Document title

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The environmental impacts of road vehicles in use

Introduction

1. Public understanding about the environmental impacts of road transport is not well-developed. Many people remain unsure of the extent to which road vehicles actually damage the environment or harm our health, or of the progress which has been made to reduce the environmental impact of road vehicles. This background paper aims to provide more information. Published by DETR for the Cleaner Vehicles Task Force to accompany its first report *Driving the Agenda - The first report of the Cleaner Vehicles Task Force.* The paper is intended to be an accessible factual account of some of the major environmental impacts associated with vehicle use in the UK.

2. Emissions from vehicles affect the quality of the air we breathe, and have the most impact close to where traffic is greatest in the centres of towns and cities and near to busy roads. Road vehicles are also one of the major sources of carbon dioxide emissions from the UK. While CO_2 is not harmful to health, it is the most important of the greenhouse gases which are widely believed to cause global climate change. Traffic noise too has become a greater nuisance, especially around busy roads, while the way vehicles are produced and scrapped can have considerable implications for the sustainable use of natural resources.

3. This paper brings together, as clearly and concisely as possible, the latest understanding on some of the impacts of most concern: air quality, climate change and noise. It looks at the environmental impact of different types and ages of vehicle, and the progress made to date to reduce these impacts. It also outlines the general Governmental policy framework, as well as the targets and objectives that have been set to tackle these impacts in the UK over the next decade.

4. The paper does not consider all the environmental impacts of road transport; for instance, the impacts of road infrastructure development on biodiversity or the physical environment are not discussed, as these issues are beyond the scope of the Task Force. Neither are some of the other environmental impacts associated with vehicle use, such as the effect of vehicle collisions with wildlife or the effect of contaminated water running-off roads. The paper also does not consider any of the impacts from the production and scrappage of vehicles, for instance when disposing of worn tyres, though these can be significant. A further background paper covering some of these issues will be published by the Task Force in due course.

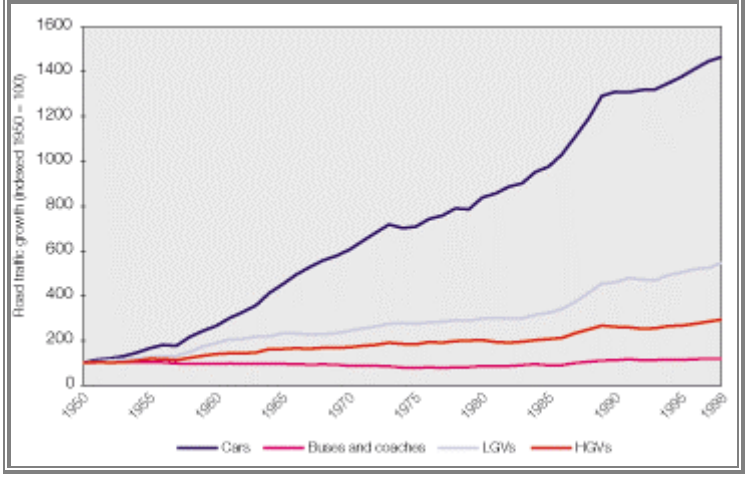
5. The paper does not address further measures to improve the environmental performance of road vehicles. The Cleaner Vehicles Task Force has been considering a range of specific measures in greater detail, and this recommendations are set out in *Driving the Agenda The first report of the Cleaner Vehicles Task Force*.

The impact of traffic growth on the environment

6. Growing public concern about the environmental impact of road transport is partly a result of the increasing number of cars on our roads. Britain's rising wealth and prosperity during the second half of this century, which has resulted in a threefold increase in disposable household income, along with a decrease in real terms in the costs associated with owning a car, has seen a ten-fold increase in car ownership. In 1950 there were just under 2 million cars registered in the UK, with only 14% of households owning a car. By 1998 the number of cars registered had reached over 21.6 million vehicles, with over 70% of households owning at least one car.[1]

7. This increase in car ownership has led a fundamental change in the travelling patterns of ordinary households, with the car replacing the bus as the predominant mode of transport: 82% of journeys by mileage are car. Its flexibility and convenience has also enabled more people to travel further, with a corresponding increase in vehicle usage. This has meant that, as chart 1 indicates, car traffic has grown fifteen-fold since 1950, from an estimated 26 billion vehicle kilometres to 371 billion vehicle kilometres in 1998, while bus traffic has remained relatively static. Similarly, although the number of heavy goods vehicles registered has not changed significantly since 1950, the displacement of rail as the dominant mode of freight transport and the development of larger good vehicles has lead to a near three-fold overall increase in their use from an estimated 11 billion vehicle-kilometres to 32 billion vehicle kilometres in 1998. Around four-fifths of domestic inland freight transport (in terms of goods carried) now travels by road.

Chart 1: Historical road traffic growth since 1950



National road traffic forecasts

The 1997 National Road Traffic Forecasts (NRTF 1997) predict road traffic growth in Great Britain to 2031 for cars, vans, lorries and buses and coaches. The Forecasts estimate that between 1996 and 2031 road traffic will increase by 57% under the central scenario.

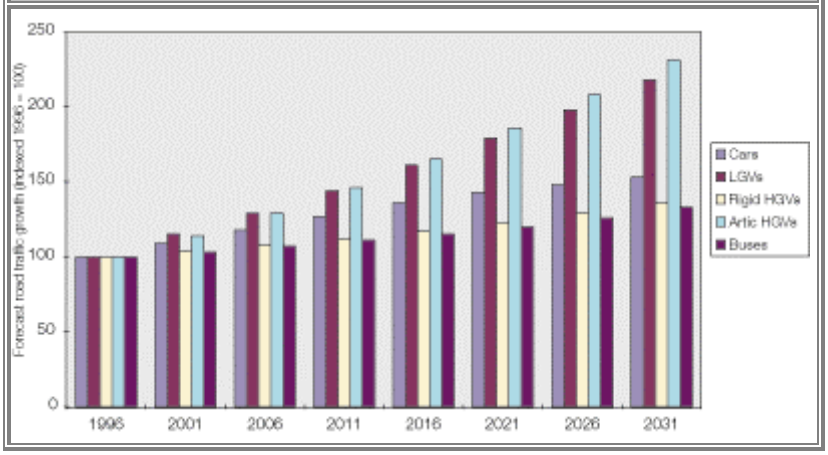
Traffic is forecast to increase, principally because people are expected to become richer and enjoy longer lives, economic activity to increase, and households to become more numerous. The main single factor leading to traffic

growth is increasing car ownership, which is expected to increase by 39% by 2031. These trends are consistent with historical and cross-sectional evidence in Great Britain and in other countries. The forecasts also take account of the impacts of increasing congestion on traffic growth, so that the rate of growth is likely to be slower than it would otherwise have been.

Car traffic is forecast to grow under the central scenario by 53% by 2031, and lorry traffic by 69% during the same period with an increasing proportion of goods being moved by the largest vehicles. Light van traffic is also expected to grow rapidly, with growth of 112% by 2031 forecast. Lower growth, of 32% to 2031, is expected in bus and coach traffic.

The forecasts were published in October 1997 during the Government's integrated transport consultation exercise, and accordingly do not take account of the impact on traffic growth of the measures announced in the White Paper, A New Deal for Transport. The White Paper commits the Department of Environment, Transport and the Regions to revise the NRTF 1997 in the light of measures in the White Paper and to seek advice from the Commission for Integrated Transport for this task.

Chart 2: Forecast road traffic growth 1996-2031



8. Increases in traffic are expected to continue, unless significant measures to reduce this traffic growth are undertaken. The 1997 National Road Traffic Forecasts[2] estimate that, under pre-Integrated Transport White Paper policies, road traffic in the UK will increase by between 24% and 51% from 1996 to 2016. Journey times are expected to increase significantly, in some areas very substantially, with times spent on journeys on urban motorways predicted to double in the peak period by 2031.

9. It is clear that the sort of increases in traffic mentioned above are not sustainable. Already in outer London one-fifth of the time taken in making a journey is spent stationary, and on the busiest roads in many cities journey times in the rush hour could lengthen by as much as 70% over the next twenty years. Furthermore, traffic congestion does not just affect journey times, it also exacerbates the environmental impact of vehicle use: even cautious estimates suggest traffic related emissions of carbon dioxide are 25% higher in the centres of large cities, as a result of congestion.[3]

10. The Government's White Paper on the future of transport, *A New Deal for Transport,* sets out the framework for a sustainable transport system which aims to reduce this traffic growth, and to tackle the adverse impacts transport can have on our health and the environment.[4] The intention is not to discourage car ownership, rather it is to encourage a more responsible approach to car use, in order to reduce road traffic growth and its impact on the environment. Some of this will be done by changing the way we travel, for instance by encouraging more walking and cycling and greater use of public transport. Nevertheless, it is accepted that road transport will remain the dominant mode for many journeys, and that it will be important to ensure that the road transport used is as clean and efficient as possible.

A new deal for transport

A New Deal for Transport, the Government's White Paper on the future of transport, was presented to Parliament by the Deputy Prime Minister in July 1998. The White Paper aims to extend choice in transport and secure mobility in a way that supports sustainable development. It sets out a new framework to provide choice for transport users, integration of transport services, accountability to users and the nation, and a revised, modern institutional framework.

