planning and land use planning has been emphasised in guidance from DOT and DOE. On the planning side the subject is covered in planning policy guidance for England (PPG13),[38] in the planning guidance now issued for Wales[39] and in draft planning guidance for Scotland.[40] These all stress the significance of the impact of road transport on the environment and the need to plan for less travel, particularly by road. In similar vein the Royal Town Planning Institute (RTPI)[41] suggests that it is particularly important that development plans should be assessed in accordance with this principle of minimising car-based travel. Guidance for the 1997/98 TPP round says 'It should also now be automatic for authorities to explain in their TPPs how their proposals fit into the local structure and development plans [and] ... demonstrate that their proposals harmonise with the guidance set out in PPG 13.'[42]

7.26 Studies of the way in which the policies in PPG 13 are being implemented[43] have shown that a great deal remains to be done. The following problems have been encountered:

differences in the level of awareness of PPG 13 issues (both within different departments in local authorities and amongst different sectors of developers) and a limited understanding of the transport implications of particular patterns of development with a need for more guidance on how to implement the policies in practice;

commercial pressures which, for example, mean that local authorities do not feel able to be unduly stringent in imposing conditions to reduce traffic generation for instance by restricting parking provision and resistance in some quarters (for instance amongst commercial developers with large land banks) to respond to the change in policy;

the time difference between elements of the land use planning process, the time-lag between proclamation of new policies, their incorporation in thoroughly revised structure plans and translation into the local plans against which individual applications are judged and the different cycle for TPPs which operate on an annual timetable;

the absence of an adequate institutional framework at national, regional and local level which would facilitate transport and land use planning issues being addressed in a comprehensive and consistent manner;

the difficulty of dealing with the issue of parking.

7.27 While there are some encouraging signs, more must be done to co-ordinate and integrate land use planning and the various aspects of transport planning to reduce the need to travel, the distances travelled and dependence on cars and lorries. Action is needed on a number of fronts:

institutional arrangements should be put in place which enable transport and land use planning issues to be considered together at all levels, national, regional, sub-regional and local;

the institutional arrangements should ensure greater consistency of treatment for example of parking standards and controls. This might include the greater use of call-in powers by the Secretary of State;

changes in land use planning policy should be reflected more speedily in structure and local plans;

the time-scales and coverage of transport and land use planning processes should be harmonised;

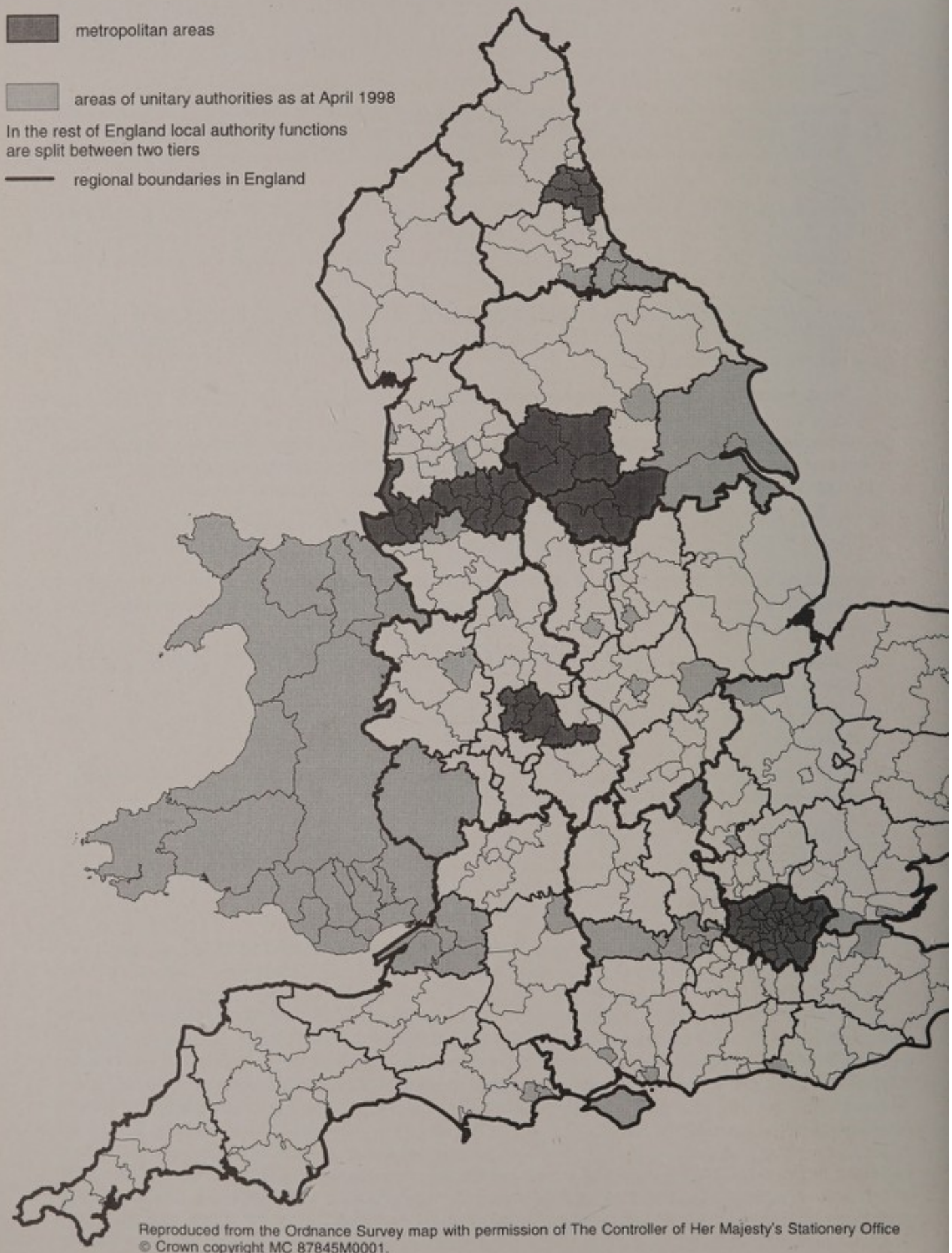
it should be possible for local planning authorities to be able to require and a developer to contribute to relevant public transport spending;

applications for major developments should set out fully the transport implications and be accompanied by access plans.

Air quality management

7.28 The new legislation on local air quality management, which is not yet in force, was mentioned earlier (2.16), together with the draft guidance on the part traffic management should play in air quality action plans (2.95). The measures it is envisaged local authorities will have to take in order to improve air quality include traffic restraint, promoting alternatives to car travel and deterring indiscriminate car use. Measures of this nature will also feature in the TPP for the area: in guidance for the 1997/98 TPP round local authorities were advised to 'continue to pay particular attention to air quality ..., especially through consideration of measures to reduce traffic levels and traffic emissions in sensitive areas'.[44] In areas with two tiers of local government the air quality action plan will be prepared and implemented by the district council, whereas the TPP will be prepared by the county council as highways authority. It is likely however that most of the areas with the most serious air pollution problems will be in areas (including the metropolitan areas) in which there is only one tier of local government. Figure 7-I shows the areas of England in which there will be all-purpose authorities after April 1998 and the new structure of unitary authorities in Wales; local governmentin Scotland now also consists entirely of unitary authorities. The Environment Act 1995 extends the

Figure 7- I
Local authority areas in England and Wales



purposes for which highways authorities can make orders regulating traffic to include pursuit of air quality objectives. Local authorities will thus have power to ban specified types of vehicle from town or city centres unless they are using specified fuels which cause less pollution.

7.29 There has been no practical experience of air quality action plans as yet. Preliminary studies indicate that the only form of transport policy likely to have a district-wide effect on vehicle emissions is an integrated transport and traffic management plan involving some form of restraint on car use. Urban traffic management may be of greater relative importance in reducing carbon dioxide emissions (which are not covered by air quality action plans) than in achieving air quality objectives, although individual traffic restraint schemes may bring about large local improvements.[45]

7.30 The time-horizon for local air quality action plans is 2005. This is now a relatively short period ahead. A crucial issue is what is likely to happen to air quality after 2005 (2.97). Despite the uncertainties about the extent, effectiveness and timing of technological improvements to new vehicles, air quality planning by local authorities must take into account the longer-term prospects.

The need for new machinery

Local level

7.31 To be environmentally sustainable, a transport system has to be planned in such a way that it will improve and protect air quality, reduce exposure to noise, reduce carbon dioxide emissions and contribute to the other environmental objectives identified in the Eighteenth Report (see appendix A). It will have to be integrated with land use planning. It will incorporate a quality public transport system which provides an integrated service. Policies towards private road transport will form a coherent whole with policies to promote public transport, cycling and walking.

7.32 We have considered, in the light of recent developments, whether the existing machinery is capable of creating an integrated and environmentally sustainable transport system. There are some aspects, identified in earlier chapters, on which action by central government or the European Union will be crucial. There will be other aspects that are appropriately carried out at national level, such as regulation, co-ordination and enhancement of the national rail network. However we believe the primary focus for creation of an integrated transport system covering all modes of transport will be at local level. The recipe for success will differ from area to area depending on local circumstances. Local authorities are already responsible for traffic management and have functions in relation to public transport. They are also responsible for land use, air quality and other aspects of the environment such as noise. Only they have full knowledge of local circumstances, and provide a mechanism for taking the necessary decisions in an accountable way.

7.33 We are impressed by the innovative way in which some local authorities are developing policies for transport. Often they are doing so as part of wider policies aimed at achieving sustainable development through implementation of Agenda 21, the document agreed at the Earth Summit in Rio de Janeiro in 1992. However it is far from being the case at present that local authorities generally are planning effectively for creation of integrated transport systems. In part this is the result of deficiencies in the powers available to them, which we have addressed elsewhere. But we do not in any event believe that the existing procedures summarised in table 7.1 provide a satisfactory basis for planning and implementation by local authorities. Reliance on several separate procedures brings with it a risk of fragmentation. There are mismatches between the different procedures both in their time-horizons and in the timetables on which plans are prepared and reviewed. The slowness of some procedures means that it is taking too long for more sustainable policies to become effective. The procedures as a whole do not take sufficient account of the longer-term prospects. The areas of local authorities do not always match those required for sensible transport planning. Co-ordination at regional level is not yet sufficiently effective.

7.34 We believe that unitary authorities and county councils should be placed under the statutory duty of assessing the transport system in their area and planning on a long-term basis for the creation of an integrated transport system. The assessment should cover both the effectiveness and efficiency of the transport system and all aspects of its environmental impact, in the light of national targets

for environmental protection and related European Community legislation. It should include assessments of the potential roles of all modes of transport, including taxis, cycling and walking, and where appropriate detailed policies for their management and development over a 15–20 year period.

7.35 Integrated transport plans must equally cover the regulation and management of private road transport. This aspect should extend not only to traffic management, parking policies (6.38–6.41) and the possible introduction of road pricing (6.30–6.38), but also checks on compliance with roadworthiness legislation as it relates to emissions (2.50) and noise (3.8).

7.36 It is doubtful that the best way of overcoming the present fragmentation of planning and giving it an immediate new impetus would be to try to merge the planning procedures for land use, air quality and all aspects of transport. Land use planning deals with many other issues besides transport, and there are other important sources of air pollution which are regulated by local authorities. Nevertheless one solution might be to subsume new procedures for transport planning in the existing system of structure plans and local plans for land use. In any event preparation of long-term transport policies must proceed simultaneously with preparation of structure and local plans and, in any given area, both aspects of planning should cover the same period ahead. Every effort must be made to accelerate preparation of longer-term transport and land use plans which are mutually consistent and directed towards sustainable development (7.27).

Separate transport authorities

7.37 Local authority areas are not always the appropriate areas for transport planning. In Greater London policies relating to public transport are drawn up and carried out by London Regional Transport, a public corporation whose members are appointed by DETR. Traffic management at the strategic level is the responsibility of the Traffic Director for London and parking is the responsibility of the Parking Director for London. In the areas of the six former metropolitan counties in England (shown in dark grey on figure 7-I) and in the former Strathclyde Region of Scotland the functions of local authorities relating to public transport are exercised by a passenger transport authority (PTA, a policy-making body made up of members appointed by the local authorities, and with only a small staff) and a passenger transport executive (PTE, a statutory corporation with a chief executive and directors appointed by the PTA which implements PTA policies). PTEs participate alongside the Franchising Director in the franchising of rail services in the relevant metropolitan area (see figure 4-I). They receive funding from central government in the form of Metropolitan Railway Passenger Services Grant in order to ensure the continued provision of rail services at 1996 levels.

7.38 We believe the present PTAs/PTEs should be given the duty of producing long-term integrated transport plans for their areas, and should be renamed 'transport authorities/transport executives'. They should take over all the traffic management functions of local authorities in their areas and the new powers we envisage such as carrying out roadside checks on emissions, operating road-pricing schemes and regulating private parking. The local authorities would remain responsible for the maintenance (and, where necessary, construction) of local roads, for land use planning and for air quality management. The functions of the transport authorities/executives would be confined to regulation and co-ordination; they would be required to divest themselves of the railed transport systems some of them still operate.

7.39 The Eighteenth Report recommended that additional PTAs/PTEs should be established.[46] The case for creating more transport authorities/executives should be examined, especially in those conurbations which do not already have them. The risk that local authority areas might not make sense in terms of transport planning has increased with the abolition of regional authorities in Scotland and the creation of unitary authorities in Scotland, Wales and parts of England covering sometimes quite small areas. In many areas however we believe that, subject to the other changes we envisage, it will be possible for integrated transport systems to be created successfully by the existing local authorities.

Regional planning

7.40 To be effective, the integrated transport plans produced by individual transport authorities/executives or local authorities must be regionally co-ordinated. Otherwise a town or city may be

unwilling to adopt and enforce the policies required to restrict traffic growth for fear that developers will try to find a more pliable neighbouring authority. The difficulties of establishing and enforcing restrictive policies on the amount of parking permitted in new developments are a good example. There was a commitment in the Labour Manifesto to introduce legislation in due course to enable directly elected regional governments, with predominantly unitary local authorities, to be created in those English regions where a referendum clearly favoured that course.[47] For the time being however integration at regional level must be sought through other structures.

7.41 Outside London co-ordination is provided at present by nine Government Offices for the Regions, which exercise the functions of DETR and two other government Departments. The Secretary of State issues non-statutory regional planning guidance for each region on the basis of advice from informal regional planning conferences made up of the local authorities in each region. The Labour Manifesto contained a commitment to build on this existing machinery by establishing 'regional chambers to co-ordinate transport, planning, economic development, bids for European funding and land use planning'. Legislation in the current session will enable the government to establish regional development agencies with functions which include co-ordinating regional economic development. Among issues on which views have been sought about a possible role for regional development agencies are the 'provision or operation of transport infrastructure or other transport' and 'transport planning'.[48]

7.42 The consultation paper for the current strategic roads review recognises that 'The trunk road network has to be planned and managed not just in the context of the transport system as a whole but also having regard to economic development and other land-use and environmental considerations.'[49] There has been widespread support for proposals by the former DOT and DOE that integration of trunk road and land use planning should be pursued by extending the procedures for preparing regional planning guidance to include the strategy for managing and improving trunk roads in the region.[50] The government is now considering how those proposals can best be incorporated in new arrangements for regional governance, strategic planning and regional development. There has been no formal involvement of regional bodies in the planning of investment by public transport operators, although regional planning conferences may discuss this subject from time to time.