The centrepiece of the White Paper is the introduction of local transport plans. Local authorities will now set out five year strategies for transport together with long term targets for improving air quality, road safety and public transport and reducing road traffic. They will be in turn allowed new tools including road user charging and levies on workplace parking to tackle congestion and pollution with the revenues helping to fund further transport improvements.

The Government, for its part, will revise planning guidance to reduce reliance on the car, and encourage a shift in emphasis away from the car by promoting walking, cycling and public transport where these are valid alternatives. The White Paper also recognised that fiscal measures and economic instruments will have a major role to play in influencing travel choice and encouraging sustainable development. To take the work of the White Paper forward, a Commission for Integrated Transport has been established to provide independent advice to the Government.

Several daughter documents, which outline the Government's proposals in greater detail in several key areas, have subsequently been published. These include *Breaking the Logjam* (December 1998), a consultation on the proposals for road user and workplace parking charges; *Sustainable Distribution: A Strategy*, (March 1999) which set out a long term strategy for an efficient and sustainable freight distribution sector; and *From Workhorse to Thoroughbred a better role for bus travel (April 1999).*

1 All figures from Transport Statistics Great Britain 1998.

2 Published by the Department of the Environment, Transport and the Regions in October 1997.

3 Based on analysis published in the White Paper, using the framework developed for the 1997 National Road Traffic Forecast and Highways Agency data.

4 A New Deal for Transport: Better for Everyone, published by the Department of Environment, Transport and the Regions, July 1998.

Air quality

11. People are increasingly concerned about the impact that air pollution has on health, and on the urban and rural environment. This concern is also backed up increasing scientific evidence. And whilst there is no evidence that healthy individuals are likely to experience acute health effects at typical pollution levels experienced in the UK, a major report published by the Department of Health last year noted that the deaths of between 12,000 and 24,000 vulnerable people are bought forward every year by the effects of air pollution from all sources.[5]

Air quality and health

A key report published in January 1998 by the independent expert Committee on the Medical Effects of Air Pollutants (COMEAP) for the Department of Health was the first official attempt to quantify the impact of short term air pollution on the health of people living in the UK. It suggested that the deaths of between 12,000 and 24,000 vulnerable people may be brought forward each year and that between 14,000 and 24,000 hospital admissions and readmissions may also result from poor air quality. These effects are attributed to three of the eight pollutants for which objectives have been set in the National Air Quality Strategy (discussed below): particulate matter (PM_{10}), (which is estimated to bring forward 8,100 deaths annually), sulphur dioxide (3,500 deaths) and ozone (from 700 to 12,500 deaths).

The report only tried to quantify the short term effects of these three pollutants. It did not quantify the long term chronic impacts, nor cover the other emissions associated with transport such as benzene or 1,3 butadiene, which are known carcinogens, or lead which is associated with harming cognitive development in children, as it was considered inappropriate to quantity health effects of these pollutants in this way. More information about the health effects of different pollutants can be found in the National Air Quality Strategy.

Clearly, the levels of these pollutants which give rise to health effects are not solely due to road transport, even in the most congested areas. For instance, emissions of sulphur dioxide (SO_2) are principally produced by fossil-fuelled power stations. However, vehicles make a significant contribution to local air pollution, and this proportion maybe even higher when pollution levels are very high.

12. Air pollution also has other effects on our environment; forests, lakes, crops, wildlife and buildings can all suffer significant damage from high levels of airborne pollutants. Oxides of nitrogen (NO_x), for instance, can be transported over hundreds or even thousands of kilometres before being deposited as acid rain, which can acidify soil and, because of its ability to fertilise the soil, can cause changes in species composition and biodiversity. NO_x also reacts with volatile organic compounds (VOCs) in the atmosphere in the presence of sunlight to form ground level ozone, a significant component of summertime smog. Ozone is also a long range pollutant which can cause direct effects on sensitive vegetation. It has been associated with reduced yields in crops and forestry, as well as with changes in species composition and biodiversity in natural and semi-natural ecosystems.

13. Air pollution does not just affect us when we are out in the open. Pollution levels indoors can be sometimes higher than outdoors, although the main sources of indoor air pollution often arise outside, especially when windows are open. Furthermore, recent research suggests that road users could be exposed to up to 3 times as much air pollution when inside a vehicle compared to when walking, or even cycling, by the side of the road.[6] This is due to exhaust emissions concentrating in the middle of the road, which vehicles then travel through.

14. In response to the growing scientific evidence and increasing public concern about the adverse effects of air pollution, the Government began in July 1997 to implement the National Air Quality Strategy (NAQS), published by the last administration following the 1995 Environment Act.[7] It aims to set out, as far as possible, the future of ambient air quality policy in the UK to 2005 and beyond. It is important that, in order to do this, the Strategy is regularly reviewed to ensure that the evidence behind the policies is as up to date as possible The Government also announced in July 1997 that it was bringing forward its first review of the Strategy. This review has been looking at the latest scientific, economic and technical information available, and in January 1999 a report on the review was published which contained a number of proposals to amend the Strategy in the light of this evidence.[8] These proposals have been subject to consultation, and a revised Strategy will be produced later in 1999.

Table 1: Summary of NAQS Standards and Objectives

	NATIONAL AIR QUALITY STRATEGY			**REVIEW OUTCOME**
Pollutant	**Standard**		**Objective to be achieved by 2005**	**Proposals for amendments to the NAQS objectives**
	concentration	***measured as***		
Benzene	5ppb	running annual mean	5ppb	5ppb (16.2mg/m^3) by 31.12.2003: indicative level of 1ppb (3.2mg/m^3) by 31.12.2005
1,3-Butadiene	1ppb	running annual mean	1ppb	1ppb (3.2mg/m^3) by 31.12.2003
Carbon monoxide	10ppm	running 8-hour mean	10ppm	10ppm (11.65mg/m^3) by 31.12.2003
Lead	0.5mg/m^3	annual mean	0.5mg/m^3	0.5mg/m^3 by 31.12.2004 0.25mg/m^3 by 31.12.2008
Nitrogen dioxide	150ppb	1 hour mean	150ppb, hourly mean*	104.6ppb (200mg/m^3) by 31.12.2005 (maximum of 18 exceedences)

	21ppb	annual mean	21ppb, annual mean*	21ppb (40mg/m^3) retained as objective for 31.12.2005. New annual national objective for the protection of vegetation of 15.7ppb (30mg/m^3) for 31.12.2000.
Ozone	50ppb	running 8-hour mean	50ppb, measured as the 97th percentile* of daily maximum 8 hour running mean, equivalent to 10 exceedences per year)	50ppb (100mg/m^3) retained as indicative level for 31.12.2005.
Particles (PM_{10})	50mg/m^3	running 24-hour mean	50mg/m^3, measured as the 99th percentile* of daily maximum running 24 hour mean, (equivalent to 4 exceedences per year)	New annual objective of 40mg/m^3 and 24 hour objective of 50mg/m^3 (maximum of 35 exceedences,) for 31.12.2004. 50mg/m^3 as 99th percentile of daily maximum running 24 hour means to be retained as indicative level for 31.12.2005. New indicative annual level of 20mg/m^3 and 24 hour level of 50mg/m^3, (maximum of 7 exceedences) for 31.12.2009.
Sulphur dioxide	100ppb	15 minute mean	100ppb, measured as the 99.9th percentile* of 15 minute mean, (equivalent to exceedences of 35 periods of 15 minutes per year)	100ppb (267mg/m^3) as 99th percentile of 15 minute means adopted as firm objective for 31.12.2005. New 1 hour objective of 131ppb (350mg/m^3) not to be exceeded more than 24 times per year and 24 hour objective of 46.8ppb (125mg/m^3), not to be exceeded more than 3 times per year for 31.12.2004. New national annual and winter objectives for the protection of eco-systems of 7ppb (20mg/m^3) for 31.12.2000.
ppm = parts per million; ppb = parts per billion; mg/m^3 = micrograms per cubic metre.* these objectives were to be regarded as provisional in the Strategy.				

The National Air Quality Strategy

The National Air Quality Strategy aims to provide a clear and workable framework for improving air quality in the UK. It sets standards and objectives for eight major air pollutants, which are detailed below. The Strategy seeks to strike a balance between national and local action, recognising that in many cases the sources of emissions and the most effective means of reducing them vary widely between areas.

One of the major tools to achieve the Strategy's aims is through local air quality management, whereby local authorities must assess whether the air quality objectives will be met throughout their districts by 2005. Where this does not appear likely, local authorities must declare Air Quality Management Areas. For each of these Areas, the local authority, working in conjunction with other bodies such as the Environment Agency and the highways authorities, will devise and implement an action plan, with the aim of achieving all of the objectives.

The air quality standards represent levels at which no significant health effects should occur. They are based purely on scientific and medical evidence. The objectives are derived from the standards, but take into account the feasibility and practicability of their achievement and the associated costs and benefits. They apply to all locations where people may reasonably be expected to be exposed to the pollutant for the relevant period.

The objectives have been given statutory force by the Air Quality Regulations 1997, with the exception of that for ozone. This was excluded on the basis that the primary pollutants which react to form ozone are often emitted many miles from locations where higher concentrations of the gas are experienced. Thus, the local authority for an area where an exceedance of the ozone objective occurred would generally be unable to influence levels significantly.