7.43 We believe firmer and more specific co-ordination of transport and land use policies at regional level is an essential pre-condition for an integrated transport policy, and that this must apply equally to all modes of transport, not simply to the trunk road programme. Whatever structures are created should be capable of producing and implementing integrated transport strategies at regional level, with a coverage corresponding to the integrated transport plans we have described at local level.

London

7.44 The government has set out in a consultation paper proposals for a Greater London Authority (GLA), an Assembly and a directly elected Mayor.[51] The GLA would produce a transport strategy covering all forms of transport, including international links. It would also develop a London-wide strategy on air quality designed to achieve national air quality objectives (table 2.1), and possibly a noise reduction strategy. Subject to central government's responsibility for transport services and facilities of national importance, responsibility for delivering these strategies would lie with a London Transport Authority (LTA), appointed by and accountable to the GLA. The LTA's responsibilities would be:

- those exercised at present by *London Regional Transport* (subject to whatever form of public–private partnership is devised for the Underground);
- *the strategic road network* (made up partly of trunk roads and partly of other roads), but not trunk roads which fulfil a national function such as the M25 and the main spurs running into London;
- *traffic control systems* and red routes, replacing the Traffic Director for London;
- taking forward London-wide measures to deal with *air quality problems and noise from transport*, and co-ordinating local-level initiatives;

securing the *London bus priority network* and the *London cycle network*;

ensuring that *parking regimes* are co-ordinated across London.

On issues such as bus and cycle priority routes the LTA might work through the London boroughs; but on road traffic reduction and air quality it might need direct powers. The government is considering how the LTA might influence decisions on services and investment on the former British Rail network.

7.45 The GLA would take on the strategic planning functions at present exercised by the Government Office for London and the London Planning Advisory Committee. The Mayor of London would be responsible for setting the land use planning framework for London (after obtaining the Assembly's agreement) and for ensuring 'its integration with other strategic policies for the capital'. Views have been sought on whether this framework should take the form of a structure plan (as in the rest of the country) or guidance to the boroughs (similar to the strategic planning guidance which the Secretary of the State for the Environment has issued). The government wishes to minimise the GLA's involvement in development control; but recognises that, at minimum, London boroughs would have to consult it on cases raising issues of strategic importance so that it would have the opportunity to ask the Secretary of State to call the case in for his decision.

7.46 In taking a 'holistic view' of transport the proposals in the consultation paper represent a big advance on the present situation in London, and in that respect provide a good model for other regions and other major urban areas. There needs to be much more emphasis however on the concept of an integrated transport system; London is the part of the UK which comes closest to having such a system at present (4.74), but that needs to be safeguarded and taken further. We regard taxis as an essential part of such a system, and we are concerned that the consultation paper leaves it unclear where responsibility for taxi and minicab licensing will lie.[52] We are also concerned that the government's proposals may not achieve the close relationship required between transport and land use policies.

A Scottish Parliament

7.47 If the government's proposals are implemented, the present responsibilities of the Scottish Office for the environment, land use and many aspects of transport will pass to an Executive of Scottish Ministers accountable to the Scottish Parliament, which will legislate in those fields.[53] In particular the Scottish Executive will be responsible for the Scottish road network, bus policy, some rail grant powers, the Strathclyde Passenger Transport Executive, cycling, taxis and minicabs and consultative arrangements in respect of public transport; it will also have administrative responsibility for overseeing Scottish rail passenger services and for freight facilities and track access grants, although the Scottish Parliament will not have power to legislate in these latter fields. The aspects of transport for which the Executive and the Parliament would not have responsibility under the proposals relate to safety and regulation. The present government plans to publish a White Paper in 1998 to set out 'proposals for a workable, effective and integrated transport policy appropriate to the needs of Scotland'.[54] It is carrying out a review of the trunk road programme, broadly corresponding to that in England (1.19), and in parallel an examination of means of restraining traffic growth.[55] In preparing the White Paper and reviewing the trunk road programme, account will be taken of comments submitted in response to a Green Paper in February 1997.[56] Policy on the integration of transport and land use is still at the draft stage.[57]

A Welsh Assembly

7.48 If a Welsh Assembly is established in accordance with the government's proposals, it will take over the responsibilities of the Welsh Office for environment, planning and transport, including making secondary legislation. One of its major executive responsibilities will be trunk roads.[58] Past decisions on proposed road schemes in Wales have emphasised protection of the rural landscape;[59] but there has been criticism that modification of planning policies to integrate transport and land use[60] has been slower than in England, and that the Welsh Office has failed to develop a cross-modal approach in funding local authority expenditure.[61] One of the advantages claimed for a Welsh

Assembly is that it will be able to 'develop new strategies on complex issues ... which require a co-ordinated approach'.[62] Much of the work will fall to subject committees, which will have powers to employ special advisers, take expert evidence and amend proposed secondary legislation. If the allocation of responsibilities follows the present structure of the Welsh Office, a single committee would deal with transport, planning and environment, but that decision will be for the Assembly to take. The Assembly would also establish regional committees, but they would be only advisory.[63]

Northern Ireland

7.49 The most recent statement of transport policies for Northern Ireland was published in September 1995.[64] It recognised increasing public concern that the growth in demand for travel posed a threat to the quality of life; the interdependence of transport and land use; that demand management can have an important part to play in preserving the benefits of the car in the light of the constraints on the road network that may be necessary in the interests of sustainable development. It said that for the immediate future, in preference to restrictions on choice, the government would encourage people to make the move away from car dependence by supporting a public transport service which, in terms of frequency, reliability, comfort and journey time, would provide an attractive alternative to the car.

Financing an integrated transport system

7.50 Much of the investment required to create an integrated transport system will be undertaken by private sector transport operators. The existing investment programmes of the transport operators, and the extent to which they might need to be augmented, have been discussed in chapter 4. Another important part will come from the Private Finance Initiative or other forms of private sector-public sector partnership. What is essential is to harness private funding to consistent and coherent strategies, with clear objectives, produced either by central government or by local authorities for their own areas.

7.51 Significant costs will fall on the public sector. It seems unlikely that large additional resources will be available from general taxation in the foreseeable future to meet such costs. The government has said it is not currently persuaded of the merits of a business levy to finance transport spending in London. However some of the measures envisaged in this report could provide resources for the repayment of substantial additional investment in the creation of integrated transport systems. Road pricing and income from levies on non-residential parking spaces could provide a main source of income for financing development in urban areas. Although we do not in general favour the levying of tolls for use of motorways (6.18–6.19), if such tolls are introduced revenue from them should be regarded as a source of funding for maintenance and operation of the road network in order to supplement resources for developing other aspects of transport provision.

7.52 The Eighteenth Report recommended that revenue from road pricing should be retained by the local authority introducing a scheme and used to finance public transport and other infrastructure improvements.[65] The public acceptability of road pricing may well depend on whether the revenue will be used in a positive and related way. Income from parking charges should be treated in the same way. All the road-pricing schemes which have been introduced or seriously considered in Europe involve use of the revenue to fund transport improvements. We believe local authorities should be permitted to use the revenue from road pricing and new forms of parking charge as an additional source of spending on transport including improved facilities for cyclists and walkers and improvements to public transport, and restrained from using it for other purposes.

7.53 Improvements to other modes of transport would benefit motorists in two ways: those who were deterred from using their cars because of road pricing would have the alternative of improved public transport available, and those who continued to use their cars would benefit from the effects of improved public transport in reducing traffic. The combination of road pricing with use of the revenue to fund improvements in public transport would give a powerful boost to use of alternative modes. The availability of this source of funding for transport improvements will be all the more important if present plans remain unmodified and transport supplementary grant paid to local authorities in England falls sharply.[66]

Main conclusions

Chapter 8

INTEGRATED SOLUTIONS

Reversing previous trends

8.1 For national sustainability goals to be met, transport in the UK must be radically modified. As at the time of the Commission's Eighteenth Report, official forecasts for the next quarter century show road traffic continuing to increase at a similar rate to the last quarter century (1.23), with no assurance as yet that improvements in vehicle technology will bring about the required improvements in air quality (2.90 and box 2D). Unless this position changes, the consequences will be environmentally, economically and socially unacceptable:

pollution from road vehicles will continue to have effects on health and the natural and built environment (2.6–2.14);

emissions of carbon dioxide from road vehicles will make a growing contribution to the greenhouse effect, and thus to climate change (2.34–2.35);

traffic noise and intrusion will have ever more extensive effects on the quality of life (3.1–3.4);

the road network will be used less efficiently because of increasingly costly congestion (6.31).

8.2 Recent improvements in vehicle technology have principally focused on meeting the increasingly stringent emission limits for health-related pollutants. This will continue to be the case as stage III and, we hope, stage IV limits are developed in the European Union (EU) (2.25–2.28). In future, however, technological innovation will increasingly need to be directed at meeting the challenge of reducing carbon dioxide emissions from road vehicles (2.42–2.43). Transport is the only sector which, despite the measures taken within the UK's 1994 Climate Change Programme, is forecast to maintain growth in emissions to 2020 and beyond. The Eighteenth Report recognised this and proposed tough targets for reducing carbon dioxide emissions from surface transport, setting out a series of measures which would enable them to be met (2.86).

8.3 The government has set the comparably challenging target of reducing total carbon dioxide emissions to 20% below the 1990 level by 2010. It seems clear that a substantial proportion of the necessary reduction in emissions will have to come from road transport (2.85). Important as they are, we do not believe that increases in the price of motor fuel, which have been the central element so far in government policy, will by themselves have a big enough effect on consumer demand or manufacturer response (2.46). They need to be accompanied by, on the one hand, technology-forcing mechanisms to accelerate the development of more efficient and cleaner road vehicles and, on the other hand, policies to improve the management of traffic and encourage people to switch to modes which are less damaging to the environment.

8.4 This review of what has happened since publication of the Commission's Eighteenth Report in 1994 has found signs of hope in:

the general recognition that land use and transport must be co-ordinated (7.25–7.28);

the development of the UK National Air Quality Strategy (2.17);

increased attention by motor manufacturers to the fuel consumption of cars (2.41–2.42);

a greater recognition of the role of public transport (1.7); and

an optimistic spirit in the public transport (4.44–4.49, 4.53–4.59, 4.70) and rail freight (5.8–5.10) industries.

8.5 There is nevertheless no sign as yet of large changes in previous trends. Statistics becoming available since the Eighteenth Report show that:

road traffic has started to grow again following the recession (1.23);

contrary to expectation, there is some evidence of rising concentrations of nitrogen dioxide (2.90);

there has been a small reduction in the average fuel consumption of new petrol cars (2.82), but other factors are tending to offset that (2.35);

use of public transport has not fallen further, but has not reversed earlier declines (1.24);

the proportions of freight carried by rail and water have fallen further (1.31);

there is further evidence of decline in cycling and walking (1.25).

An integrated transport system

8.6 A fundamentally different approach is needed if the UK is to avoid serious environmental damage and at the same time offer people the opportunities they want for continued economic growth, for their livelihoods and for leisure. The government is committed to establishing an integrated transport system. The kind of transport system that is desirable in environmental, economic and social terms must be an integrated one in the sense that all its parts work together to fulfil agreed social objectives.

8.7 The recent creation of a government Department which combines responsibility for transport with responsibility for land use and other aspects of environmental policy should facilitate integration. But restructuring government Departments does not in itself guarantee that coherent policies will emerge, as shown by experience in the 1970s when the Department of the Environment had responsibility for transport. In this chapter we set out our understanding of what is required for the creation of an integrated and environmentally sustainable transport system and the roles of different actors in bringing that about. We hope the conclusions we have reached as a result of this review of recent developments and their implications will be given full weight in the fundamental review of transport policy now in progress (1.18).

8.8 The starting-point is the objectives that underlie the creation of an integrated transport system. Economic well-being and quality of life both require an effective transport system which moves people and goods cleanly and efficiently with minimal impact on the environment.

8.9 Although cars are likely to remain the dominant mode for many types of journey, most of the objectives proposed in the Eighteenth Report as the basis for an environmentally sustainable transport system (appendix A) depend, directly or indirectly, on the creation of a much more efficient and attractive public transport system than now exists in the UK. Moreover, good public transport is an essential ingredient in reinforcing the vitality of town centres, in restoring decayed inner city areas, and in enabling London to retain its position as a world city. The availability of public transport greatly extends opportunities for the one-third of households which do not have use of a car, and widens choice for those which do. A revival of cycling and walking would also have enormous benefits not only as a contribution to reduced energy use, better air quality and improved fitness, but in ensuring that our streets are populated and agreeable places.

8.10 Most freight transport will also continue to be by road, but there is potential for large shifts to other modes which are capable of moving goods more efficiently and more cleanly along routes where demand is high.

8.11 We have identified six important respects in which an environmentally sustainable transport policy must be based on integration:

transport policies need to cover *all modes of transport* and deal with them in a consistent way, so that in each area the policies adopted towards the private car and alternative modes are coherent and mutually reinforcing (chapter 6);

to be attractive in competition with the car, there has to be an *integrated public transport system* in which people can change quickly and easily from one route to another and from one mode of transport to another (chapter 4);

policies towards freight should be based on *an integrated approach to logistics*, using different modes in combination to increase efficiency and reduce environmental damage (chapter 5);

there must be *integration of policies* covering not only transport and land use (chapter 7), but also air quality management (chapter 2) and control of exposure to noise (chapter 3);

taxes and charges should be levied in a co-ordinated way, so that the overall costs any business or individual faces when making a transport decision broadly reflect the environmental and other social costs the decision will impose on the community (chapter 6);

there should be *consistent signals* to expedite development and introduction of transport technologies which are cleaner and more efficient (chapters 2 and 6).

8.12 In relation to public transport, the ultimate aim is to persuade people to choose it for a substantial proportion of the journeys they currently make by car. Essential intermediate steps are, first, to make public transport financially and socially viable, and stem its decline, then to reverse that decline by ensuring the maximum share of growth in travel goes to public transport. Some fundamental issues about public transport have been obscured in recent debate by disproportionate emphasis on its ownership and sources of finance. It would be a mistake to assume that market forces and competition can on their own bring about an integrated transport system. Equally mistaken would be any suggestion that an 'integrated transport system' implies either some giant centralised organisation with executive responsibility for all forms of public transport and freight, as existed briefly in the 1940s in the shape of the British Transport Commission, or a monolithic planning organisation laying down routes and timetables for all forms of public transport on a national basis. Public transport is a diversified and decentralised industry, virtually all of which is now in the private sector. We have assumed that this will continue to be so.

8.13 In ensuring that an integrated and environmentally sustainable transport system is created, government at all levels has a vital strategic and enabling role. Liberalisation of markets can have considerable benefits, both for transport users and for the environment; but this presupposes externalities have been identified and dealt with, either through use of economic instruments or through direct regulation (1.53–1.56). Central government and local authorities should look to private sector companies in the first instance to take the necessary steps towards an integrated and environmentally sustainable transport system. Where the private sector and the operation of market forces cannot bring about such a system unaided, however, government must intervene.

8.14 The three key forms of intervention are:

promoting the development and introduction of *improved technology*;

identifying and remedying market failures in order to provide *the right incentives*, so that the power of market forces in raising technical efficiency also contributes to achieving the best practicable environmental option;

ensuring through legislation and administrative actions that *effective institutions* exist for providing regulation and planning wherever these are identified as necessary.