The first review of the Strategy has proposed a number of amendments to the objectives, in view of the latest scientific, medical and economic evidence. Objectives for five of the eight pollutants have been tightened, including the hourly objective for nitrogen dioxide. For the remaining pollutants covered by the Strategy, action on ozone is progressing at European level, and a decision on a UK objective has been deferred until the outcome of this work. The existing objective for sulphur dioxide is to be retained, supplemented by the proposed EU limit values, and it is proposed that the present objective for particulates should be replaced with the less stringent limit values set at EU level.

15. This review has also taken into account developments at the European level, where in September 1996, the European Council of Ministers adopted a Directive on Ambient Air Quality Assessment and Management (96/62/EC) which set out the framework for air quality policy in Europe. The Directive includes proposals for a number of daughter directives to cover 12 pollutants. In June 1998 the Council reached a Common Position on the first Daughter Directive, which sets legally-binding limit values for four pollutants: sulphur

dioxide, lead, nitrogen dioxide, and particulates. This Directive was adopted in April 1999 and will come into force in the summer of 1999. Detailed proposals to implement the Framework and first Daughter Directive in the UK are currently being developed, and the Government proposes to consult on these around the same time as the consultation draft of the revised Strategy is published.

CONTRIBUTION OF ROAD TRANSPORT

16. Road transport is one of the major sources of air pollution, especially in urban areas, as Table 2 indicates. The other sources being industrial and domestic emissions. In 1997 road transport accounted for around two-thirds of all national emissions of four of the eight pollutants for which objectives have been set by the Strategy; namely, benzene, 1,3-butadiene, carbon monoxide and lead. However, there have been, and will continue to be, significant reductions in these emissions, and measures already in place are expected to ensure that the Strategy's original objectives for these four pollutants will be easily met in all areas by 2005. Of more concern is that road transport is also responsible for a significant proportion of the pollutants for which objectives will be most difficult to meet - nitrogen dioxide and particulate matter - even though there will be significant reductions in these emissions too.[9]

Table 2: Contribution of road transport to UK air pollutant emissions (1997)

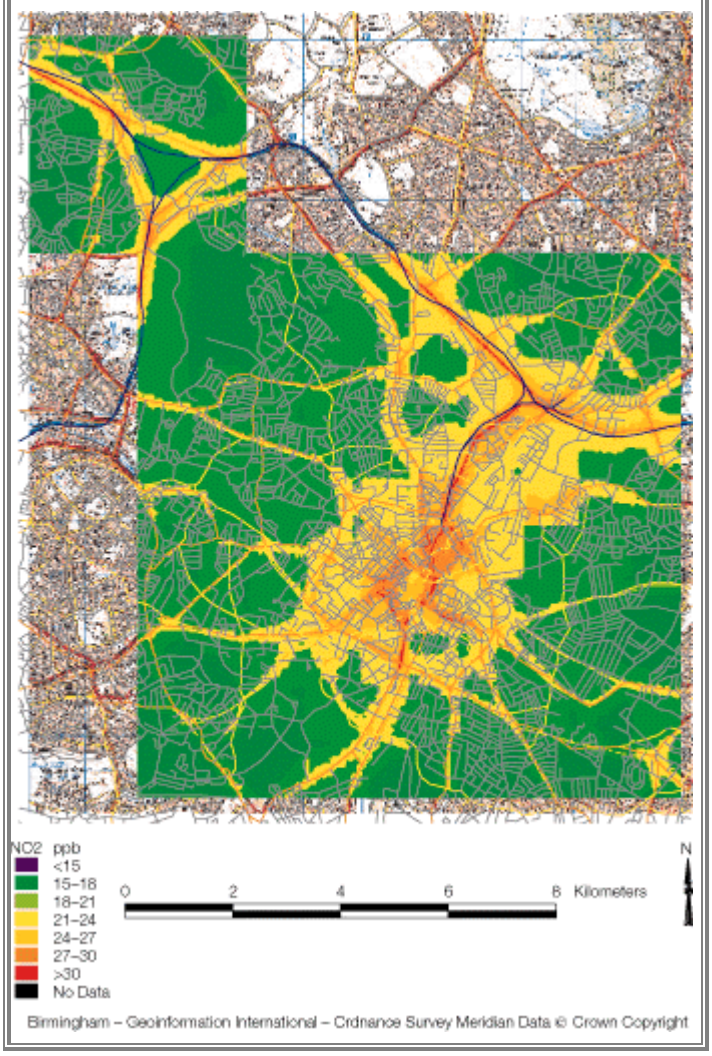
Pollutant	**1997 national emissions (k tonnes)**	**Contribution from road transport**	
		% of national emissions	**% of emissions in London[10]**
Benzene	38	65	82
1,3-Butadiene	10	77	97
CO	5090	75	97
Lead	1.31	61	not available
NO_x	1835	48	75
Particulates - PM_{10} - black smoke	184 314	26 59	78 not available
SO_2	1660	2	23
VOC	2130	30	60
Source: NETCEN/DETR			

17. But the national road transport emissions do not give a complete picture of the situation. Air pollution is predominantly a local phenomenon, albeit often with major international implications (for instance, in the well-known case of sulphur dioxide and acid rain). Accordingly, the extent to which road transport is a significant source of specific pollutants at any place and time varies depending on the level of traffic and proximity of other sources of that pollutant, as well as the prevailing meteorological conditions. In urban areas, the

contribution of road transport to overall emissions can be considerably higher than the national emission figures suggest, especially for PM_{10} and NO_x. For instance, in London and other large conurbations around three-quarters of all PM_{10} and NO_x emissions are from road transport.

18. This often means pollution levels are higher in areas with major traffic flows, especially when measured at the kerbside. Figure 1 shows the estimated annual mean level of nitrogen dioxide (NO_2) for central Birmingham in 1995 as modelled by CERC on behalf of DETR. It is clear from this map that the Strategy's annual NO_2 objective of 21ppb will be exceeded in areas around the city centre and major highways, and that this is primarily the result of concentrated vehicle emissions in these areas. Similar patterns have also been estimated for other large conurbations, with the greatest exceedences being in London.

Figure 1: Map of estimated annual mean NO_2 concentrations in central Birmingham (1995)



19. But the level of local emissions of air pollutants from road transport is not always indicative of the level of pollution in the atmosphere. Transboundary emissions can be a major source of pollution levels, depending on prevailing meteorological conditions. In the case of PM_{10}, as well as emissions from combustion sources such as road traffic, secondary sources of particulates arising from atmospheric chemical reactions and long range sources,

can be equally important in determining pollution levels. The Government is committed with other Members States to take action to tackle these transboundary sources of pollution.

20. Other local non-transport sources of emissions can be equally as important. Industry, which until recently was the dominant source of air pollution in many towns and cities, remains a producer of substantial quantities of most of the pollutants for which objectives are set in the Strategy. Industrial emissions are controlled primarily either by the Environment Agency through the integrated pollution control system or by local authorities through the local air pollution control system. Industrial processes prescribed for control must be operated in accordance with an authorisation from the appropriate regulatory authority. The authorisation contains emission limits and other conditions regarding the operation of the process. Authorisation conditions should be in line with the principle of BATNEEC - best available techniques not entailing excessive cost.

21. Emissions from domestic sources, particularly heating appliances, have also diminished in significance over the last forty years. Nevertheless, they still contribute to air pollution, especially in terms of sulphur dioxide and particulates. These problems are generally worst in coalfield areas where substantial quantities of coal are still burned. Domestic emissions of solid fuels have been tackled progressively since the late 1950s, principally through the widespread introduction of Smoke Control Areas.

EMISSION STANDARDS

22. Exhaust emissions are the predominant source of air pollutants from road transport, although tyre and brake wear is estimated to be responsible for around a tenth of all PM_{10} emissions from vehicles. The main thrust of measures to cut down on pollution from vehicles has been directed towards improving the exhaust emission performance of new vehicles, since the scope for improvements to existing vehicles is limited by their original design capabilities. The setting of mandatory vehicle emission and fuel quality standards, rather than the specification of particular technologies, gives manufacturers the flexibility to develop a solution which best suits their requirements.

23. The introduction of a series of more stringent European standards, commonly referred to as Euro standards, earlier this decade has had a particularly significant effect on vehicle emissions. Table 3 outlines the Euro standards which have been introduced since 1993, together with future standards now agreed as a result of the European Commission's Auto-Oil programme.

Table 3: Mandatory vehicle emission Euro standards

Standard	Directive	Type of vehicle	Date of introduction(for type approval)
Euro I	91/444/EEC 93/59/EEC 91/542/EEC	passenger cars light commercial vehicles heavy diesels	31 December 1992 1 October 1994 1 October 1993
Euro II	94/12/EC 96/69/EC 91/542/EEC	passenger cars light commercial vehicles heavy diesels	1 January 1997 1 October 1997 1 October 1996
Euro III	98/69/EC	passenger cars & light commercial vehicles	1 January 2001

	Common Position	heavy diesels	1 January 2001
Euro IV	98/69/EC Common Position	passenger cars & light commercial vehicles heavy diesels	1 January 2006 1 January 2006[11]

The Auto-Oil Programme

The Auto-Oil programme was set up by the European Commission in 1993 to identify the most cost-effective means of improving air quality across Europe through improvements to vehicle technology and fuel specifications. A tripartite project, it involved not just the Commission but also the European oil and motor industries. Two important Directives based on the recommendations which emerged from the programme were adopted by the Council of Ministers in June 1998. One of these Directives sets tighter limits for emissions of particulates, nitrogen oxides, carbon monoxide and hydrocarbons from cars and light vans which will apply from 2000 (Euro III), with further, even more stringent limits (Euro IV) coming into force in 2005.