In the remainder of this chapter we consider each of these forms of intervention in turn. We then discuss the requirements for investment in alternative modes of transport, and how a cumulative process of change can be induced.

Improving technology

8.15 The motor industry is a global one; development, design and manufacturing increasingly transcend national boundaries. UK firms have a high reputation in many branches of automotive engineering. Their future success depends on how rapidly they adapt to the emerging worldwide demand for cleaner and more efficient vehicles.

8.16 There is still much to be done to make vehicles cleaner and more efficient. A major challenge is to reduce emissions of particulates and nitrogen oxides from diesel vehicles (2.62–2.65). If transport is to make a contribution to reducing emissions of greenhouse gases, there will have to be substantial reductions in the fuel consumption of road vehicles. We do not consider the motor industry is giving sufficient priority to meeting these challenges.

8.17 Many available technical options for reducing fuel consumption remain unexploited under current conditions (2.43). There should be a concerted publicity and information campaign to change people's attitudes about the performance of their cars and the pollution they cause (2.101). Changes in taxation to internalise externalities (8.24) will exert a powerful influence for the introduction of more efficient and cleaner technologies.

8.18 It is unlikely that the necessary improvements in design and technology will be developed and introduced unless governments also press the motor industry to change its marketing strategies, and make wise use of regulation. To provide a stimulus to rapid innovation demanding standards for vehicle emissions should be set to come into force at a fixed point in the future.

8.19 Europe is both a major market and a major player in the global motor industry. Further evolution of European Community (EC) legislation governing the technical characteristics of vehicles will be guided by regular consultations that now take place between the European Commission and regulatory authorities in the USA and Japan. The UK government should exert pressure to keep to the timetables for further EC legislation (2.25–2.28), and for its content to be ambitious, scientifically sound, and practically enforceable. This should cover in particular strengthening EC requirements for inspection and maintenance of vehicles in use, including tightening the limits applying to emissions from existing vehicles (2.50); and, despite industry resistance, more stringent stage IV limits for emissions from new vehicles to come into effect in 2005–06. For carbon dioxide emissions neither the reductions being offered by motor manufacturers nor those being sought by the European Commission (2.41–2.42) are as yet on a sufficiently large scale. Legislation may be necessary on this front too.

8.20 Introduction of advanced technologies will be prevented unless the sulphur content of diesel and petrol is reduced (2.30–2.32). There may be a case for EC legislation to bring about further reductions in noise from roads and road vehicles and limit noise from railways (3.26).

8.21 Industry should begin to move now towards radically different technologies which are cleaner and much more efficient, probably using hybrid propulsion (2.78–2.79), and eventually fuel cells (2.76). This is preferable in principle to using tailpipe devices, such as catalytic converters, to deal with the emissions from inherently polluting engines. The European Commission's Car of Tomorrow project, based on partnership with industry, has considerable potential to stimulate the development of cleaner and more efficient technology (2.75). The UK government should press for this project to receive substantial financial support under the Fifth Framework Programme for Research and Development.

8.22 Improved technology will also be of vital importance in other directions. New forms of public transport are being developed (4.53–4.58). Electronic ticketing and information systems can considerably increase the convenience and attractiveness of public transport (4.73). Electronic systems can also enable more efficient use to be made of the existing road network through improved control of vehicle flows and by opening up the possibility of new forms of charging (6.15–6.17, 6.30–6.31). Not least, further developments in communications could remove the need for some journeys (4.13).

Setting the right incentives

8.23 Achieving a less environmentally damaging transport system requires significant changes in the behaviour of firms and individuals. Wherever possible such changes should be brought about by working with market forces rather than against them. Many businesses are reducing the amounts of fuel used by their vehicle fleet and thereby making significant cost savings. More people might modify their behaviour if they were more aware of the true cost to them of their own decisions, given present prices and levels of taxation; others might be prepared to do so if they became more aware of the

environmental consequences of their decisions, even if this were to increase their costs. Much could be achieved by improving the quality, comprehensibility and prominence of the information available to users and purchasers (2.48, 2.101). Beyond a certain point, however, changes in behaviour depend on either regulation or changing the costs on which companies and individuals base their decisions. Clearly stated government intentions to internalise environmental and other social costs, or to raise particular taxes in stages over a period (as is happening with fuel duty), are an effective way of influencing behaviour, especially the motor industry's design and marketing strategies.

8.24 We believe central government should employ a combination of instruments to internalise the environmental costs imposed by road transport. The following either already exist in some form or could be introduced quickly:

> *increases in the average rate of fuel duty* as an incentive to limit distances travelled in private road vehicles and to buy vehicles with a lower fuel consumption. Future increases should be larger than 6% a year in real terms as earlier increases have been largely offset in practice by falls in the retail price before duty (2.44–2.45). It would be preferable for such increases to form part of phased increases across the EU (2.100);
>
> *variations in the rate of fuel duty* to reflect differences in the environmental damage caused by different fuels. The size of these differentials should be increased (2.31, 2.65);
>
> *substantial variations in vehicle excise duty (VED) for cars and light goods vehicles* according to their certified fuel consumption, as an additional incentive to choose vehicles with lower fuel consumption (2.56).

We welcome the introduction of an incentive for early purchase of less polluting heavy goods vehicles (HGVs) and buses or for retrofitting of emission control equipment in existing vehicles (2.57).

8.25 Some aspects of present fiscal arrangements send conflicting signals and in effect subsidise road use. Two important distortions should be remedied:

> irrespective of the environmental and other social costs they impose, the VED paid for *HGVs* does not cover the damage they cause to roads. The most practicable solution for the time being is to issue permits (*vignettes*) for use of UK motorways by HGVs of any nationality and levy a charge which is at least large enough to cover the whole of the infrastructure costs imposed (6.21);
>
> the tax treatment of *company cars* continues to be an incentive for the acquisition and excessive use of cars. To end that situation, further changes in the rules are needed (6.7–6.8).

8.26 In addition to these fiscal measures at national level, local authorities, including transport authorities/executives in the areas they cover (8.38), should also be able to use market forces to help create an integrated transport system. If, following an assessment of environmental and other impacts, a local authority concludes that obtaining more efficient use of road space is an essential element in its integrated transport plan (8.36–8.37) it should have a new power to charge for the use of roads in all or part of its area (7.35). It should also have a new power to control, and possibly levy taxes on, existing private parking (6.39). As the purpose of such charges or taxes would be to increase the efficiency of the transport system, we believe local authorities should be permitted to use the revenue as an additional source of spending, not only on roads, but on improving facilities for cyclists and walkers, and on improvements to public transport as part of plans for creating integrated transport systems. That may well be an essential pre-condition in political terms for securing public acceptance of such schemes.

8.27 Another aspect of setting the right incentives is the level of fares charged for public transport. Fares should not be kept low at the expense of the reliability and quality which are essential to make public transport attractive. Low fares might also encourage people to walk or cycle less. Nevertheless, an essential feature of an integrated transport system is to ensure that public transport fares are competitive in relation to the cost of private transport, and that relative costs reflect the different environmental and social impacts of each mode.

8.28 Within the framework of land use planning policies designed to minimise the need to travel and encourage use of alternative modes (7.25), the profit motive should be used where possible to achieve integration. Sites with good transport links provide attractive locations for development. As well as being profitable, carefully planned developments at rail and bus stations can boost the viability of public transport and counter car dependence. If any further major developments are permitted on sites which do not already have good access by public transport, the developer should be legally required to put in place and maintain access arrangements which do not require travel by private car (7.27).

Effective institutions

8.29 Bringing about the creation of an integrated transport system which will encourage increased use of public transport and less use of cars will require effective institutions operating on three fronts:

intervening where necessary to ensure that different rail services function as an integrated system (4.76), and similarly for bus services (4.49);

ensuring that public transport as a whole functions as a convenient and reliable system of high quality, with satisfactory connections between different forms of public transport and to and from other modes (4.73–4.74);

ensuring consistency between policies for public and private transport (6.28–6.29).

8.30 An integrated transport system also involves an integrated approach to freight movement. In this field we do not consider any changes in present institutions are needed, provided that planning policies recognise the need for sites with rail or water access for warehouses and depots, and provided further steps are taken towards internalising the costs imposed by HGVs. The changes associated with rail privatisation have created a much more flexible framework within which Railtrack, the major rail freight operator (English Welsh & Scottish Railway), other rail operators and road freight operators can work together to provide customers with intermodal services of high quality and realise the full potential of rail freight (5.8–5.11).

8.31 We therefore focus here on passenger transport. There is a sharp contrast at present between the highly regulated rail industry, with train operating companies holding franchises for a number of years and in most cases having the assurance of receiving subsidy throughout that period, and the almost unregulated bus industry, in which only a minority of services are subsidised by local authorities and not generally on a long-term basis.

8.32 During privatisation of the railways, there was considerable debate about whether they would continue to form an integrated system. Responsibility for ensuring this lies at national level with the Rail Regulator (who oversees the train operating companies) and Railtrack. The functions of the Franchising Director are also appropriately exercised at national level. The government is considering amendments to the present structure (4.71). We believe further legislation should not only facilitate the strategic development of the rail system but also ensure that it contributes fully to an integrated public transport system (4.78–4.79).

8.33 A major issue in achieving an integrated transport system is the future legal framework for the bus industry. The government is reviewing policy in this field (4.48). The Eighteenth Report advocated nationwide adoption of the system of franchising groups of bus routes which exists at present in London. Opinion among operators and local authorities favours the concept of a 'quality partnership' between the local authority and a designated operator (4.51). We believe that, to be effective, such an approach will require legislation. Given the necessary legislation, the quality partnership approach may be more appropriate than franchising in certain parts of the country. However, we believe franchising on the London model is the right solution for major conurbations (4.51).

8.34 It has been suggested that the bus and rail industries should be overseen by a single regulator. If such a change takes place, the functions of the national regulator in relation to the bus industry should not extend beyond regulating competition and those functions exercised at present by the Traffic Commissioners (4.78).

8.35 The primary focus for creation of an integrated transport system covering all modes of transport should be at local level. The recipe for success will differ from area to area depending on local circumstances. Local authorities are already responsible for traffic management and have functions in relation to public transport. They are also responsible for land use, air quality and other aspects of environmental protection. Only they have full knowledge of local circumstances and provide a mechanism for taking the necessary decisions in an accountable way (7.31–7.36).

8.36 Unitary authorities and county councils should be given the statutory duty of assessing the transport system in their area (7.34). This should include assessments of the potential roles of all modes of transport, including taxis, cycling and walking, and, where appropriate, detailed policies for their management and development. As well as promoting the effectiveness and efficiency of the transport system, such assessments should cover the full range of environmental requirements on the transport system, including improving air quality (2.95–2.96), limiting exposure to noise (3.25) and reducing carbon dioxide emissions (2.88). One object should be to increase use of public transport by giving it priority in traffic management in ways that will increase its speed and reliability by comparison with cars (6.26).

8.37 The development of transport services must also be integrated with land use plans. In contrast to the present transport policies and programmes, plans for integrated transport systems produced by local authorities need to cover 15–20 years ahead, a similar time-scale to structure plans for land use. One solution would be to subsume new procedures for transport planning in the existing system of structure plans and local plans for land use. In any event, preparation of long-term transport policies must proceed simultaneously with preparation of structure and local plans and, in any given area, both aspects of planning should cover the same period ahead. Every effort must be made to accelerate preparation of longer-term transport and land use plans which are mutually consistent and directed towards sustainable development (7.27).

8.38 In some cases the area covered by a unitary authority bears too little relation to travel patterns to make a sensible unit for drawing up and implementing integrated transport plans. A single transport authority should be established for London, probably as an important component of the functions of the proposed London-wide elected authority (7.40). The functions of the existing passenger transport executives should be extended to include traffic management, and they should be renamed 'transport executives' (7.38). They should continue to participate in the franchising of rail services in conurbations and be given a new responsibility for franchising bus services (8.33). To ensure that an integrated transport system is created, it may be necessary to establish further transport authorities/executives on similar lines in some other conurbations (7.39).

8.39 A stronger framework is needed at regional level. We believe firmer and more specific co-ordination of transport and land use policies at regional level is an essential pre-condition for an integrated transport policy, and that this must apply equally to all modes of transport. Whatever structures are created in pursuit of the government's regional policies should be capable of producing and implementing integrated transport strategies at regional level, with a coverage corresponding to the integrated transport plans we have described at local level.

Boosting investment in alternative modes

8.40 Producing more efficient and cleaner road vehicles and the cleaner fuels they need will require massive investment by the motor and oil industries over an extended period. We focus here on the requirements for investment to improve the quality of public transport and create an integrated transport system. The Eighteenth Report advocated double the 1994/95 level of investment for these purposes over a 10-year period. In fact investment in key areas has failed to increase since 1994/95, and in some cases has dropped.

8.41 An urgent task is to replace old rolling stock and signalling systems which are undermining reliability on the London Underground and the rail network (4.53, 4.70). Expanding the capacity of the rail network requires major investment over and above Railtrack's existing programme, although we envisage this would be directed to using existing infrastructure more efficiently rather than building

new rail lines on new alignments (4.68). Major investment is also required to develop the potential for rail freight (5.13–5.19).

8.42 Much of the investment needed is to develop urban transport systems extending from cycle ways to some new light rail systems, and including interchanges and real-time information systems (4.26–4.27, 4.55). A major element is purchase of much more comfortable buses with much lower emissions, and with low floors for easy boarding, in sufficient numbers to replace those which are not of a satisfactory standard at present and meet increased demand (4.43, 4.75).

8.43 We welcome the government's aim of winning more passengers and freight onto rail, and its proposal to establish a new rail authority, combining functions previously carried out by the Franchising Director and the Department of Transport, 'to provide a clear, coherent and strategic programme for the development of the railways involving higher levels of investment' (4.71). In the case of most train operating companies additional investment may not be forthcoming unless the length of franchises is extended (4.69).

8.44 We remain of the view that an enhanced programme of investment over a 10-year period is needed in order to create an environmentally sustainable transport system. Funds will have to come from a number of sources. We have made the assumption that public transport operators will continue to be predominantly private sector companies, as will freight operators, and will be able to draw on substantial private sector funds for investment, provided they can demonstrate that the investments will be profitable. Even so there will remain a very substantial requirement for investment projects initiated by the public sector, primarily by local authorities. Much of that is likely to be funded through the Private Finance Initiative or other forms of partnership between public and private sectors. The availability of future revenues from new forms of charging (8.26) seems an essential pre-condition for widespread use of private finance in such cases.

A cumulative process

8.45 Bringing about radical modifications to transport in the UK is of vital importance but will not be easily achieved. The decline in public transport is a self-reinforcing process (4.43). So is the decline in cycling, and especially walking (4.31).

8.46 Car dependency and transport intensity are the outcome of decisions by companies and other organisations about siting their operations, and myriad decisions by individuals about where to live, where to work, where their children should go to school, how to spend their leisure, and how to travel between these various activities. Given the existing patterns of land use and social provision they have inherited and the current transport system, the seven out of ten households which have regular use of a car may justifiably feel they have few choices. Not to travel by car would seriously circumscribe the opportunities available to them or cause very great inconvenience. On the other hand their opportunities are often constrained at present by congestion. And the present situation limits, often severely, the choices available to the three out of ten households which do not have regular use of a car.

8.47 Less tangible cultural influences are also important, such as the extent to which a car is seen as a source of status and apparent security. Available technology that could reduce fuel consumption significantly is not applied because customers are believed to prefer higher performance to reducing their impact on the environment. There should be a concerted campaign to change public attitudes about cars. Fiscal incentives are a means of encouraging demand for cars with lower fuel consumption so that a market can develop for much more efficient models.

8.48 A transport system is a network in which the whole is more than the sum of the parts. The individual elements may well become viable only when added together and working as a system. New infrastructure, such as guided bus or light rail systems or networks of cycle routes, will take some time to construct and may not be well used until they are complete. Within each area all modes of transport have to be dealt with in a coherent way so that policies for the private car and for alternative modes are mutually reinforcing. This will require a combination of sticks and carrots: measures to manage, and where appropriate restrain, car traffic must be phased in carefully with improvements

to public transport and improved facilities for cycling and walking. That may mean that significant capital expenditure has to be incurred before the local authority starts to receive income from new road or parking charges. The arrangements must be flexible enough to allow for that.

8.49 In this review, and particularly in this concluding chapter, we have tried to bring together the full range of environmental and transport policies that must contribute to reversing previous trends and to inducing a cumulative process of change that will create an environmentally sustainable transport system. The Eighteenth Report suggested that there are three fundamental conditions for bringing about such a reversal:

a thoroughgoing commitment to change, expressed in objectives and targets;

a package of measures of all types, both incentives and restrictions, covering all aspects of transport-related behaviour, in order to maximise the positive interactions;

a 10-year investment programme to develop alternative modes and so provide the essential basis for the process of cumulative change.

8.50 We emphasise that an effective transport system, which moves people and goods cleanly and efficiently with minimal impact on the environment, is vital for improving air quality, limiting the greenhouse effect and reducing other forms of environmental damage, as well as for ensuring economic well-being. We believe that such a system must be an integrated one, created through a cumulative process of change over a period of at least ten years through the consistent application of coherent long-term policies.

ALL OF WHICH WE HUMBLY SUBMIT FOR YOUR MAJESTY'S GRACIOUS CONSIDERATION

John Houghton *Chairman*
Selborne
Geoffrey Allen
Martin Holdgate
Michael Banner
Geoffrey Boulton
Clair Chilvers
Roland Clift
Peter Doyle
John Flemming
Richard Macrory
Michael Marmot
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64. Society of Motor Manufacturers and Traders (SMMT) (1995a). *The Motor Industry Response (to the Royal Commission on Environmental Pollution's Report on Transport and the Environment).* Presented to Government, February 1995.
65. Calculations are made on the basis that every gallon of petrol burnt produces about 11 kg of carbon dioxide and every gallon of diesel produces about 12 kg of carbon dioxide. To convert litres/100 km to miles per gallon, divide 282.5 by the litres/100 km value.
66. Report on the Commission's Discussions with the Automobile Industry on an Agreement to Reduce CO_2 Emissions from Passenger Cars. *Commission Staff Working Paper SEC(97) 176*, 28.1.97. Commission of the European Communities, Brussels.
67. Greenpeace's fuel efficient car poses challenge to vehicle industry. *ENDS Report*, No. 259, August 1996, 26–27; Why isn't the world's motor industry willing to produce a car like this? *The Independent*, 14 August 1996, page 20; SmILE milestone. *Financial Times*, 12 December 1996, page 16.
68. Smart move for watch that turned into a car. *The Independent*, 2 May 1997, page 13.
69. OECD (1995).
70. UK Climate Change Programme (1994), paragraph 3.66. Some measures adopted for other purposes, such as reducing traffic congestion or improving road safety, were also seen as having a beneficial effect on carbon dioxide emissions. These include encouraging freight traffic to use rail rather than road transport and passengers to use public rather than private transport.
71. DOT (1996a), table 2.4.
72. Eighteenth Report, recommendation 28 and paragraph 7.58.
73. SMMT (1995a), paragraph 84.
74. The Institute of Advanced Motorists (IAM) highlights the potential role of driver education in reducing the environmental pollution associated with motor vehicles. Driver education and the application of advanced motoring skills lead to more efficient vehicle use and reduction in the amount of pollutants produced. Information supplied by IAM, November 1996.
75. Eighteenth Report, recommendation 35.
76. Quoted in European Commission Communications and Proposals based on the Auto/Oil Programme, June 1996.

77. The European Community (EC) Roadworthiness Directive 77/143/EEC (and amendments) lays down the requirements for roadworthiness testing for goods vehicles. Subsequent Directives have covered private cars (Directive 91/328/EEC) and tightened the requirements for all vehicles (Directive 92/55/EEC).
78. *Clean Cars – Clean Air. A Consumer Guide to Auto Emission Inspection and Maintenance Programs.* Consumer Federation of America.
79. Pierson, W.R. (1996). New Directions. Motor vehicle inspection and maintenance programs – How effective are they? *Atmospheric Environment*, **30**(21), i–iii.
80. Eighteenth Report, paragraph 8.64.
81. SMMT (1995b). *'New cars for Old'. A UK Vehicle Scrappage Scheme. Measures to improve the environmental profile of the UK vehicle parc.* July 1995.
82. Eighteenth Report, paragraph 8.65.
83. Revision of car taxation in line with emissions levels. *Germany Environmental Information Note*, Note No. 26.97(E), 30 April 1997.
84. House of Lords (1996), paragraph 4.22.
85. Eighteenth Report, paragraph 8.49.
86. DOT (1996b). *New Car Fuel Consumption Figures.* Vehicle Certification Agency, an Executive Agency of DOT. April 1996. Published annually, this booklet contains fuel consumption figures for new vehicles obtained in tests specified by Directive 80/1268/EEC. A new series of tests (Directive 93/116/EC) is being phased in which should provide results that are more representative of actual average on-road fuel consumption.
87. UK National Air Quality Strategy (1997), paragraph 30.
88. Tax measures to help the environment. *HM Treasury Press Notice*, No. 4, 2 July 1997.
89. Eighteenth Report, paragraph 7.39 and box 7B.
90. In 1995, 53% of all new car registrations in Great Britain were company cars; a further proportion of cars is provided by an employer but registered in the employee's name. Information supplied by Transport Statistics, DOT, February 1997.
91. *Company Car Taxation. A contribution to the debate.* The Ashden Trust, London First and the University of Westminster. June 1997.
92. Eighteenth Report, paragraph 8.31. The comparison takes into account that producing diesel at a refinery requires less energy.
93. Eighteenth Report, figure 8-VI.
94. Information supplied by Transport Statistics, DOT, February 1997. Figures refer to vehicles licensed in 1995.
95. Gover, M.P., Hitchcock, G.S., Collings, S.A. and Moon, D.P. (1994). *UK Petrol and Diesel Demand. Energy and emissions effects of a switch to diesel.* A report to the Department of Trade and Industry (DTI) and DOT from the Energy Technology Support Unit (ETSU). HMSO. November 1994.
96. Information obtained during visits by Commission Secretariat to US Department of Energy and Environmental Protection Agency, April 1997.
97. Eighteenth Report, paragraph 8.33.
98. Eighteenth Report, paragraph 8.28.
99. HM Treasury's memorandum of evidence to House of Lords (1996), contained in the supplementary *Volume of Evidence*, House of Lords Paper 117-I.
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102. Information supplied by South Coast Air Quality Management District, California, March 1997.
103. Information supplied by Dr Claire Holman, June 1997.
104. House of Lords (1996), paragraphs 2.12 and 3.9.
105. Information supplied by Dr Claire Holman, June 1997.
106. Eighteenth Report, paragraphs 8.20–8.21 and 8.74–8.75.
107. Gover, M.P., Collings, S.A., Hitchcock, G.S., Moon, D.P. and Wilkins, G.T. (1996). *Alternative*

Road Transport Fuels – A Preliminary Life-cycle Study for the UK. Volume 1. A study co-funded by DTI and DOT from ETSU. HMSO. March 1996.

108. French Academy of Science (1996). *Air Pollution Induced by Transport. Effects on Health and Technological Progress.* June 1996. Translation provided by the United Kingdom Petroleum Industry Association, November 1996.
109. House of Lords (1996), paragraphs 4.13 and 4.15.
110. Eighteenth Report, recommendation 14.
111. The government rejected similar recommendations for the use of economic instruments contained in the Fifteenth Report; see: *Government's Response to Fifteenth Report, 'Emissions from Heavy Duty Diesel Engined Vehicles'.* November 1992.
112. Fuelling a cleaner approach to power. *Surveyor*, 27 March 1997, 14–16; 'Powershift' aims to move clean vehicle sales up a gear. *Air Health Strategy*, May 1997, page 4.
113. Randle, J.N., Jones, M.R. and Sawyer, T.M. (1993). *An analysis of future power train requirements.* Royal Academy of Engineering. The British Association Lectures 1993. Pages 5–24; Randle, J.N. (1996). *Designing a vehicle to meet the needs of the environment.* Symposium Code WED.24. British Association Festival of Science, University of Birmingham, 11 September 1996.
114. Eighteenth Report, paragraphs 7.50 and 8.74.
115. Information supplied by Dr Claire Holman, June 1997.
116. *Partnership for a New Generation of Vehicles. Technical Accomplishments.* US Department of Commerce and USCAR, Washington D.C. and Dearborn (Michigan). July 1996.
117. Peake (1997).
118. *Partnership for a New Generation of Vehicles. Program Plan.* US Department of Commerce and USCAR, Washington D.C. and Dearborn (Michigan). 29 November 1995.
119. House of Lords (1996), paragraph 3.36.
120. House of Lords (1996), paragraph 4.30.
121. For example, trials of those manufactured by the Canadian firm, Ballard; reported in: Taylor, D. and Fergusson, M. (1996). *Fuelling the Debate. An appraisal of the role of advanced technologies in reducing vehicle emissions.* Prepared for Friends of the Earth by the Institute for European Environmental Policy, London. November 1996. See page 35; information supplied by Johnson Matthey plc, December 1996.
122. House of Lords (1996), paragraph 4.30.
123. Randle *et al.* (1993).
124. Randle (1996).
125. Taylor and Fergusson (1996), page 32.
126. Daniels (1997).
127. Lovins, A.B. and Lovins, H.L. (1995). Reinventing the wheels. *Atlantic Monthly*, January 1995.
128. Eighteenth Report, paragraphs 8.81–8.85 and recommendation 16.
129. House of Lords (1996).
130. French Academy of Science (1996).
131. Information supplied by Vehicle Standards and Engineering Division, DOT, January 1997.
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133. Eighteenth Report, paragraph 7.54.
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135. MVA Consultancy (1996). *Effects and Elasticities of Higher Fuel Prices.* Unpublished study commissioned by DOT.
136. Ministers act on biocides, CO_2 emissions from cars. *ENDS Report*, No. 257, June 1996, 39–41.
137. Eighteenth Report, paragraphs 8.50–8.51 and figure 8-III; CONCAWE (1995). *Motor Vehicle Emission Regulations and Fuel Specifications in Europe and the United States. 1995 Update.* Report No. 5/95. CONCAWE, Brussels. December 1995.

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139. The carbon dioxide emissions figures and projections used in these calculations are from the UK Climate Change Programme (1997); figures originally expressed in terms of million tonnes carbon dioxide were converted to million tonnes carbon (MtC) by multiplying by 12/44. The estimate of the effect of the enhanced fuel duty strategy on carbon dioxide emissions from transport was reported in: Increases in fuel duties to help the environment. *HM Customs and Excise Press Notice*, No. CE 3, 2 July1997.

140. The 44% contribution was suggested in: Socialist Environment and Resources Association (SERA) (1997). *Taking a cool look: Policies to reduce UK CO_2 emissions by 20%.* July 1997.

141. UK Climate Change Programme (1997), paragraph 2.41. Data for figure 2-III are from UK Climate Change Programme (1997), tables A1.I and A2.I; estimates do not include transport-related emissions from refineries and power stations.

142. The original Directive was: Directive (70/220/EEC) on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive ignition engines of motor vehicles. *Official Journal of the European Communities*, **L76**, 6.4.70. The 10th Amendment to Directive 70/220/EEC made it necessary for petrol-engined cars to be fitted with three-way catalytic converters: Directive 91/441/EEC. *Official Journal of the European Communities*, **L242**, 30.8.91. Stage II limits for cars which came into effect in 1996–97 are contained in: Directive 94/12/EEC of the European Parliament and the Council of 23 March 1994 relating to measures to be taken against air pollution by emissions from motor vehicles and amending Directive 70/220/EEC. *Official Journal of the European Communities*, **L100**, 19.4.94.

143. London's air quality deteriorates despite catalytic converters. *ENDS Report*, No. 243, page 10; Catalysts fail to dent NO_2 pollution levels. *ENDS Report*, No. 258, 6–7.

144. Information from: DETR (1997); Broughton *et al.* (1997); Doubts grow over benefits of catalytic converters. *ENDS Report*, No. 263, December 1996, page 11; Catalytic converters fail to clear the air in Birmingham. *Air Health Strategy*, January 1997, page 4; *UK Nitrogen Dioxide Survey 1995.* AEA Technology. Reported in: Urban NO_2 levels stay high despite catalytic converters. *ENDS Report*, No. 266, March 1997, 10–11.

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147. *Part IV The Environment Act 1995. Local Air Quality Management. Review of Air Quality Measures to Combat Poor Air Quality in Small and Medium European Cities.* A paper by Professor Derek Elsom, Oxford Brookes University, commissioned for DOE. December 1996.

148. For example, modelling work on pedestrianisation schemes in Chester shows significant environmental gains in the pedestrianised area but some increase in pollutant concentrations outside the area due to redistribution of traffic. Reported in: Chiquetto, S. and Mackett, R. (1995). Modelling the effects of transport policies on air pollution. *The Science of the Total Environment*, **169**, 265–271.

149. Eighteenth Report, paragraphs 8.14 and 8.24. The exception is sulphur dioxide, for which a rapid improvement was expected in 1997 following the reduction in the permitted sulphur content of diesel.

150. Eighteenth Report, paragraph 8.23 and appendix B.

151. Eighteenth Report, paragraph 8.25.

152. Eighteenth Report, paragraph 8.22i. It was assumed that the limits for cars would be roughly equivalent to the Californian ultra low emission vehicle standard (1.76 g/km for carbon monoxide and 0.28 g/km for hydrocarbons and nitrogen oxides); that emissions of particulates from heavy duty diesels would be halved; and that parallel changes would be made in the limits for light goods vehicles.