A second Directive requires petrol and diesel fuels to meet a new, cleaner specification from 1 January 2000. This Directive also prohibits the general sale of leaded petrol from that date. Again even more stringent standards will apply from 2005, mandating the use of ultra-low sulphur petrol and diesel. For petrol, maximum sulphur limits will be reduced from the current level of 500 mg/kg to 150 mg/kg in 2000 and 50 mg/kg in 2005, along with reductions in benzene from 5% to 1%. For diesel, the principal change will be a reduction in maximum sulphur levels to 50 mg/kg (from a current level of 500 mg/kg) in 2005.

The Council of Ministers also agreed a Common Position in December 1998 on a further Directive which will require heavy goods vehicles and buses to meet tighter emission limits from 2000 (Euro III) and even more stringent limits from 2006 (Euro IV). This Directive is now subject to scrutiny by the European Parliament, before it can be adopted.

24. The mandatory fitting of three-way catalytic converters required to achieve the Euro I standard for new petrol engined cars and vans has already had a considerable impact on a number of key pollutants. A three-way catalytic converter typically reduces emissions of carbon monoxide (CO), hydrocarbons (including VOCs), and NO_x from an individual petrol car by 75%. There are now more than 9 million cars on the road fitted with these devices. Consequently, overall emissions of CO and VOCs from road transport have been reduced by around 40% and 30% respectively over the last decade, despite significant traffic growth. Further reductions of this magnitude are expected, as pre-Euro I cars are gradually phased out and replaced with vehicles meeting more stringent Euro standards.

25. Diesel cars and vans are subject to similar controls, and the level of permitted emissions of PM_{10} and NO_x from new vehicles has been significantly reduced. Considerable progress

has also been made on emissions from heavy goods vehicles and buses, with, for instance, permitted levels of particulate emissions now at around half of the levels allowed at the beginning of the decade.

26. Charts 3 and 4 show the trend in emissions of PM_{10} and NO_x from road transport since 1970, along with the latest projections in emissions up to 2025. The projections take into account the forecasts of traffic growth (including estimates of the composition and turn-over of the vehicle fleet and typical vehicle use) and the relevant emission factor for each vehicle type, which is calculated from measurements of emissions from vehicles under different driving cycles and conditions. It should be noted that the traffic forecasts used do not take into account the impact of the policies outlined in the Integrated Transport White Paper to reduce traffic growth.

Chart 3: National PM_{10} emissions from road transport 1970-2025

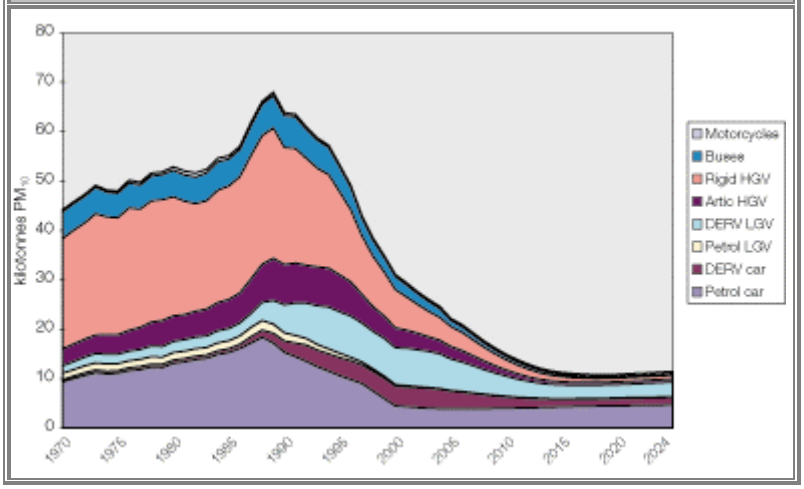
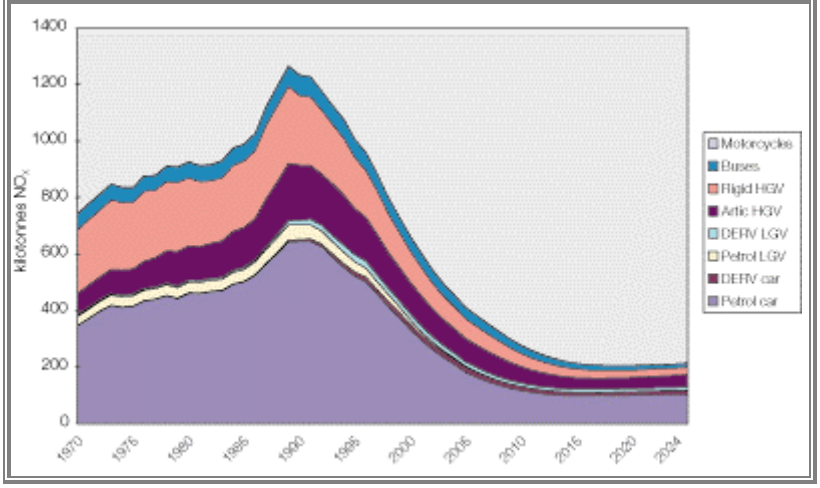


Chart 4: National NO_x emissions from road transport 1970-2025



27. As traffic has grown over the past twenty years, so emissions have increased, but due to progressively tighter vehicle standards, emissions of all local air pollutants are significantly lower than they were ten years ago. Between 1995 and 2010, the increasing proportion of

vehicles meeting Euro I and II standards is expected to lead to reductions in NO_x emissions of around 55% and of PM_{10} of about 33%.

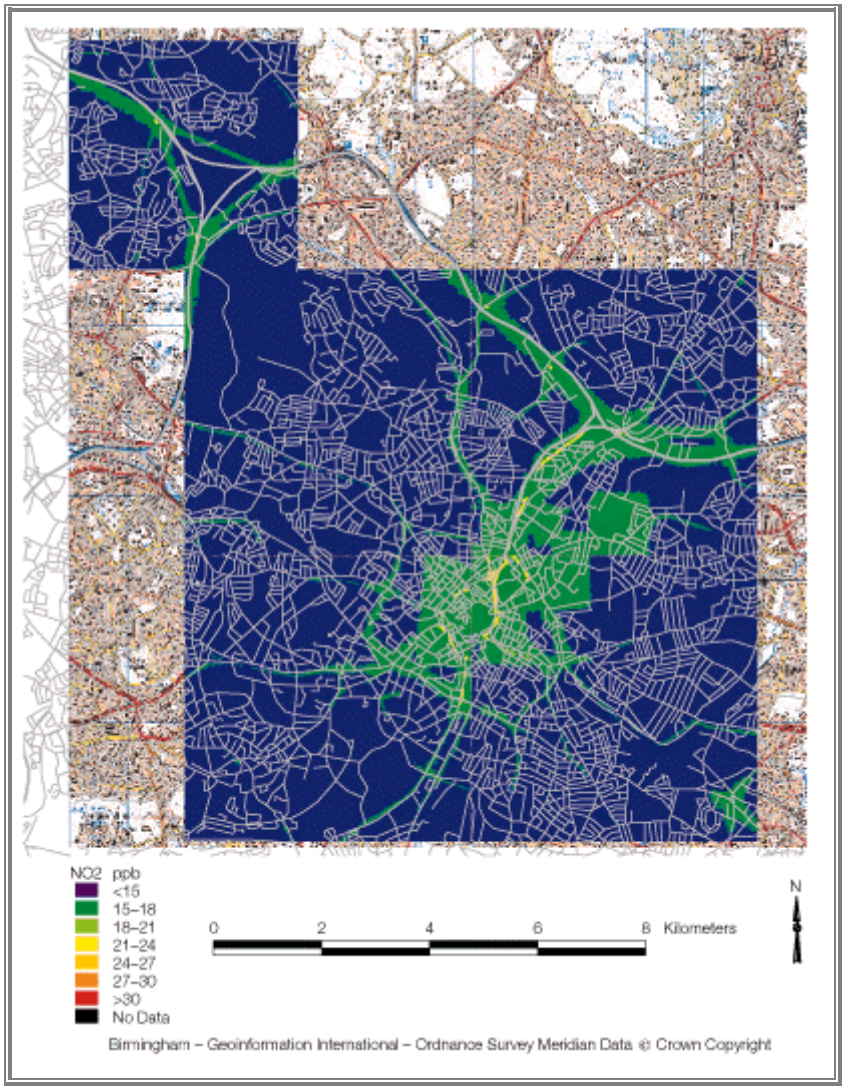
28. The new Euro III and IV standards will have a further significant impact, introducing even cleaner vehicle technologies as standard for new vehicles. Better catalytic converters will be required for petrol cars manufactured to Euro III standards, and diesel cars are likely to be fitted with exhaust after-treatments. Heavy diesel buses and lorries will almost certainly be required to be fitted with particulate traps, to achieve Euro IV standards. The adoption of these standards will further reduce NO_x emissions by around 35% and emissions of PM_{10} by about 40%.

29. The trend of declining emissions for NO_x and PM_{10} is expected to slow down considerably from about 2010, come to a halt around 2020, and then slightly reverse as engine and fuel improvements are offset by continuing traffic growth. Emissions of other local air pollutants are expected to follow a similar pattern, with VOCs and CO emissions continuing to fall until around 2015 and 2019 respectively when they are projected to start gradually rising again. Of course, any further, even more stringent, vehicle or fuel standards coming into force after Euro IV would result in changes to these projected emission trends.

30. However, even the significant improvements in emissions shown in the charts above will not be sufficient to to meet the Strategy's objectives in London and several other large conurbations for PM_{10} and NO_2 by 2005 without the introduction of other significant local measures. These may include measures like selective traffic restraint and targeted local traffic management practices.

31. Figure 2 shows the estimated level of NO_2 emissions in the central area of Birmingham for 2005, assuming 1995 meteorological conditions, as a result of more stringent vehicle emission standards. Compared to 1995 shown in Figure 1, emissions have significantly decreased to the extent that most of the area will meet the Strategy's objective for NO_2, but there are still small exceedences around the city centre and very close to major highways. In such cases, it will be for the local authority to address these exceedences by declaring Air Quality Management Areas and putting into place an action plan.

Figure 2: Map of estimated annual mean NO_2 concentrations in central Birmingham (2005)



EMISSIONS BY VEHICLE TYPE

32. Within the broad trends identified above, the performance of different types of vehicle varies widely. Table 2 shows the relative performance by fuel and emission standard for different vehicle types on a urban test cycle. The emissions levels from pre-Euro I vehicles are clearly significantly higher than for those vehicles being produced now (Euro II) and those that will be produced under Euro III and IV.

Table 2: Relative emission performance of different vehicle types by fuel and emission standard on an urban test cycle[13]

Type of Vehicle	Emission Standard	Carbon monoxide	Hydro-carbons	Oxides of Nitrogen	Parti-culates
Petrol car	pre-Euro I	100	100	100	5
	Euro I	15	9	19	2
	Euro II	10	4	9	2
	Euro III	7	3	6	2
	Euro IV	4	2	3	2

Diesel car	pre-Euro I Euro I Euro II Euro III Euro IV	7 4 3 2 2	10 4 3 2 1	43 29 21 13 7	100 55 31 20 10
Petrol LGV	pre-Euro I Euro I Euro II Euro III Euro IV	151 30 21 17 7	120 6 3 2 1	114 21 9 6 3	10 5 5 5 5
Diesel LGV	pre-Euro I Euro I Euro II Euro III Euro IV	10 8 6 4 3	20 15 9 4 3	82 40 30 26 13	209 115 63 41 20
Rigid HGV	pre-Euro I Euro I Euro II Euro III Euro IV	38 21 17 9 6	192 113 105 47 33	640 440 316 224 158	484 318 168 113 22
Articulated HGV	pre-Euro I Euro I Euro II Euro III Euro IV	44 22 18 9 7	183 87 78 47 33	1704 893 650 461 325	700 482 185 124 24
Bus	pre-Euro I Euro I Euro II Euro III Euro IV	63 28 22 11 8	83 90 84 50 35	795 859 614 436 307	458 304 187 125 24
Motorcycle	less than 50cc: two stroke greater than 50cc: two stroke greater than 50cc: four stroke	34 74 67	135 338 68	2 4 13	- - -

33. The table shows that a diesel car produces more emissions of PM_{10} and NO_x than a similar sized petrol car fitted with a catalytic converter. It also typically emits more black smoke and noxious fumes. However, diesel vehicles produce less carbon monoxide and hydrocarbons, and because they are more fuel efficient than petrol vehicles, they produce lower emissions of carbon dioxide, the main greenhouse gas. Unlike current diesel engines, emissions from petrol-engined catalyst cars may be higher during the first few minutes of operation due to the time needed for the catalyst to warm up. In older catalyst cars this may be anything up to five minutes, although in new cars designed to meet Euro III standards, this will take no more than a few seconds.

34. This variation in emission performance means that it is difficult to clearly recommend one fuel type over the other. Diesel vehicles individually tend to have more of an impact on local air quality, for those pollutants that we are most concerned about, than petrol. On the other hand, petrol vehicles produce more CO_2, with implications for climate change. The emission performance also varies with the age of vehicles: for instance pre-catalyst petrol cars produce significantly more NO_x than their diesel counterparts, but the introduction of catalytic converters has significantly reduced the amount of NO_x produced by petrol cars. It is therefore difficult to say categorically which fuel has the least environmental impact, and there are trade-offs between the different fuel. However, given that air quality problems are locally concentrated, the case for looking at alternatives to diesel is much stronger when a vehicle is predominantly used in urban areas.

35. Regardless of this, due to their greater number, petrol cars collectively currently produce over half of NO_x emissions from road transport, and are the third most important source of PM_{10} emissions behind HGVs (goods vehicles weighing over 3.5 tonnes) and LGVs (good vehicles weighing under 3.5 tonnes), as charts 3 and 4 showed. However, according to the latest forecasts, they will have been overtaken in proportional share of NO_x emissions by HGVs by 2006. LGVs are also expected to be an increasingly significant source of emissions, as a result of the switch from petrol to diesel at the beginning of 1990s and strong forecast growth in van use. By 2005 lorries and vans will be the dominant sources of particulate emissions, although the widespread introduction of particulate traps, as a result of tighter heavy diesel emission standards from 2006, should lead to a significant reduction in particulate emissions from these sources.

36. Some types of vehicles also tend to be kept on the road for longer than others, so the introduction of new Euro standards will take much longer to have an effect. Currently, the oldest section of the fleet is buses, with the majority of the bus fleet manufactured to pre-Euro I emission standards, although an increasing number of older vehicles have been re-engined to higher emission standards. There are still large numbers of petrol cars on the roads which do not have catalytic converters.

37. Collectively, cars manufactured to pre-Euro standards before 1993 are estimated to have produced 83% of the NO_x emissions and 82% of the PM_{10} emissions from cars in 1997. This proportion would be higher, but new cars are used much more extensively than older cars, with a brand new car on average doing over 14,000 miles a year while an average ten year old car does only 6,700 miles. The greater penetration of diesel in the new car market over the last decade from 4% in 1986 to 18% in 1996 has also meant the level of PM_{10} and NO_x emissions from new cars is higher than it would otherwise be.

IN USE EMISSION STANDARDS

38. Besides the introduction of tighter emission standards for new vehicles, emission standards for all vehicles in use have been set to ensure that they are well maintained. Light vehicles are tested to these standards at an annual MOT test after three years and heavy vehicles at an annual roadworthiness test. These standards may also be spot tested at the roadside.

39. Emissions checks from petrol-engined vehicles were first introduced into the MOT scheme in 1991, and into the annual road worthiness testing scheme for heavy diesel engined vehicles in 1992. The checks were extended to diesel-engined cars and vans in 1994. They

apply to petrol-engined vehicles first used from 1 August 1975 to cars, vans and taxis first used from August 1979 and to all other diesel vehicles regardless of age.

40. These emission checks include:

- free acceleration smoke (FAS) from diesel engines, to ensure compliance with prescribed black smoke limits;
- carbon monoxide and hydrocarbons limits for petrol engines; and
- the engine management system on catalyst equipped vehicles, to ensure it is maintaining oxygen into the catalyst at the right level to promote maximum NO_x reduction

All vehicles also have a visual check to ensure no excessive smoke is emitted. Emission limits were tightened by approximately 23% and 10% respectively for petrol and diesel engined vehicles in 1995 with special limits introduced for catalyst cars a year later.

41. Roadside emission testing suggests that some classes of vehicles tend to be a lot better maintained than others. Buses and HGVs, for instance, are typically the best maintained vehicles on the roads. The Vehicle Inspectorate carried out emissions-only checks on nearly 115,000 vehicles between April 1997 and March 1998, and prohibited for failing to comply with emission standards: 1.8% of public service vehicles; 2.5% of HGVs; 4.3% of cars; 4.8% of LGVs; and 9.6% of taxis. Seven local authorities are also taking part in a trial in which local authority traffic officers carry out roadside emission tests, which have have seen 16% of vehicles failing to meet the prescribed emission standards.

CLEANER FUELS AND TECHNOLOGIES

42. Conventional road fuels have also become much cleaner, as result of more stringent mandatory European fuel quality standards. For instance, the introduction of tighter maximum sulphur limits for diesel in 1996 have reduced PM_{10} emissions from HGVs by over 10%. But the use of even cleaner fuels can bring further significant improvements in the emissions performance of road transport, as well as enabling the use of technology which can significantly reduce emissions. The Auto-Oil programme will result in further significant improvements in the environmental performance of conventional fuels, and will affect the majority of fuels supplied on filling station forecourts. One of the most significant measures will be the banning of the sale of leaded petrol from January 2000. This will mean emissions of lead from road transport will be almost negligible, and will ensure that the National Air Quality Strategy's objective for lead to be met by 2005 in all areas not affected by major industrial sites.

43. Ultra low sulphur diesel (ULSD), which meets the 2005 Auto-Oil mandatory fuel specification, is likely to become the standard diesel on sale in the UK by the end of 1999, due to the introduction of a fuel duty differential in its favour in 1997. ULSD can result in reductions of up to 40% in emissions of particulates from existing vehicles, compared with conventional diesel. Because of its low sulphur content, it also offers the potential for additional environmental benefits by enabling the use of technology which can further reduce emissions, such as particulate traps which can cut emissions of PM_{10} by up to 90%.