Chapter 3

1. Fourth Report, paragraph 224.
2. Eighteenth Report, paragraph 14.24.
3. Department of the Environment, Transport and the Regions (DETR) (1997). *Digest of Environmental Statistics No. 19 1997.* A publication of the Government Statistical Service. The Stationery Office. See table 6.10.
4. Future Noise Policy. European Commission Green Paper. *COM(96)540.* 1996; cited as EC Green Paper (1996).
5. Eighteenth Report, paragraphs 4.18 and 4.22.
6. World Health Organization (WHO) (1980). *Noise.* Environmental Health Criteria Document No. 12. WHO, Geneva.
7. EC Green Paper (1996).
8. EC Green Paper (1996).
9. Member States are not bound to set limits equal to those contained in optional directives but cannot erect trade barriers by setting more stringent limits. *Manual of Environmental Policy: the EC and Britain.* Ed. N. Haigh. Institute for European Environmental Policy, London.
10. Implemented in the UK by *The Road Vehicles (Construction and Use) (Amendment) (No. 5) Regulations 1996.* Statutory Instrument SI 1996 No. 2329. HMSO. The limits were summarised in the Eighteenth Report, table 8.8.
11. National Society for Clean Air and Environmental Protection (NSCA) (1997). *1997 Pollution Handbook. The Essential Guide to UK and European Pollution Control Legislation.* Ed. L. Murley. NSCA, Brighton.
12. EC Green Paper (1996).
13. Eighteenth Report, paragraph 8.63.
14. Eighteenth Report, recommendations 21 and 22.
15. Nationwide pressure for quieter roads. *Environmental Health*, **104**(9), September 1996, pages 253 and 255; Residents challenge DoT in 'noisiest road' row. *Surveyor*, 14 November 1996, page 9.
16. Information supplied by the Department of Transport (DOT), June 1997.
17. Plagued by noise. *New Scientist*, No. 2056, 16 November 1996, 14–15.
18. Information supplied by DOT, June 1997.
19. Information supplied by DOT, June 1997.
20. Nationwide pressure for quieter roads. *Environmental Health*, **104**(9), September 1996, pages 253 and 255.
21. NSCA (1997).
22. EC Green Paper (1996).
23. Eighteenth Report, paragraph 4.15; NSCA (1997).
24. Information supplied by Railtrack plc, June 1997.
25. Since 1992, heavily trafficked roads carrying over 75,000 vehicles per day have generally been constructed with asphalt surfaces due to noise concerns. The Highways Agency approved the use of whisper concrete on all roads where concrete is technically suitable in May 1996. The results of trials showed that whisper concrete was quieter than conventional concrete and some asphalt surfaces, as well as being safe and durable. Reported in: Minister launches quieter concrete road surface. *Highways Agency Press Notice*, HA 168/96, 22 May 1996.
26. Reported in: *This Common Inheritance. UK Annual Report 1997.* Cm 3556. The Stationery Office. February 1997; cited as This Common Inheritance (1997).
27. *Transport – The Way Forward. The Government's Response to the Transport Debate.* Cm 3234. HMSO. April 1996. See paragraph 12.32.
28. Eighteenth Report, recommendations 23 and 24.
29. Department of the Environment (DOE) (1994). *Planning Policy Guidance Note 24 (PPG 24): Planning and Noise.* HMSO; cited as PPG 24 (1994).
30. Eighteenth Report, recommendation 25.
31. PPG 24 (1994).

32. *UK Government Comments on EC Green Paper on Future Noise Policy*. DOE. March 1997.
33. Information supplied by Air and Environment Quality Division, DETR, June 1997.
34. This Common Inheritance (1997).

Chapter 4

1. Derived from tables 2Aii and 2Bii in Department of Transport (DOT) (1996a). *National Travel Survey 1993/95*. Transport Statistics Report. A publication of the Government Statistical Service. HMSO. July 1996. These statistics include journeys of less than one mile.
2. Disabled Persons Transport Advisory Committee (1996). *Royal Commission on Environmental Pollution 18th Report: Comments from the Disabled Persons Transport Advisory Committee*. June 1996.
3. Automobile Association (1997). *Living with the car*.
4. ESRC Transport Studies Unit, Oxford University and RDC Inc, San Francisco (1995). *Car Dependence*. A report for the RAC Foundation for Motoring and the Environment; cited as RAC (1995). See executive summary, page 9. See also Eighteenth Report, paragraphs 2.17–2.23.
5. RAC (1995), page 123.
6. Information supplied by Hertfordshire TravelWise, June 1997.
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9. Transport Green Paper (1996.)
10. RAC (1995).
11. Derived from tables 2Ai and 2Bi in DOT (1996a).
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14. Sustrans (1997). *Annual Review 1996*.
15. Sustrans (1997).
16. Sustrans (1996). *How to establish a Safe Routes to School Project*.
17. DOT (1996b). *Developing a strategy for walking*. DOT Walking Steering Group.
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19. Cairns, S. (1996). Delivering alternatives. *Transport Policy*, **3**(4), 155–176.
20. Shelf-life of supermarkets is called into question. *The Guardian*, 1 February 1997.
21. Davis, R. (1986). *Tele-shopping in the Food Trades: Current Status and Future Potential*. Research Paper Series B3. OXIRM, Oxford.
22. Cairns (1996).
23. British Telecommunications plc (1997).
24. House of Commons Environment Committee. *Shopping Centres*. Fourth Report, 1996/97 Session. House of Commons Papers 210-I and 210-II. March 1997.
25. Office for National Statistics (1997). *Social Trends 27*. 1997 Edition. A publication of the Government Statistical Service. The Stationary Office; cited as Social Trends 27 (1997).
26. DOT (1996c). *Transport Statistics Great Britain*. 1996 Edition. A publication of the Government Statistical Service. HMSO. September 1996. See table 9.4
27. DOT (1996d). *The National Cycling Strategy*; cited as National Cycling Strategy (1996).
28. National Cycling Strategy (1996).

29. Information supplied by the Department of the Environment, Transport and the Regions (DETR), July 1997.
30. DOT (1996c), table 1.1.
31. Information supplied by CENTRO, the West Midlands Passenger Transport Executive, December 1995, from: Wood, C. (1995). *Energy Use by Different Passenger Transport Modes.* Working Paper for the Open University. February 1995.
32. Emission limits for mopeds and motorcycles contained in Chapter 5 of Directive 97/24/EEC; information supplied by Vehicle Standards and Engineering Division, DETR, July 1997.
33. Information supplied by DETR, July 1997.
34. Pedestrians Policy Group (1996). *Walking Forward.*
35. Pedestrians Policy Group (1996).
36. Transport 2000 and Environ (1996). *Small Steps, Giant Leaps.*
37. DOT (1996b).
38. DOT (1996c), table 9.4; Eighteenth Report, figure 2-I.
39. A fall of 1.2% in the number of journeys was balanced by an increase in the average length of journeys.
40. Social Trends 27 (1997).
41. DOT (1996a), table 2.3. Between 1988/89 and 1996/97 journeys by bus in London rose by 25% and passenger-kilometres by 21%; information supplied by London Transport Buses, July 1997.
42. For example in Merseyside (information supplied by the Passenger Transport Executive Group, December 1996) and on route 66 into Ipswich (Grimm, P. (1997). *Ipswich Superoute 66*. Paper given to ICM Urban Mass Transit Conference held in London on 8–9 May 1997).
43. House of Commons Transport Committee. *The Consequences of Bus Deregulation.* First Report, 1995/96 Session. House of Commons Papers 54-I to 54-III. November 1995; cited as House of Commons (1995).
44. House of Commons (1995).
45. Cowie's £282 million bid for British Bus referred to Monopolies Commission. *The Guardian,* 1 November 1996.
46. Social Trends 27 (1997), page 204.
47. Eighteenth Report, paragraph 13.43.
48. Fifteenth Report, paragraphs 7.12 and 7.15.
49. *Government's Response to Fifteenth Report, 'Emissions from Heavy Duty Diesel Engined Vehicles'.* November 1992.
50. Information supplied by London Transport Buses, July 1997.
51. As a recent example, use of a local bus service to Heathrow Central increased by 150% when the frequency was increased from 20 minutes to 10 minutes. Information supplied by BAA plc Heathrow, January 1997.
52. Information supplied by Volvo Buses Limited, August 1997.
53. House of Commons (1995).
54. DOT (1997). *Transport Report 1997 – The Government's Expenditure Plans 1997–98 and 1999–2000;* cited as Transport Report (1997).
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60. Eighteenth Report, paragraphs 13.41–13.47.
61. DOT (1996c), tables 1.1 and 5.21.
62. DOT (1996c), table 9.8.
63. Mogridge, M. (1997). *The rejuvenation of inner London.* Report commissioned by London Transport (summarised in: *Evening Standard*, 17 March 1997).

64. London Transport (1996). *Planning London's transport to win as a world city.*
65. Train delays and station closures 'an insult to passengers'. *Evening Standard*, 24 February 1997.
66. DOT (1996c), tables 1.1, 5.21 and 5.24–5.28.
67. The term 'tram-train' is being used in France; for example, in: Des trams-trains vont être mis en place pour améliorer le trafic des banlieues. *Le Monde*, 9 April 1997.
68. Information supplied by Nexus, February 1997.
69. University of Bristol, Advanced Transport Group (1997). *ULTRA: Transport for the future.*
70. Information supplied by Merseyside Passenger Transport Authority, June 1997.
71. Eighteenth Report, table 6.3. The percentage figure for rail use given for Britain in this table is not comparable with the figure given in table 4.1 as it was calculated on a different basis.
72. Information supplied by Railtrack plc, June 1997.
73. Powell, T. (1997). *The Prospects for the Franchised Railway.* A report by Transport Advisory Services for Save Our Railways.
74. *Making Connections.* Report by a sub-group of the UK Round Table on Sustainable Development. 1997; cited as UK Round Table (1997).
75. Railways Act 1993, section 4(1)(b), (d), (e), (g).
76. Railways Act 1993, section 5(1)(a).
77. Railtrack (1997). *Network Management Statement 1996/97.* See page 49.
78. Railtrack (1997), page 25.
79. Railtrack (1997), page 50.
80. Labour Party (1997). *New Labour because Britain deserves better.*
81. UK Round Table (1997).
82. This point was emphasised in evidence to the House of Commons Transport Committee; House of Commons (1995).
83. Information supplied by Nexus, February 1997.
84. Kendall, I. (1997). *A consortia case study: Lessons to be learnt from Tramlink project.* Paper given to ICM Urban Mass Transit Conference held in London 8–9 May 1997.
85. Helm, D. (1997). *Regulating Transport in the UK.* Paper given to The Rail Freight Conference *'97 held in London on 4 June 1997.*

Chapter 5

1. Plowden, S. and Buchan, K. (1995). *A New Framework for Freight Transport. A summary.* A report for the Civic Trust.
2. European Council of Applied Sciences and Engineering (1996). *Mobility, Transport and Traffic in the perspective of Growth, Competitiveness, Employment.*
3. Steer Davies Gleave (1995). *Alternatives to Traffic Growth: The role of public transport and the future for freight.* A report for Transport 2000. This report refers in turn to: McKinnon, A. (1995). *The Effect of Logistical Restructuring on Road Freight Demand.* Economic and Social Research Council Report. See also McKinnon, A. (1996). *Logistical Restructuring, Freight Traffic Growth and the Environment.* Paper presented at the Inaugural Workshop of the Logistics Academic Network, September 1996.
4. Eighteenth Report, paragraphs 14.77 and 7.19.
5. See for instance *Vehicle Utilisation – Making the most of every journey.* Freight Matters, 3/95. Policy Briefing Note from the Freight Transport Association.
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8. McKinnon, A. (1996). The empty running and return loading of road goods vehicles. *Transport Logistics*, **1**(1), 1–19.
9. European Council of Applied Sciences and Engineering (1996). This report refers in turn to: European Logistics Association (1992). *Achieving customer satisfaction leadership in Europe.*

10. *Food Miles Action Pack: A guide to thinking globally and eating locally.* The SAFE Alliance. 1996.
11. Holman, C. (1996). *The Greening of Freight Transport – Final Report.* Report for the European Federation for Transport and Environment.
12. *Transport – The Way Forward. The Government's Response to the Transport Debate.* Cm 3234. HMSO. April 1996. See paragraphs 15.15–15.18.
13. Freight by rail could halve lorry miles. *Rail Freight Group Press Release*, July 1997; paper by the Rail Freight Group responding to the government's review of the national roads programme.
14. Information supplied by English Welsh & Scottish Railway, April and July 1997.
15. Information supplied by Railtrack plc, June and July 1997.
16. Railtrack plc (1997). *Promotion of Rail Freight*. April 1997. Other recent developments from Railtrack include inviting hauliers and logistics companies to purchase their own track access and promoting the development of terminals for access to rail.
17. *The Rail Freight Challenge: Increasing Rail Freight by Meeting Customers' Needs.* A study by the Freight Transport Association's Rail Freight Council. 1995.
18. *Making Connections.* Report by a sub-group of the UK Round Table on Sustainable Development. 1997; cited as UK Round Table (1997).
19. UK Round Table (1997) suggests transfer costs to rail amount to at least 5–10% of door-to-door intermodal transport costs which must be offset by larger savings elsewhere.
20. Harman, R. (1995). *New Directions: a manual of European best practice in transport planning.* A report for Transport 2000.
21. *Transport the Way Forward.* The Civic Trust Response. 1996.
22. UK Round Table (1997).
23. Freight villages may solve terminal problem. *The Financial Times*, 13 December 1996.
24. Information supplied by Railtrack plc, June 1997.
25. See for example, Steer Davies Gleave (1995).
26. National Audit Office (1996). *Department of Transport: Freight Facilities Grants in England.*
27. Information supplied by the Department of the Environment, Transport and the Regions, July 1997.
28. Announcement by John Watts, Minister for Railways, Roads and Local Transport, reported in: John Watts gives piggyback the green light. *Department of Transport Press Notice,* No. 74, 6 March 1997.
29. Eighteenth Report, paragraph 10.60.
30. Eighteenth Report, paragraph 10.60.
31. House of Commons Transport Committee. *The Road and Bridge Maintenance Programme. Volume I.* First Report, 1996/97 Session. House of Commons Paper 105-I. January 1997.

Chapter 6

1. Evidence from Treasury quoted in: Eighteenth Report, paragraph 7.5. The present vehicle excise duty (VED) developed from the road fund, which was originally intended to finance the provision of roads. The revenue from VED is no longer hypothecated in this way, and the Treasury considers fuel duty to be an excise duty unrelated to road spending. Nonetheless for many years DOT published an annual table showing the revenue from these taxes against the costs of roads. The last such table, for 1994/95, showed that tax revenues of £20.4 billion exceeded costs by £13.6 billion. Observers have often sought to compare this excess with the environmental and other social costs attributable to road use.
2. *Transport – The Way Forward. The Government's Response to the Transport Debate.* Cm 3234. HMSO. April 1996; cited as Transport Green Paper (1996). See annex 4.
3. Eighteenth Report, paragraph 7.19 and table 7.3.
4. Acutt, M.Z. (1996). Modelling greenhouse gas emissions from cars in Great Britain. *Transportation Planning and Technology* **19**, pp191–206.
5. Fowkes, A.S., May, A.D., Nash, C.A. and Siu, Y.L. (1996). *Forecasting road traffic growth*:

demographic change and alternative policy scenarios. Institute of Transport Studies, University of Leeds. Paper for ESRC Conference on Transport and the Environment. March 1996.

6. Fowkes *et al.* (1996). This is consistent with the estimate by Acutt (1996) that reducing public transport fares to one-fifth the 1992 level would reduce carbon dioxide emissions from surface transport in 2027 by only 3%.
7. Eighteenth Report, paragraph 6.13f.
8. Smeed, R.J. (1968). Theoretical studies and operational research on traffic congestion. *Journal of Transport Economics and Policy* **2.**
9. Ashden Trust, London First and University of Westminster (1997). *Company car taxation: a contribution to the debate*. June 1997.
10. Eighteenth Report, recommendation 31.
11. Ashden Trust *et al.* (1997).
12. The importance of this issue was emphasised in submissions from the Institute of European Environmental Policy and Transport 2000.
13. Department of Transport (DOT), Office of Passenger Rail Franchising, Office of the Rail Regulator. *Transport. The government's expenditure plans 1997–98 to 1999–2000*. Cm 3606. The Stationery Office. March 1997; cited as Transport Report (1997).
14. Eighteenth Report, paragraphs 13.81–13.84.
15. Department of the Environment, Transport and the Regions (1997). *What role for trunk roads in England? Volume 1: A consultation paper*. June 1997.
16. Transport Report (1997).
17. Written Answer by the Minister for Transport, House of Commons Hansard, 19 June 1997.
18. Eighteenth Report, recommendations 57, 63.
19. Transport Report (1997).
20. Information supplied by DOT, June 1997.
21. Eighteenth Report, recommendation 49.
22. Eighteenth Report, paragraphs 6.25–6.35.
23. Information supplied by South Coast Air Quality Management District, California, March 1997.
24. Tindale, and Holtham, (1996). *Green Taxes: pollution payments and labour tax cuts. Institute for Public Policy Research.*
25. Maddison, D., Pearce, D., Johansson, O., Calthrop, E., Litman, T. and Verhoef, E. (1996). *Blueprint 5: The True Costs of Road Transport*. Earthscan Publications Limited.
26. Eighteenth Report, recommendation 59.
27. The Member States which operate the system are Germany, Belgium, Denmark, Luxembourg, Netherlands and Sweden; a separate system operates in Austria. Information supplied by DETR, July 1997. If tolling is introduced on German motorways, that would of course replace the *vignette* system.
28. Eighteenth Report, recommendation 76.
29. DOT (1989). *Roads for prosperity*. Cm 693. HMSO.
30. DOT (1992). *Transport Statistics for London*. HMSO (see charts 3a and 8); DOT (1996). *Transport Statistics Great Britain*. 1996 Edition. A publication of the Government Statistical Services. HMSO. September 1996. See table 4.13.
31. Eighteenth Report, paragraph 11.55.
32. Eighteenth Report, box 6A.
33. DOT (1996). Developing a Strategy for Walking. A publication of the Walking Steering Group. December 1996.
34. DOT (1996).
35. Eighteenth Report, paragraphs 7.28–7.29.
36. Eighteenth Report, paragraph 7.41.
37. Eighteenth Report. paragraph 6.55.
38. Eighteenth Report, paragraph 6.56.
39. Maddison *et al.* (1996).

40. Government Office for London (1995). *The London Congestion Charging Research Programme, Principal Findings*. July 1995.
41. Tindale and Holtham (1996).
42. Austin (1995). *Road Pricing in London for Congestion and Emissions*.
43. Leeds Institute for Transport Studies (1995). *An investigation into the effects of various transport policies on the levels of motorised traffic in GB in 2006*.
44. Austin (1995).
45. Eighteenth Report, box 6C and paragraph 6.57.
46. Information supplied by Western Area of Swedish National Roads Administration, October 1996.
47. Information supplied by Councillor David Begg, the City of Edinburgh Council, February 1997.
48. Information supplied by Leicester City Council, August 1997.
49. Transport Green Paper (1996), paragraphs, 14.69–14.70.
50. Eighteenth Report, recommendation 95.
51. Eighteenth Report, recommendation 90.
52. Information supplied by BAA plc, January 1997.
53. Eighteenth Report. recommendation 95.
54. It was assumed, for example, that the effect of achieving target C1 for reducing the proportion of journeys made by car in urban areas would be to reduce the growth of car traffic in urban areas to half the overall rate indicated by the low forecast made by DOT in 1989 (Eighteenth Report, appendix D, paragraph D.3).

Chapter 7

1. Eighteenth Report, paragraph 14.51.
2. Eighteenth Report, paragraph 9.37.
3. Nineteenth Report, paragraphs 2.19–2.23.
4. Nineteenth Report, table 2.1, based on: Department of the Environment (DOE) (1993). *Countryside Survey 1990. Main Report*. Report prepared for DOE by the Institute of Terrestrial Ecology and the Institute of Freshwater Ecology.
5. Analysis of official figures in: Sinclair, G. (1992). *The Lost Land – Land use change in England 1945–1990*. Council for the Protection of Rural England.
6. DOE (1996). *Indicators of Sustainable Development for the United Kingdom*. A publication of the Government Statistical Service. HMSO. March 1996. See indicator f7.
7. DOE (1996). See indicator f6.
8. Out-of-town for these purposes is defined as 'An out-of-centre development on a green field site, or on land not clearly within the current urban boundary'. This definition is from annex A in DOE (1996a). *Planning Policy Guidance Note 6 – Town centres and retail development*.
9. House of Commons Environment Committee (1997). *Shopping Centres*. Fourth Report, 1996/97 Session. House of Commons Papers 210-I and 210-II. The Stationery Office (TSO). March 1997; cited as House of Commons (1997).
10. House of Commons (1997).
11. House of Commons (1997).
12. House of Commons Environment Committee (1994). *Shopping Centres and Their Future*. Fourth Report, 1993/94 Session. House of Commons Papers 359-I to 359-III. HMSO. October 1994.
13. Rural areas are defined for this purpose as the 150 most rural local authority districts.
14. Information supplied by the Rural Development Commission (RDC), August 1997.
15. *Rural England: A Nation Committed to Living Countryside*. Rural White Paper. Cm 3016. HMSO. October 1995; cited as Rural White Paper (1995).
16. Submission from Robert Maclennan MP.
17. Information supplied by the RDC, August 1997. Rural is defined as settlements of 3,000 people or less.

18. A telecottage is a centre in a rural area which provides computers and other equipment such as faxes so that local residents can work there rather than at an employer's premises a long distance away.
19. *Sustainable Development. The UK Strategy*. Cm 2426. HMSO. January 1994.
20. *Household Growth: Where Shall We Live?* Cm 3471. HMSO. November 1996; cited as Household Growth Green Paper (1996).
21. Information supplied by the RDC, June 1997.
22. Rural White Paper (1995).
23. Nineteenth Report, paragraph 2.21.
24. *Our Future Homes: Opportunity, Choice, Responsibility*. Housing White Paper. Cm 2901. HMSO. 1995.
25. DOE (1997). *Sustainable Use of Soil: Government Response to the Nineteenth report of the Royal Commission on Environmental Pollution.* See paragraph 20.
26. Household Growth Green Paper (1996).
27. Comments by the Royal Commission on Environmental Pollution on the Discussion Paper on Household Growth, submitted in a letter of 17 March 1997 to DOE from the Secretary to the Commission.
28. *Housing and Urban Capacity*. UK Round Table on Sustainable Development (1997). February 1997; cited as UK Round Table (1997a); Los Angelisation off the agenda. *The Independent*, 29 July 1997.
29. Household Growth Green Paper (1996), paragraphs 5.58–5.59.
30. Nineteenth Report, recommendation 14; DOE (1997), paragraphs 47–52.
31. UK Round Table (1997a).
32. The Royal Town Planning Institute (1994). *Transport Policy Statement*. October 1994.
33. A new approach to trunk road planning. *Department of Transport/Department of the Environment Press Notice*, No. 49, and consultation letter, 18 February 1997.
34. Department of Transport (DOT) (1996) *Transport Policies and Programme Submissions for 1997/98*. DOT Local Authority Circular No. 2/96. May 1996.
35. Council for the Protection of Rural England (1997). *Improving local transport policy*. A campaign briefing. July 1997.
36. DOT, Office of Passenger Rail Franchising, Office of the Rail Regulator. Transport. The Government's expenditure plans 1997–98 and 1999–2000. Cm 3606. TSO. March 1997; cited as Transport Report (1997).
37. Audit Commission (1997). *It's a small world: Local government's role as steward of the environment*. June 1997. See exhibit 14; this figure includes structural maintenance of roads.
38. Audit Commission (1997).
39. DOE and DOT (1994). *Planning Policy Guidance: Transport*. PPG 13. March 1994.
40. Welsh Office (1996). *Planning Guidance (Wales): Planning Policy* Canllawian Cynllunio (Cymru): Polisi Cynllunio. May 1996.
41. Scottish Office (1996). *National Planning Policy Guideline: Transport and Planning*. May 1996.
42. DOT (1996)
43. UK Round Table on Sustainable Development. *Getting Around Town*. February 1997.
44. DOT (1996)
45. *Part IV The Environment Act 1995. Local Air Quality Management. Review of Air Quality Measures to Combat Poor Air Quality in Small and Medium European Cities*. A paper by Professor Derek Elsom, Oxford Brookes University, commissioned for DOE. December 1996. See also 2.96 above.
46. Eighteenth Report, recommendation 43. This said these PTAs/PTEs should have powers to regulate on-street and public parking in their areas (paragraph 13.24); the Commission now considers that such authorities need to have much wider traffic management functions.
47. Labour Party (1997). *New Labour because Britain deserves better*. See pages 34-35.
48. DETR (1997b). Regional development agencies: issues for discussion. Issued with DETR News Release 214. Regions invited to have their say. 11 June 1997.

49. DETR (1997a).
50. A new approach to trunk road planning. *Department of Transport/Department of the Environment Press Notice*, No. 49, and consultation letter, 18 February 1997. The proposal was first put forward in paragraphs 11.47-11.49 and annex 1 of the 1996 Transport Green Paper (1.11).
51. Department of the Environment, Transport and the Regions (1997c). *New leadership for London. The government's proposal for a Greater London Authority*. Cm 3724. TSO. July 1997.
52. DETR (1997c), paragraph 4.34.
53. Scottish Office (1997). *Scotland's Parliament*. Cm 3658. TSO. July 1997.
54. Written Answer by Lord Sewel (Parliamentary Under-Secretary of State, Scottish Office), House of Lords, 19 June 1997.
55. These were announced in the same Written Answer.
56. Scottish Office (1997). *Keeping Scotland moving. A Scottish Transport Green Paper*. Cm 3565. TSO.
57. Scottish Office, Development Department (1996). *National Planning Policy Guidance. Transport and Planning*. Draft for public consultation, May 1996.
58. Welsh Office (1997). *A voice for Wales. The government's proposals for a Welsh Assembly/Llais dros Gymru. Cynigion y llywodraeth ar gyfer Cynulliad Cymreig*. Cm 3718. TSO. July 1997.
59. Eighteenth Report, paragraph 6.22.
60. Policy on this subject is stated in Welsh Office (1996).
61. Submission from Save our Severnside and Alarm UK (South Wales).
62. Welsh Office (1997), paragraph 1.13.
63. Welsh Office (1997), chapter 4.
64. Department of the Environment for Northern Ireland (1995). *Transportation in Northern Ireland: the way forward.*
66. Eighteenth Report. recommendation 95.
67. Transport Report (1997).

Appendix A

TARGETS FOR POLICY PROPOSED IN THE COMMISSION'S EIGHTEENTH REPORT

A: To ensure that an effective transport policy at all levels of government is integrated with land use policy and gives priority to minimising the need for transport and increasing the proportions of trips made by environmentally less damaging modes.

B: To achieve standards of air quality that will prevent damage to human health and the environment.

B1: To achieve full compliance by 2005 with World Health Organization (WHO) health-based air quality guidelines for transport-related pollutants.

B2: To establish in appropriate areas by 2005 local air quality standards based on the critical levels required to protect sensitive ecosystems.

C: To improve the quality of life, particularly in towns and cities, by reducing the dominance of cars and lorries and providing alternative means of access.

C1: To reduce the proportion of urban journeys undertaken by car from 50% in the London area to 45% by 2000 and 35% by 2020, and from 65% in other urban areas to 60% by 2000 and 50% by 2020.

C2: To increase cycle use to 10% of all urban journeys by 2005, compared to 2.5% now, and seek further increases thereafter on the basis of targets to be set by the government.

C3: To reduce pedestrian deaths from 2.2 per 100,000 population to not more than 1.5 per 100,000 population by 2000, and cyclist deaths from 4.1 per 100 million kilometres cycled to not more than 2 per 100 million kilometres cycled by the same date.

D: To increase the proportions of personal travel and freight transport by environmentally less damaging modes and to make the best use of existing infrastructure.

D1: To increase the proportion of passenger-kilometres carried by public transport from 12% in 1993 to 20% by 2005 and 30% by 2020.

D2: To increase the proportion of tonne-kilometres carried by rail from 6.5% in 1993 to 12% by 2000 and 20% by 2010.

D3: To increase the proportion of tonne-kilometres carried by water from 25% in 1993 to 30% by 2000, and at least maintain that share thereafter.

E: To halt any loss of land to transport infrastructure in areas of conservation, cultural, scenic or amenity value unless the use of the land for that purpose has been shown to be the best practicable environmental option.

F: To reduce carbon dioxide emissions from transport.

F1: To reduce emissions of carbon dioxide from surface transport in 2020 to no more than 80% of the 1990 level.

F2: To limit emissions of carbon dioxide from surface transport in 2000 to the 1990 level.

F3: To increase the average fuel efficiency of new cars sold in the UK by 40% between 1990 and 2005, that of new light goods vehicles by 20%, and that of new heavy duty vehicles by 10%.

G: To reduce substantially the demands which transport infrastructure and the vehicle industry place on non-renewable materials.

G1: To increase the proportion by weight of scrapped vehicles which is recycled, or used for energy generation, from 77% at present to 85% by 2002 and 95% by 2015.

G2: To increase the proportion of vehicle tyres recycled, or used for energy generation, from less than a third at present to 90% by 2015.

G3: To double the proportion of recycled material used in road construction and reconstruction by 2005, and double it again by 2015.

H: To reduce noise nuisance from transport.

H1: To reduce daytime exposure to road and rail noise to not more than 65 $dBL_{Aeq,16h}$ at the external walls of housing.

H2: To reduce night-time exposure to road and rail noise to not more than 59 $dBL_{Aeq,8h}$ at the external walls of housing.

Appendix B

ANNOUNCEMENT OF THE COMMISSION'S REVIEW

On 25 October 1996 the Commission issued a news release in the following terms:

ROYAL COMMISSION SEEKS INFORMATION FOR A REVIEW OF TRANSPORT AND THE ENVIRONMENT

Two years after publishing its report on transport and the environment the Royal Commission on Environmental Pollution announced today that it is going to review the issues raised by that report in the light of subsequent developments.

There is now general recognition that transport presents the UK with an enormous challenge – technical, organisational and social. The aim must be to prevent road traffic causing serious environmental damage while at the same time securing the access people want for their livelihoods and for leisure, and enabling the UK economy to provide sustainable increases in standards of living. Following the Royal Commission's original report the government launched a national debate on transport. April of this year saw publication of *Transport – the way forward*, the first government paper on overall transport policy for 20 years.

The Royal Commission welcomes the government's acceptance that a fundamentally different, and more strategic, approach to transport policy is required for the future. It now wants to make a further contribution to the vital task of developing an environmentally sustainable transport policy.

Because this review will cover the subject of a previous report, and the issues have now been widely discussed, the Royal Commission has decided not to follow its normal practice with new studies of inviting submissions of evidence. Instead, it will take as the initial basis for its inquiry the considerable volume of existing material, such as statements produced in the course of the national debate and reports by other bodies on specific aspects of transport. It will also take account of new research findings, advances in technology and regulation, and the redirection of government policies that has already taken place.

The Royal Commission is inviting anyone interested to draw its attention to relevant existing material of a factual or analytical kind that has appeared since the original report was published in October 1994 and which might otherwise be overlooked by the Commission, or which those responding regard as especially important. Letters with the same invitation are being sent direct to organisations and individuals with whom the Secretariat is already in touch as a result of the original study. The date by which the Commission wishes to receive copies of, or references to, such existing material is Tuesday 10 December.