44. Ultra low sulphur petrol, which already meets the 2005 Auto-Oil standards for petrol, is also being made available, though currently only at a limited range of sites in London. This cleaner petrol offers NO_x emission reductions and, crucially, allows the introduction of direct

injection petrol engine technologies which are considerably more fuel efficient than existing petrol engine technologies.

45. Alternative fuels, such as liquefied petroleum gas (LPG), compressed Natural Gas (CNG) and electricity, have the potential to significantly reduce emissions of air pollutants. Emissions of NO_x and PM_{10}, are considerably lower from gas powered vehicles than their diesel counterparts, especially for heavy duty applications. A report in 1998 by the widely supported Cleaner Fuels Forum suggested that the use of LPG in buses can result in 61% lower emissions of PM_{10} than the same vehicle would produce using conventional diesel, as well as 76% less NO_x, 33% less carbon monoxide and 44% less hydrocarbons.[14] The reductions arising from switching from petrol are considerably lower, as petrol produces less NO_x and PM_{10} in the first place.

46. Electric vehicles can also offer environmental benefits, producing zero emissions at point of use, although they result in increased emissions from power stations. They are best suited to urban operations, because of their relatively limited range. Wider application, depends greatly on the success of ongoing efforts, including those of some UK companies, aimed at developing advanced batteries, vehicles, novel uses, and better infrastructure.

47. Hybrid electric vehicles and fuel cell vehicle technologies are continuing to develop, and offer the possibility of widespread application with significant potential for reducing emissions of both local air pollutants and greenhouse gases. Whilst some electric hybrids are already in use, many development, commercialisation and safety issues remain to be addressed before fuel cells can be expected to start to enter the market on any significant scale, though progress in recent years has been very rapid because of increased investment by vehicle manufacturers.

5 Quantification of the Effects of Air Pollution on Health in the United Kingdom, Committee on the Medical Affects of Air Pollutants, published by the Department of Health, January 1998.

6 Road user exposure to air pollution, published by the Environmental Transport Association on behalf of the Department of Environment, Transport and the Regions, November 1997.

7 The United Kingdom National Air Quality Strategy, published by the Department of Environment, March 1997.

8 Report on the Review of the National Air Quality Strategy: Proposals to Amend the Strategy, published by the Department of Environment, Transport and the Regions, January 1999.

9 When calculating emissions from road transport, oxides of nitrogen (NOx) are measured, rather than nitrogen dioxide (NO2), for which the air quality objective is set, as all combustion processes actually produce NOx, a mixture of NO and NO2. NO is then converted to NO2 via a chemical reaction in the atmosphere with substances such as ozone.

10 Figures for 1996.

11Further NOx emission standards would also be introduced from 1 January 2009 as part of the same directive.

12 Projections calculated by the National Environmental Technological Centre on behalf of DETR using the road traffic emission factors and methods incorporated in the National Atmospheric Emissions Inventories.

13 Emission performance indexed to petrol car without three way catalyst (Pre-Euro 1 = 100), except for particulates where it is indexed to pre-Euro 1 diesel car. Legislative standards for particulates exist only for diesel vehicles. Petrol figures included for comparison. Motorcycles are not subject to Euro standards.

14 Cleaner Air: the role for cleaner fuels published by the Cleaner Fuels Forum, National Society of Clean Air, 1998.

Climate change

48. Climate change is one of the greatest environmental threats facing the world today. There is now a broad consensus amongst the world's foremost climate scientists on the Intergovernmental Panel on Climate Change that human activities are having a discernible effect on the climate. Certain gases, naturally present in the atmosphere, keep the Earth at a temperature suitable for life by trapping outgoing terrestrial radiation from the earth's surface. Levels of some of these so called 'greenhouse gases' are increasing as a result of human activity and this, scientists believe, is leading to a gradual increase in the temperature of the atmosphere. Climate models predict that the global temperature will rise by between 1.5šC and 3.5šC by 2100. This will exceed any climate change experienced since the last Ice Age 10,000 years ago.

Potential impacts of climate change
It is still too early to predict accurately the size and timing of climate change in specific regions, but the impact on the global environment is likely to be significant. Sea levels are expected to rise causing flooding to low lying areas. Storms and other extreme weather events could become more severe and frequent. Climatic zones could shift towards the poles. Many natural habitats could decline or fragment and individual species become extinct. Water resources will be affected, some regions may experience food shortages and economic activities and human settlements will experience many direct and indirect effects. Climate change is also likely to have wide-ranging and mostly adverse impacts on human health, with potentially significant loss of life. The latest studies suggest that in the UK we could see greater climatic extremes such as more frequent severe winter gales, increased autumn and winter rainfall leading to a greater risk of flooding, and more frequent summer droughts in the south east, as well as greater coastal erosion and flooding due to a sea level rise of about 5 centimetres per decade. More information about the impact of climate change and recent developments in climate change science is to be found in the Meterological Office publication, *Climate Change and its impacts* and the UK climate impacts programme publication, *Climate Change Screening for the United Kingdom.*

49. The main human activity believed to be responsible for climate change is the burning of fossil fuels and their derivatives (coal, oil, gas, petrol and diesel) to provide heat and power for our homes, industry and transportation. This releases carbon dioxide - the most important greenhouse gas (accounting for around 80% of UK greenhouse gas emissions) - adding to the natural levels of this gas in the atmosphere and increasing the average global temperature. Other significant greenhouse gases include methane and nitrous oxide (N_2O).

50. The Government takes the threat of climate change very seriously, and is committed to taking action to reduce greenhouse gas emissions. The UK now has a legally-binding greenhouse gas emission reduction target of 12.5% on 1990 levels by 2008-12 as part of the international response following the Kyoto Climate Change Convention in December 1997, together with a domestic aim of reducing UK carbon dioxide emissions to 20% below 1990 levels by 2010.

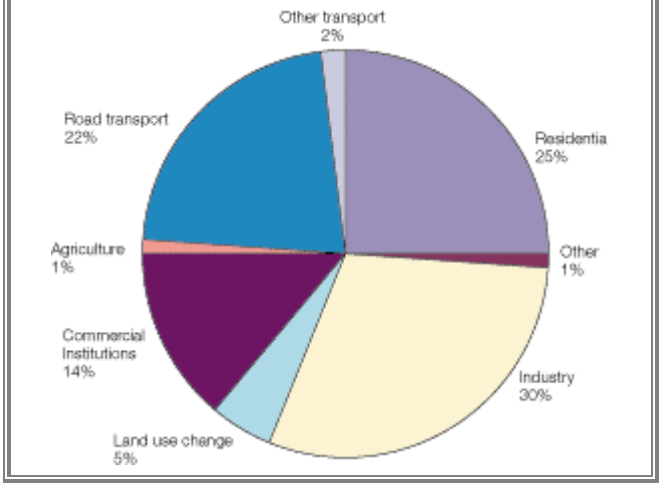
The International Response
The United Nations Framework Convention on Climate Change was signed by 154 countries at the Rio Earth Summit in 1992. Its objective is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. It is thought that a reduction in emissions of 60 to 70% by the year 2100 will be necessary. As a step towards that objective, Parties to the Convention met in Kyoto, Japan in December 1997 and agreed the Kyoto Protocol. It commits developed countries to legally-binding targets for reducing greenhouse gas emissions to an average of 5.2% below 1990 levels by the period 2008 to 2012. The EU agreed to an 8% reduction and within that, as part of a burden sharing agreement among Member States, the UK has agreed to cut emissions by 12.5%. Conferences, such as the Bonn meeting in October/November 1999, will take forward discussion on how countries can meet their Kyoto commitments.

51. The Government published a consultation paper in October 1998 seeking views on policy options for meeting the UK's legally-binding Kyoto target and to move towards its domestic aim.[15] The intention is to develop a balanced programme of cost effective measures across all sectors of the economy. It will build on other Government priorities and exploit opportunities for a more energy efficient industrial sector, the development and marketing of new innovative technologies, better insulated homes and a more sustainable, less polluting transport system.

THE CONTRIBUTION OF ROAD TRANSPORT

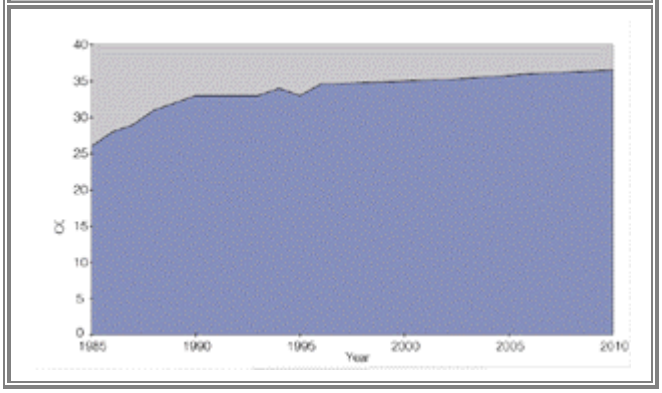
52. Road transport is the third largest source by end user of carbon dioxide emissions in the UK, after industry and domestic users, as chart 5 shows. The sector was estimated to account for 34.6 million tonnes of carbon (MtC) in 1996, or around 20% of the UK's carbon dioxide emissions. More importantly, as CO_2 emissions are directly proportional to the fuel consumption of a vehicle, traffic growth and the limited improvement in the vehicle fuel efficiency over the last thirty years has meant that road transport has been one of the fastest growing sources of these emissions. This is in contrast to regulated emissions from road transport, where all vehicles of a particular type have needed to meet the same increasing stringent emission standards, regardless of fuel consumption.

Chart 5: UK CO_2 emission by end user (1996)



53. Chart 6 illustrates the growth in CO_2 emissions since 1970 and forecasts how this will change in the future. Under pre-Integrated Transport White Paper policies, road transport emissions are forecast to continue to rise to 36.5 MtC by 2010.[16] But future road transport emissions will be lower in particular if the EU CO_2 from cars strategy, which includes a voluntary agreement with motor manufacturers to reduce CO_2 emissions from new cars, is achieved. CO_2 emissions from road transport could fall to approximately 34.5 MtC in 2010 as a result of the voluntary agreement.

Chart 6: Historical and forecast growth in CO_2 emissions from road transport



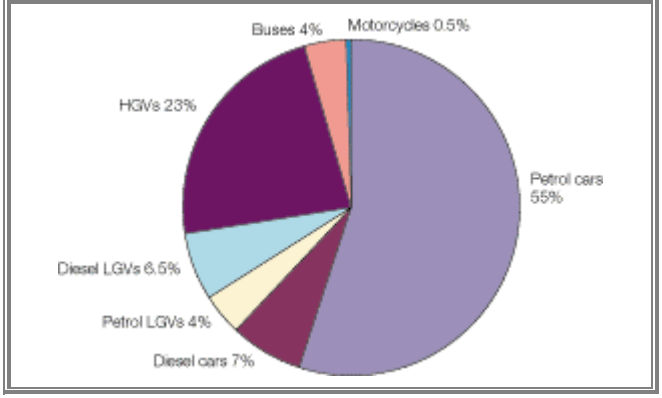
54. A range of further possible measures to ensure the road transport sector makes an appropriate contribution to reducing CO_2 emissions are considered in the Government's consultation paper on the UK Climate Change Programme. These include the introduction of graduated Vehicle Excise Duty and the reform of the company car tax regime. The consultation paper also suggests that stricter enforcement of the 70mph speed limit could make a significant contribution towards reducing CO_2 emissions in 2010, producing a forecast reduction of between 0.4 and 2.8 MtC. In addition, many of the measures announced in the Government's Integrated Transport White Paper should reduce CO_2 emissions, as they succeed in reducing the rate of traffic growth.

55. The consultation paper also explores how other sectors of the UK economy could contribute to meeting the UK's Kyoto commitments. Unlike the road transport sector, even under current policies, many of these sectors are forecast to show significant reductions in CO_2 and other greenhouse gas emissions. For example, emissions from the energy supply industry are forecast to fall from 72 MtC equivalent in 1990 to 59 MtC in 2010, helped by the significant switch to gas-fired electricity generation that has occurred since 1990. This drop in energy supply emissions is reflected in forecast reductions for the business sector, down from 87 MtC to 75 MtC.

BREAKDOWN BY VEHICLE TYPE

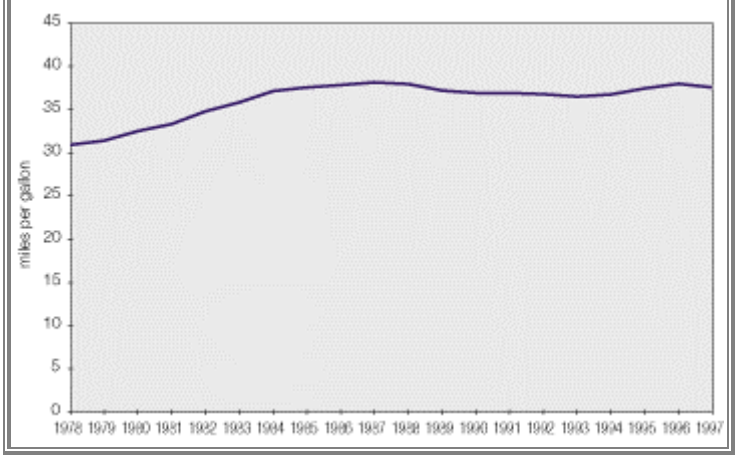
56. CO_2 emissions from the road transport sector can be broken down further to show the contribution of the different vehicle types, as shown in Chart 7. Petrol cars were the biggest single producer of CO_2 from road transport in 1996, accounting for around 57% of the total, due partly to the large number of this type of vehicle, although lorries are responsible for nearly a quarter of all emissions. Fuel choice is also important for emissions since, in general, diesel engines are more efficient than equivalent petrol engines, consuming less fuel and producing significantly less CO_2 per kilometre than equivalent petrol engines.

Chart 7: CO_2 emissions from road transport by vehicle type (1996)



57. It is clear from chart 7 that, with all cars responsible for 63% of all carbon dioxide emissions from road transport in 1996, reducing emissions from this source is paramount. But, while manufacturers have made significant progress on improving emissions of regulated pollutants for cars, less has been achieved on fuel consumption. In fact, the fuel efficiency of the average petrol car produced now differs little from those produced ten years ago, as chart 8 shows, mainly because the considerable improvements in engine efficiency that have been made have been offset by tighter noise, regulated emission and safety standards, but also because of the increasing preference for additional features like power steering.

Chart 8: Average fuel consumption from new petrol cars since 1980



58. To improve the fuel efficiency of the cars which people buy requires action not just to introduce fuel saving technologies into vehicle design, but also to persuade consumers to switch to the purchase of smaller cars which generally consume less fuel. Vehicle weight is also an important factor. There are a wide range of technologies which are under development which could be introduced, such as lean burn direct fuel injection engines in petrol cars and light weight materials. An important stimulus to the introduction of these technologies is likely to come through the EU strategy on CO_2 from cars, which the Government fully supports.

EU CO_2 from cars strategy

The European Commission's strategy on CO_2 from cars aims to reduce emissions of CO_2 from new cars sold in the EU to an average of 120 grammes per kilometre (g/km) by 2005, or at the latest 2010. This represents a cut of about a third on the current average. This strategy was endorsed by the Council of Ministers in June 1996. It seeks to achieve the target in large part through a voluntary commitment by European vehicle manufacturers, supplemented by fiscal measures and fuel economy labelling to influence consumer demand.

In July 1998, the Commission reached an agreement with ACEA, the European car manufacturers' representative, where ACEA committed itself:

- to reduce an average CO_2 emission figure of 140g/km by 2008 for all its new cars sold in the EU, a cut of about 25% on current levels;
- to bring to the market individual car models with CO_2 emissions of 120g/km or less by 2000;
- to an indicative intermediate target of 165-170g/km in 2003 as the basis for monitoring progress;
- to review in that year the potential for additional improvements with a view to moving the new car fleet average further towards 120g/km by 2012. ACEA has also pledged to produce individual car models with CO_2 emissions of less than 120g/km by 2000.

The agreement was approved by the European Council of Ministers in October 1998. Its implementation will be monitored jointly by the Commission and ACEA, and the Commission will report to the European Parliament and the Council of Ministers annually.

Similar voluntary agreements are currently being negotiated by the Commission with Japanese and Korean motor manufacturers, as part of CO_2 from cars strategy.

59. Action to improve the fuel consumption of other vehicle types is also needed: collectively, they account for 37% of all CO_2 emissions from road transport, and this proportion is expected to grow considerably. The average individual fuel consumption for all lorries - the largest source of CO_2 emissions from road transport after cars - has slightly increased throughout this decade. Between 1992 and 1998 the average fuel efficiency for all rigid vehicles increased from 7.9 to 8.5 miles per gallon, whilst fuel efficiency for articulated vehicles increased from 6.9 to 7.7 miles per gallon over the same period.[17] Although rigid lorries are generally smaller than articulated ones, there is only a relatively small difference in fuel consumption between them. This reflects the fact that the former is predominantly used in urban areas, where constantly accelerating and braking increases fuel consumption, while the latter is used for longer, inter-city journeys. Within this trend, it should be noted that the average fuel consumption for the larger articulated lorries - those over 33 tonnes gross vehicle weight - has improved by approximately 13% over the same period, partially as a result of more efficient engines, and aerodynamic body frames.

60. Although no direct measures similar to the EU CO_2 from cars strategy are proposed at this stage, the Government is pursuing a number of policies to encourage improvements in fuel efficiency more widely, as part of its Sustainable Distribution Strategy. For instance, the policy of annual above inflation increases in fuel duty encourages greater fuel efficiency in the manufacture, purchase and use of vehicles. For HGVs, driver training is an important way of improving fuel consumption, since simply accelerating and braking unnecessarily can increase fuel consumption by up to 15%. Many haulage companies use driver training precisely for this reason, and there is evidence to suggest that driver training could produce fuel savings for other vehicles, including cars. Minimising empty running and better logistics management can also significantly reduce fuel consumption. The gradual introduction of intelligent transport systems and telematics systems such as adaptive cruise control could also contribute to overall improvements in fuel consumption by helping to smooth out stop-start running and reducing journey times.

15 UK Climate Change Programme: consultation paper published by the Department of Environment, Transport and the Regions, 1998.

16 Estimates of CO_2 emissions from road transport are derived from the National Road Traffic Forecasts

17 Continuing Survey of Road Goods Transport (Great Britain) 1999 published by the Department of Environment, Transport and the Regions.