The Royal Commission has identified certain aspects of the subject on which it would particularly like to be informed of recent material of a factual or analytical kind. These are:

- the environmental impacts of different modes of transport per tonne-km or per passenger-km, either in terms of direct impacts or on the basis of life-cycle analysis
- the costs imposed by pollution from vehicle emissions or by traffic congestion, or by measures to reduce such pollution or restrain traffic
- the aggregate demands for transport created by different patterns of development
- the impact on travel of the present rules for company cars
- the success achieved by measures to reduce car dependence
- the effectiveness of measures to increase the use of public transport, cycling or walking
- the effectiveness of present regulatory or administrative structures.

In order to focus on the most pressing issues related to land transport, the review will not have such a wide scope as the original report. Subjects which the Royal Commission has decided not to revisit on this occasion are air transport, the environmental impact of shipping and the recycling of the materials used in building vehicles and roads.

Appendix C

CONDUCT OF THE REVIEW

The news release which announced the review on 25 October 1996 (appendix B) contained an open invitation to submit information to the Commission. Advertisements were placed in the *London, Edinburgh* and *Belfast Gazettes*. Invitations were also sent direct to over 250 bodies and individuals who had contributed to the Eighteenth Report or were otherwise known to have an interest in this subject.

Over 100 organisations and individuals responded to this invitation. The Commission Secretariat also held informal discussions with officials in a number of divisions of the Department of Transport and the Department of the Environment (now combined in the Department of the Environment, Transport and the Regions), who were most helpful in providing information requested. Specific information was also requested where necessary from other organisations and individuals.

As indicated in the news release, the Commission did not take oral evidence or make visits.

The main body of work on the review was undertaken by a group of Commission Members chaired by Sir John Houghton, consisting both of Members who had taken part in producing the Eighteenth Report and others who had joined the Commission more recently. Drafts of the report were discussed, revised and approved by the full Commission, and the published report represents its views.

The organisations and individuals listed below either submitted information in response to the initial invitation or provided information on request for the purposes of the review. The Commission greatly appreciates the co-operation it received from many different quarters.

Government Departments

Department of the Environment
Department of the Environment for Northern Ireland
Department of the Environment, Transport and the Regions
Department of Health
Department of Trade and Industry
Department of Transport
Government Office for London
Scottish Office
Welsh Office

Other organisations

Aberdeen City Council, Planning and Strategic Development Department
Association of County Councils
Association of District Councils
Automobile Association
Aviation Environment Federation
BAA plc
Berkeley Hanover Consulting
Birmingham City Council, Environmental Services Department
British Chambers of Commerce
British Medical Association
British Ports Association
British Road Federation
British Trust for Ornithology
Building Research Establishment
Centro (West Midlands Passenger Transport Executive)

Chartered Institute of Transport UK
Children's Play Council
Civic Trust
Confederation of British Industry
Confederation of Passenger Transport UK
Cory Environmental Limited
Council for National Parks
Council for the Protection of Rural England
Cranfield University, School of Management
Cyclists' Public Affairs Group
Cyclists' Touring Club
Docklands Forum
Ecoscope Applied Ecologists
Electricity Association
English Nature
English Welsh & Scottish Railway
Environmental Industries Commission
Energy Technology Support Unit (ETSU)
Freight Transport Association
Friends of the Earth
Friends of the Earth, Scotland
Greater Manchester Passenger Transport Executive
Heriot-Watt University, Department of Business Organisation
Hertfordshire TravelWise
Inland Waterways Association
Institute for European Environmental Policy, London
Institute of Advanced Motorists
Institute of Grocery Distribution
Institution of Civil Engineers
Institution of Highways and Transportation
Johnson Matthey plc
Kingston upon Hull City Council
Lex Service plc
London First
London Planning Advisory Committee
London Regional Transport
Marks and Spencer plc
Meteorological Office
Metro (West Yorkshire Passenger Transport Executive)
Midlands Amenity Societies Association
Moray Council
National Atmospheric Emissions Inventory, National Environmental Technology Centre
National Household Hazardous Waste Forum
National Society for Clean Air and Environmental Protection
National Trust
Natural Environment Research Council
Nexus (Tyne and Wear Passenger Transport Executive)
Northamptonshire County Council, Planning and Transportation Department
Office of the Rail Regulator
Oxfordshire County Council, Environmental Services Department
Passenger Transport Executive Group
Pedestrians Policy Group
Policy Studies Institute
RAC Motoring Services
Rail Freight Group
Railtrack plc
Railway Development Society
Rees Jeffreys Road Fund

Road Danger Reduction Forum
Road Haulage Association
Rover Group Ltd
Royal Academy of Engineering
Royal Institution of Chartered Surveyors
Royal Society for the Protection of Birds
Royal Town Planning Institute
Rural Development Commission
SAFE Alliance
Save our Railways
Save our Severnside and Alarm UK
Scottish Environmental Protection Agency
Scottish Natural Heritage
Sheffield Health
Shell International Limited
Shell UK Limited
Socialist Environment and Resources Association
Society of Motor Manufacturers and Traders Limited
Surrey County Council, Highways and Transportation Department
Sustrans – Paths for People
Symonds Travers Morgan
Thursfield Smith Consultancy
Transmo Limited
Transport 2000
UK Centre for Economic and Environmental Development
United Kingdom Petroleum Industry Association
University College London, Bartlett School of Planning
University College London, Centre for Social and Economic Research on the Global Environment
University College London, Jackson Environment Institute
University of Cambridge, Department of Engineering
University of Kent, Centre for European, Regional and Transport Economics
University of Leeds, Institute for Transport Studies
University of London, Centre for Transport Studies
University of Oxford, Environmental Change Unit
University of Surrey, Centre for Environmental Strategy
Urban Nature Magazine
Wildlife Trusts

Organisations outside the UK

European Commission, Directorate-General XI
European Conference of Ministers of Transport
European Federation of Transport and Environment
Provincial Government, Göteborg (Department of Environment and Cultural Heritage)
South Coast Air Quality Management District, California
Svenska Emissionsteknik AB
Swebus AB
Swedish National Road Administration, Western Region
Thoreb AB
US Department of Commerce (Partnership for a New Generation of Vehicles)
US Department of Energy
US Environmental Protection Agency
World Health Organization, Regional Office for Europe

Individuals

Ms M.Z. Acutt, University of Lancaster
Dr J.G.U. Adams

Mr C. Amundson
Mr F.A. Andrews
Professor H.R. Anderson
Councillor D. Begg
Mr S. Coventry, halcrow transmark
Mrs S.R. Bilton
Professor N.F.R. Crafts
Mr J.S. Dodgson, National Economic Research Associates
Professor J.B. Ellis
Mr N.J. Eyre
Professor P.B. Goodwin
Mr T. Hart
Mr R. Harman
Professor S.T. Holgate
Dr C.D. Holman
Miss E. Mackay, Chairman, Standing Advisory Committee on Trunk Road Assessment (SACTRA)
Mr R. Maclennan MP
Mr R. Mills
Mr B. Noonan
Dr C.H. Osman
Dr S.E. Owens
Mr S. Plowden
Mr S. Priestley
Professor J.N. Randle
Mr M. Roberts
Dr L. Schipper
Mr R. Swainson
Professor R.W. Vickerman
Mr M.J. Welsby

Commissioned paper

Prior to announcing the review the Commission asked Professor P.B. Goodwin, Director of the Centre for Transport Studies at the University of London, to prepare an initial paper on developments since the Eighteenth Report.

Appendix D

THE EUROPEAN AUTO/OIL PROGRAMME[1]

D.1 The European Commission outlined the principles of the Auto/Oil Programme as follows:[2]

> In these proposals [for emission standards to apply from 2000] the Commission shall take the following approach:
>
> - the measures shall be designed to produce effects to meet the requirements of the Community's air quality criteria and related objectives,
> - an assessment of the cost effectiveness of taking each measure shall be undertaken; in this global assessment full account shall be taken, inter alia, of the contributions that:
>   - traffic management, for example by spreading the environmental costs appropriately,
>   - enhanced urban public transport,
>   - new propulsion technologies (eg electric transmission),
>   - the use of alternative fuels (eg biofuels),
>
>   could make to improve air quality,
> - the measures shall be proportional and reasonable in the light of the intended objectives.

D.2 In the light of this statement, the Auto/Oil Programme was launched at the end of 1992 between the European Commission and Europia and ACEA, the European trade associations for the oil and motor industries respectively. The objective of the Programme was:

> to provide policy-makers with an objective assessment of the most cost-effective package of measures including vehicle technology, fuel quality, improved durability and non-technical measures, necessary to reduce emissions from the road transport sector to a level consistent with the attainment of the new air quality standards being developed for adoption across the European Union.

D.3 The work programme consisted of three independent but inter-related studies:

> *a.* air quality studies to predict future air quality in seven European cities and, for ozone, across the European Union (EU), and derive emission reduction targets for a range of pollutants;
>
> *b.* EPEFE – the European Programme on Emissions, Fuels and Engine technologies – a joint motor and oil industries research programme to investigate the effects of vehicle technology and fuel characteristics on emissions;
>
> *c.* a cost-effectiveness study in which the costs and emissions impact of a range of abatement techniques were collated and the most cost-effective packages of measures to meet the emission reduction targets identified.

Air quality studies (*a*)

D.4 The following pollutants were investigated: carbon monoxide in cities; particulate matter in cities; benzene in cities; nitrogen dioxide in cities; tropospheric ozone, principally at the regional level. For each of these pollutants, the objectives were:

> to predict the air quality in the year 2010;
>
> to compare the predicted air quality in 2010 with air quality targets; and
>
> to define emissions reduction targets where predicted air quality was worse than the target.

The year 2010 was chosen as reference year because the Programme was designed to identify measures which would take effect from 2000. Measures introduced in 2000 will have only a gradual effect on air quality as the existing vehicle fleet is replaced; it was considered that by 2010, it would be possible to judge their impact.

D.5 Seven representative European cities (Athens, Cologne, The Hague, London, Lyon, Madrid and Milan) were chosen for study. Local emissions inventories were used as the main input to the air quality models for these cities; for the ozone modelling, the 1990 CORINAIR inventory was used. To predict the effect of already agreed measures, growth in the economy, trends in energy use, etc, on these 1990 emissions inventories, two models were used to produce an inventory for 2010: the International Institute for Applied Systems Analysis' RAINS model for stationary sources and the European Commission's FOREMOVE model[3] for road transport sources.

D.6 In order to judge whether the predicted air quality levels in 2010 would be satisfactory or not, the European Commission adopted a set of air quality criteria for each pollutant. The Auto/Oil Programme was undertaken at the same time as the preparation of the Framework Directive on Ambient Air Quality Assessment and Management and its Daughter Directives. Therefore it was not possible to use the new standards that will be introduced in the EU in due course for the purposes of Auto/Oil. Instead, upper and lower air quality targets were used based largely on existing European Community (EC) air quality standards and revised World Health Organization (WHO) air quality guidelines. For benzene and PM_{10}, where there were neither EC standards nor WHO guideline values, proposed or existing guide values from individual Member States were used.

D.7 The modelling results predicted a considerable improvement in air quality in 2010 as a result of existing measures. All seven cities were predicted to meet the less stringent (upper) targets for all pollutants and the more stringent (lower) targets for carbon monoxide and benzene. However, to meet the more stringent target for nitrogen dioxide, most cities, including London, will require a further reduction in urban emissions of nitrogen oxides of up to 50%. No modelling was carried out for PM_{10}, due to a lack of available emissions inventories and models able to estimate the formation of secondary particulate matter. This led the European Commission to adopt a simplistic emission reduction target for traffic of 50–65% from 1995 levels.

D.8 Ozone levels were modelled on the basis of expected trends in emissions of nitrogen oxides and volatile organic compounds (VOCs) across Europe. It was noted that further emission reductions applied to traffic will, in the absence of parallel measures applied to other sources, especially sources of VOCs, have at most a marginal impact. For the purpose of cost-effectiveness assessment, the European Commission set an emission reduction target of 70% for ozone precursors (nitrogen oxides and VOCs) from road transport compared to 1990 levels.

European Programme on Emissions, Fuels and Engine technologies – EPEFE (b)

D.9 The investigation of the effects of vehicle technology and fuel characteristics on emissions – EPEFE – was an integral part of the Auto/Oil Programme and was carried out in parallel with other studies. Prior to the start of EPEFE, the European oil and vehicle industries collaborated in a review of all available data concerning the relationship between vehicle emissions, fuel properties and engine technologies and gaps were identified in the understanding of certain fuel and vehicle interactions; there were more gaps in the information for diesel technologies. The vehicles chosen for EPEFE were a combination of those meeting 1996 requirements (both light and heavy duty vehicles) and more advanced vehicle technologies. Fuel formulations were chosen not to be representative of any specific current or future fuel, but to enable the effects of individual fuel parameters to be determined.

Cost-effectiveness study (c)

D.10 Data on the costs and emissions impact of a range of emission reductions packages were collated. The analysis looked at packages of measures in the following four areas: fuel quality changes; vehicle technology changes; improved durability of emission control systems; and complementary local technical and non-technical measures. In looking at measures for improving the durability of emission control systems, the following mechanisms were examined: increased severity of compulsory

inspection and maintenance checks; manufacturers liability for the performance of emission control systems extended from 80,000 km to 160,000 km; electronic sensors installed on the vehicle to monitor the performance of the emission control systems (on-board diagnostics); recall procedures whereby models can be recalled and refitted if their emission performance deteriorates beyond an acceptable level; improved mechanisms for the remote roadside detection of vehicles emitting above acceptable levels.

D.11 The measures looked at in the last area of analysis (local technical and non-technical options) included both local measures (traffic bans, speed regulation, cheaper public transport, alternative fuels), certain non-fiscal economic instruments (road pricing, scrappage subsidies) and the use of fuel taxes, vehicle purchase taxes and annual vehicle circulation taxes to influence transport users. In the final analysis, road pricing, traffic bans, the subsidy of public transport, scrappage subsidies and the conversion of urban buses to alternative fuels were included. The quantification of the costs and benefits of these local and non-technical measures entailed considerable uncertainties, not least because the response of transport users to the various measures proposed could not be predicted exactly.

D.12 Touche Ross collected data on the costs of the individual measures and combined this with information on their emissions impact. These were used as the input data for TransOpt, an optimisation model developed in the Programme, to identify the least-cost packages of measures to meet the emissions reduction targets. This aimed to provide policy-makers with an objective assessment of possible measures that could be adopted within the road transport sector to achieve higher air quality standards.

D.13 Several parameters were adopted to ensure that the potential contribution of each type of measure identified above was assessed on a consistent and comparable basis. These parameters covered:

the time-scale for implementation of the measures examined in the study

sectoral and geographical coverage

categorisation and treatment of costs for each measure

the methods by which costs were converted to a common basis

the methods by which the effects of each measure on emissions were estimated.

D.14 The analysis took as a baseline measures already agreed, ie 1996 standards for cars and heavy duty vehicles. Manufacturers were asked to identify the technology that would be used to meet specific emission reduction limits from the 1996 baseline. The study thus focused on measures which were considered to be technically capable of introduction by the year 2000 and would therefore be likely to have a significant impact on reducing pollutant emissions by the year 2010. The measures considered were based on established and proven technologies; manufacturers did not put forward technological measures such as de-NO_x catalysts and particulate traps.

D.15 The objective of the analysis was to identify the most cost-effective series of interlocking measures in order to achieve the desired emission reductions (D.7–D.8) at the least cost for the Community as a whole. The intention was that a certain proportion of the background levels of pollution would be removed by EU-wide technical measures and, as and where appropriate, these technical measures would be supplemented by national and/or local measures in those localities with elevated levels of pollution.

D.16 ACEA considered that the focus on the target year 2010 introduced bias into the cost-effectiveness analysis. An alternative approach, 'emission discounting', which targeted the years between 2000 and 2010, would have given greater emphasis to measures having an immediate impact on emissions, such as changes in fuel quality, while targeting the year 2010 alone tended to bias the results towards measures having a longer-term impact related to the turnover of the vehicle fleet. Europia denied that it escaped lightly because of the nature of the analysis used, arguing that refiners must meet 'mainly up-front capital costs' which are harder to recover than the increased operating costs facing car manufacturers and described the European Commission's proposals as a package of

'validated measures' which are 'consistent with the principles that underpinned' the Auto/Oil Programme and 'essentially in line' with its results.

D.17 The findings of the Auto/Oil Programme provide the technical foundation for the European Commission's vehicle emission control strategy. The proposals for vehicle emission limits and fuel specifications made as a result of the Programme are covered in the main body of the text (2.25–2.33). Proposals for standards for 2005 must be made by the end of 1998 and the European Commission has established a second Auto/Oil Programme to settle the controversial issue of tighter fuel and vehicle emission standards for 2005 and beyond. Auto/Oil II has now started with a structure very different to that of Auto/Oil I; the first meeting was held in January 1997 with the involvement of both Member States and non-governmental organisations. Auto/Oil II is expected to include a more sophisticated examination of the cost-effectiveness of controlling emissions from stationary sources; the first programme assumed a proportional reduction in emissions from stationary sources but it is not clear whether this assumption represents the most realistic or cost-effective approach.

D.18 Auto/Oil II may also shed greater light on concerns raised about the accuracy of the European Commission's modelling exercises and the need for further measures to meet air quality objectives in the most polluted cities. As well as examining stationary sources, there have been calls from Europia for Auto/Oil II to look at the use of alternative fuels such as liquefied petroleum gas and natural gas and 'non-technical', locally-tailored measures, such as the replacement of older, polluting vehicles (which would be effective in solving the problem of non-compliance with air quality objectives in some of the cities in Greece, Italy and Spain), rather than bearing down further on new vehicles.

References

1. The information for this appendix comes from the following sources unless otherwise stated: *The European Auto Oil Programme.* A Report by the Directorate Generals for: Industry; Energy; and Environment, Civil Protection and Nuclear Safety of the European Commission. Report No. XI/361/96; *Air Quality Report of the Auto Oil Programme. Report of Sub Group 2.* European Commission. Report No. XI/362/96; *A cost-effectiveness study of the various measures likely to reduce pollutant emissions from road vehicles by the year 2010.* Final Report for the European Commission. Summary for policy-makers. Touche Ross and Co. November 1995; Communication from the Commission to the European Parliament and the Council on a future strategy for the control of atmospheric emissions from road transport taking into account the results from the Auto/Oil Programme; Proposal for a European Parliament and Council Directive relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC; Proposal for a European Parliament and Council Directive relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directives 70/156/EEC and 70/220/EEC. *COM(96)248 final, 96/0163 (COD) and 96/0164 (COD)*, 18.06.96; Battle in Brussels over Auto/Oil Programme. *ENDS Report*, No. 256, May 1996, 22–24; Car industry lashes out at Auto/Oil Programme. *ENDS Report*, No. 257, June 1996, 41–43; Oil and car industries scrap over Auto/Oil outcome. *ENDS Report*, No. 258, July 1996, page 37.
2. Article 4 of Directive 94/12/EEC.
3. The European Commission FOREMOVE model was used in order to base air quality predictions on the most reliable data on the future development of the EU vehicle fleet. The model contains details of vehicle fleets in each Member State (vehicle categories, age and distance travelled) and generates information concerning the total and percentage emissions of major pollutants from each category of vehicle. The model also contains assumptions concerning the development of the vehicle fleet in each country over the next 25 years and the predicted effect of current and agreed new legislation on vehicle emissions.

Appendix E

AIR QUALITY: ACHIEVEMENT OF NATIONAL OBJECTIVES[1]

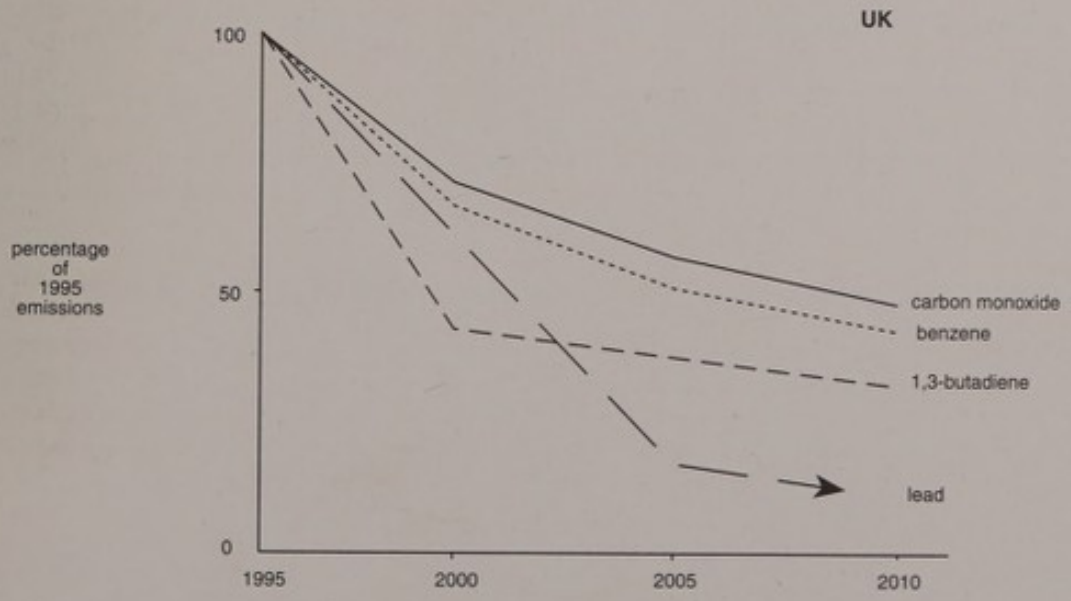
E.1 Total **benzene** emissions are expected to decline by almost 40% by 2000, over 50% by 2005 and about 60% by 2010 and emissions of **1,3-butadiene** from petrol vehicles are expected to decline by 61% by 2000 and 76% by 2010, both on a 1995 base. If these reductions are achieved evenly across the entire UK, it is likely that by the year 2000 there will be no more exceedances of either the 5 ppb standard for benzene or the 1 ppb standard for 1,3-butadiene at urban background locations and at most roadside locations. There may still be some roadside environments which, because of their close proximity to the most heavily trafficked roads, will continue to exceed the standards for these two pollutants, although exceedances are likely to be small. These environments should in turn meet national objectives by 2005.

E.2 Emissions of **carbon monoxide** are expected to decline by 32% in 2000, by 48% in 2005 and by 54% in 2010 compared with 1995 levels. If urban concentrations are reduced in the same proportions, estimates suggest that by 2000 the national objective will be met everywhere in the UK with the possible exception in some years near heavily trafficked roads. By 2010 there should be no further exceedances of the national objective.

E.3 The increasing penetration of catalyst-equipped petrol cars into the vehicle fleet will mean that emissions of **lead** from petrol vehicles should decrease by over 80% by 2005 compared with 1995 levels and to a very small amount by 2015. The proposed phasing out of leaded petrol in the European Union by 2000 will also contribute to the continued decrease in levels of airborne lead in urban areas where traffic is the main source and in the great majority of the UK. Annual average lead levels should decrease to the extent that the World Health Organization annual guideline value should be achievable by 2005 in urban areas of the UK.

E.4 Figure E-I shows the reductions in emissions expected to 2010 for the above four pollutants.

Figure E-I
Projected emissions of benzene, 1,3-butadiene, carbon monoxide and lead



Projections are for: benzene from all sources; 1,3-butadiene from petrol cars; carbon monoxide from all sources; and lead from petrol vehicles.

E.5 It is estimated that **nitrogen oxides** emissions reductions in the region of 48–62% on 1995 levels would be needed to secure the consistent achievement of the objective for **nitrogen dioxide** by the year 2005. Standards already in place and other abatement measures are likely to achieve reductions of around 42% relative to 1995 levels by 2010. Introduction of stage III vehicle emission limits and fuel specifications for 2000–01 are expected to achieve reductions of around 45–47% in urban nitrogen oxides emissions by the earlier date of 2005. This is the bulk of the reduction needed but it is estimated that there will be a shortfall in the forecast emissions reduction of around 5–10% or more.

E.6 Instruments for the control of **ozone** precursors are in place at national and European level. The UK is committed to action under both United Nations Economic Commission for Europe (UNECE) Volatile Organic Compounds (VOCs) and Nitrogen Protocols and European Community (EC) Directives on vehicle emission limits and fuel quality. The government expects that the reduction in total emissions of VOCs will be almost 40% in 2005 measured against 1988 levels. Similarly, emissions of nitrogen oxides are expected to have fallen by 40–45% over the same period (a different base year and time-scale are used to the reduction estimates in E.5). Methods of estimating the effects of these reductions on the scale of summertime ozone incidents are still in their infancy. However, despite considerable scientific uncertainties that remain, it is clear that summertime incidents in the UK cannot be contained unless there is action across Europe. Reductions of VOCs and nitrogen oxides emissions in the range 50–70% relative to the present day would significantly reduce the extent to which the national objective and the EC ozone alert threshold are exceeded.

E.7 It is estimated that reductions in $\mathbf{PM_{10}}$ emissions from vehicles of 61–67% on 1995 levels are needed to secure the consistent achievement of the objective by the year 2005. Projections based on current policies amount to a decrease in emissions of over 40% by 2005 compared to 1995. This should lead to significantly lower levels of particulates in air, which will be particularly reflected in wintertime pollution episodes, and go far towards reducing exceedances of the objective but still represents a considerable shortfall in required emission reductions.

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1. *The United Kingdom National Air Quality Strategy*. Department of the Environment, The Scottish Office and The Welsh Office. CM 3587. TSO. March 1997.

Appendix F

JOINT LETTER TO EUROPEAN INSTITUTIONS FROM THE ROYAL COMMISSION AND THE COUNCIL OF ENVIRONMENTAL ADVISORS (GERMANY)

1 February 1995

The German Council of Environmental Advisors and the *United Kingdom's Royal Commission on Environmental Pollution* wish to emphasise to the European Parliament and European Commission the importance of the environmental problems associated with transport and the need for early action to resolve those problems.

A central topic in the Environmental Report 1994 of the *German Council of Environmental Advisors*, Sustainable development, which has been submitted to the federal government, is "Traffic and environment – elements and chances of a sustainable mobility". Starting from an analysis of the present situation key points requiring action are identified and consideration given to the choice of the most appropriate policy instruments for reducing the environmental impact of traffic. The discussion covers the technical potential for reduction, environmental legislation, economic incentives and also changes in infrastructure and organisation.

Recommendations are made for actions to increase the price of transport in recognition of the finite nature of natural resources on one side and the finite capacity of transport infrastructure on the other side.

In October 1994 the *Royal Commission on Environmental Pollution* published a report on "Transport and the Environment". This analyses recent trends and their consequences for health and the environment. It discusses alternative perspectives on transport policy, the economic costs and benefits of transport, the potential of improvements in road vehicle technology and performance, and the interaction between transport and land use planning. The report puts forward, in the form of objectives and targets, the components for a sustainable transport policy, and recommends a number of measures which will help to achieve the targets.

The *Council of Enviromental Advisors* and the *Royal Commission* have identified important common elements in their analysis of the problematic nature of the present situation and in their recommendations for action. In come cases these appropriately relate to the European Union as well as the national level, and they wish to draw them to the attention of the European Union. They have therefore prepared a joint statement on transport and environmental degradation which is enclosed for your consideration.

Royal Commission on Environmental Pollution

Sir J. Houghton
(Chairman)

Sachverstandigenrat fur Umweltfragen

Prof Dr H.W. Thoenes
(Vorsitzender)

JOINT STATEMENT ON TRANSPORT AND ENVIRONMENTAL DEGRADATION

The *Council of Environmental Advisors* in Germany and the *Royal Commission on Environmental Pollution* in the UK have been watching with increasing concern the environmental degradation caused by passenger and goods transport. As a result of rising incomes in the European Union and the opening up of Eastern European countries, movements of people and goods have greatly increased. This has contributed to higher standards of living and enriched people's lives. The increase in road traffic resulting from greater mobility has led, however, to forms of environmental damage which are becoming less and less reconcilable with the principles of long term environmentally appropriate development. Emissions from internal combustion engines are endangering people's health and the environment, including the climate. Governments must now create a new framework which will make it possible to combine the benefits of an effective transport system for people and goods with protection of the environment and human health. This will require comprehensive new strategies.

There are certain points which both the Council and the Commission have identified as requiring early action at the level of the European Union. It is important to accelerate implementation of the Euro-III emission limits. It is also important to stimulate the introduction of other means of reducing emissions, especially as concerns climate effects, photochemical smog and carcinogens. In attempting to reduce the environmental damage caused by road traffic, environmental policy can no longer rely solely upon legislating for technical changes in vehicles. It takes a considerable time for vehicles conforming to a new standard to replace enough of the vehicles now on the road to produce a noticeable reduction in emissions. Moreover, the reductions brought about by imposing more stringent limits will be partly offset if the volume of traffic increases. Environmental policy must, therefore, also seek to reduce emissions by modifying human behaviour.

The most effective way of bringing about modifications in human behaviour is to provide financial incentives and disincentives. The *Council of Environmental Advisors* and the *Royal Commission on Environmental Pollution*, therefore, call for financial incentives to be used to achieve environmental objectives and bring about a closer correspondence between the costs and benefits of transport.

Electronic systems have considerable potential as a way of applying financial incentives by collecting appropriate charges from road users. They have the advantage that the rates of charge can readily be adjusted to reflect differences in the scale of the costs imposed by road users in different places and at different times. The widespread introduction of electronic systems will not occur unless common technical standards are established by the European Union to cover the design and operation of the equipment installed at the roadside and in vehicles. The *Council of Environmental Advisors* and the *Royal Commission on Environmental Pollution*, therefore, call on national governments and the European Commission to give high priority to the development and implementation of such standards.

Pending completion of that task, incentives for reducing emissions should be provided primarily by increasing the tax on mineral oil. This instrument is well suited for reducing carbon dioxide emissions from road vehicles, and would also help elasticity of transport demand, there will have to be a large increase in the mineral-oil tax over time in order to produce a noticeable effect. The *Council of Environmental Advisors* and the *Royal Commission on Environmental Pollution* consider an increase in fuel prices of 100% in real terms by the year 2005 to be appropriate and necessary, and they call on the European Commission and national governments to amend Council Directive 92/82/EEC in order to ensure that this increase is put into effect on a phased basis throughout the European Union.

London, Wiesbaden, January 1995

Appendix G

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