Noise

61. Noise from road transport has, to date, been seen as an issue of less concern than climate change or air pollution. But noise is a major environmental issue which affects a large proportion of the population. Whilst the effects of ambient noise are rarely life threatening, it can have a considerable detrimental effect on people's quality of life, and may well lead to sleep disturbance and may impact on cognitive development in children.

Measuring and understanding traffic noise

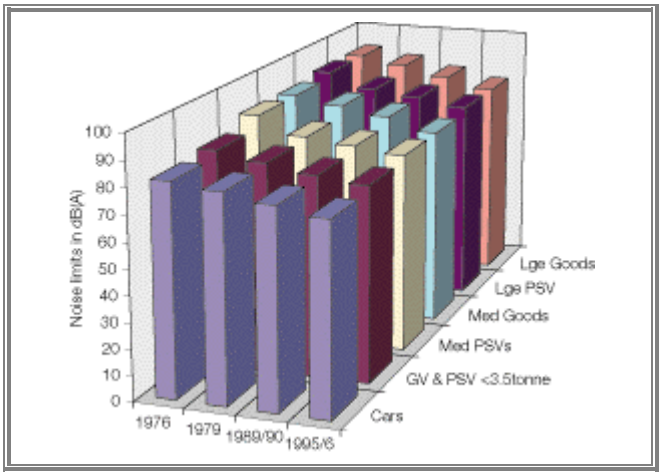
Noise levels are commonly measured in decibels (dB). An adjusted scale (dB(A)) has been devised to reflect the fact that the human ear is more sensitive to noise of certain frequencies. The decibel scale is logarithmic, and a sound perceived as twice as loud as another is approximately 10 dB(A) more, not twice the dB(A) level as the quieter sound.

Traffic noise can vary considerably, depending on the density, speed and type of traffic, as well as on the location and time of day. The Government is undertaking research to try and gain a better understanding of the problems arising from traffic noise. This includes:

- further work on the health and related effects of noise will be carried out under a three year joint Department of Health and Department of the Environment, Transport and the Regions research programme
- a study to measure noise at a representative sample of 1,000 sites in England and Wales with results available in 1999-2000
- an assessment of attitudes to noise on the same timescale (and an exploration of the practicability of linking these two surveys to allow correlations to be drawn between noise levels and attitude to noise)
- work with Birmingham City Council to carry out detailed noise mapping of its area which was completed in March 1999

62. Historically, measures to reduce traffic noise have principally focused upon setting noise emission standards for new vehicles. Mandatory standards have been in place since 1968, and the introduction of a series of stricter limits at European level has meant that by 1990 maximum noise limits of individual vehicles have effectively been halved from the previous decade. Additional reductions in traffic noise were realised through the implementation of a further EU directive in October 1996 which saw reductions ranging from 3 dB(A) for passenger cars to 5 dB(A) for intermediate trucks. Overall, noise emission limits for cars have been tightened from 82 dB(A) in 1976 to the current 74 dB(A), and 91 dB(A) to 80 dB(A) for large buses and lorries during the same period, as chart 9 indicates.

Chart 9: Mandatory European noise limits by vehicle type



63. Noise emissions from different vehicle types also vary considerably. As chart 9 shows, large buses and lorries produce more noise than most other types of vehicles, partly due to their large size, but also because diesel engines are generally noisier than petrol engines. The limits for cars and light goods vans less 3.5 tonnes gross weight are 1 dB(A) higher if the engine is diesel. Conversely, gas powered vehicles can considerably reduce noise levels, for instance an HGV running on gas instead of diesel can be up to 6 dB(A) quieter.

64. Motorcycle noise can be especially intrusive. Existing maximum noise limits for motorcycles are significantly higher than for cars, and even from June 1999, when a more stringent 80 dB(A) noise limit will be applied to new motor cycles over 175cc, limits will still be 6 dB(A) higher. These relatively high limits reflect the limited scope on motorcycles for cladding and other noise suppression techniques. Furthermore, the fitting by some motorcyclists of inappropriate or altered silencers, mainly on older machines, can exacerbate the problem of motorcycle noise. The UK now has one of most stringent series of regulations in force to control both construction standards for, and the sale of, replacement silencers for motorcycles.

65. The reductions in noise levels brought by vehicle standards will continue, as new vehicles enter the fleet. This will be particularly beneficial in urban areas where the main sources of noise from vehicles is the mechanical operation of the vehicle rather than contact between road surface and tyres. However, substantial reductions in emissions from source have been eroded by traffic growth, and if traffic continues to grow in line with forecasts, it is likely that there will be an intensification of the noise problem.

66. The UK Government is participating in the United Nations Economic Commission for Europe (UNECE) Working Group on vehicle noise which is pressing for new standards and test procedures to maximise the noise reduction benefits offered by new and emerging vehicle technology and which also take account of safety and other environmental impacts. However, it seems likely that future reductions in vehicle noise will need to come from the noise resulting from the impact between tyres and road surfaces. The majority of noise produced by new vehicles at higher speeds now results from this source. An EU Commission proposal which sets noise limits for tyres and could reduce noise levels from this source by 2bB(A), is currently under discussion. There is also continuing research and development, being conducted in both the UK and Europe, into quieter road surfaces and noise barriers, through the use of porous asphalt and other quiet road surfacing materials.

Summary: The way forward

67. There can be no doubt that air quality and climate change are the most pressing environmental priorities in relation to road vehicles. Air pollution presents the most direct health risks, while climate change is seen as one of the most serious longer term threats facing the world. Noise too is becoming an issue of growing concern, as traffic continues to increase.

68. The key points that this document has made are:

- Road vehicles have a significant impact on the environment, although there are wide variations between the impact of different vehicles and fuels.
- Tighter emission standards have led to significant reductions in emissions of local air pollutants from road transport. Additional tightening of these standards in 2000 and beyond will achieve further improvements; however, these are unlikely to be sufficient to deliver air quality objectives in all urban areas without significant further local measures such as traffic restraint.
- Little progress has been made in average fuel consumption of new vehicles over the last decade in contrast to progress on regulated pollutants (considerable improvements in engine efficiency have been offset by additional features, and the introduction of more stringent mandatory safety and emission requirements). This has meant that the road transport sector has been one of the fastest growing sources of CO_2 emissions in the UK.
- But the voluntary agreement with motor manufacturers, as part of the EU CO_2 from cars strategy, offers an important opportunity to reduce CO_2 emissions from new cars by a quarter, especially through the development of new technology, and should stabilise CO_2 emissions from road transport by 2010, although further action will be needed.
- Cars have the most environmental impact, due to their greater number, but HGVs are a significant source of emissions and are forecast to become the primary source of both PM_{10} and NO_x emissions from road transport. The forecast growth in light goods vehicles is also of concern, particularly since they have increasingly tended to run on diesel.
- Petrol and diesel vehicles have different environmental impacts, with the former producing more CO_2 and the latter producing some of the more important pollutants that affect local air quality.
- There are clear trade offs in tackling different environmental impacts, which need to be considered carefully for instance some measures to tackle climate change (such as increasing the proportion of new diesel cars) may have adverse effects on air quality.
- Significant progress has been made in reducing noise emissions, but this will be largely offset by increases in traffic.

69. Government action at national and European levels has focused on improving the emissions from new vehicles and fuels, trying to persuade people to use their cars in a more environmentally friendly, and encouraging the use of forms of transport which have less impact on the environment than cars, particularly for short journeys. However, in order to reduce the environmental impact of vehicles, action needs to be taken on a wider scale. This is why the Cleaner Vehicles Task Force has been set up. However, public action is also needed. It is hoped that this document will go some way to increasing awareness of the environmental impact of road transport and provide a context in which action can take place.

Further information

The following publications provide further information about the issues outlined in this paper.

General

A New Deal for Transport: Better for Everyone (The Government's White Paper on the Future of Transport) - The Stationery Office, 1998.

Breaking the Logjam (The Government's consultation paper on fighting traffic congestion and pollution through road user and workplace parking charges) - Department of Environment, Transport and the Regions, 1998.

Foresight Vehicle: Strategic Plan - Department of Trade and Industry, 1999.

National Road Traffic Forecasts (Great Britain) 1997 - Department of Environment, Transport and the Regions, 1997.

Sustainable Distribution: A Strategy - Department of Environment, Transport and the Regions, 1999.

Transport and the Environment - Developments since 1994 (Royal Commission on Environment Pollution: Twentieth Report) - The Stationery Office, 1997.

Transport Statistics Great Britain 1998 - The Stationery Office, 1998.

Workhorse to Thoroughbred: a better role for bus travel - Department of Environment, Transport and the Regions, 1999.

Air Quality

The United Kingdom National Air Quality Strategy - The Stationery Office, 1997.

Report on the Review of the National Air Quality Strategy - Department of Environment, Transport and the Regions, 1999.

An economic analysis of the National Air Quality Strategy Objectives - Department of Environment, Transport and the Regions, 1999.

Air Quality and Traffic Management - The Stationery Office, 1997.

Emissions of Air Pollutants 1970-1995 - NETCEN, 1997.

Quantification of the Effects of Air Pollution on Health in the United Kingdom - (Committee on the Medical Effects of Air Pollution) - The Stationery Office, 1998.

Clean Air: The role for cleaner fuels - The Cleaner Fuels Forum, 1998.

Road user exposure to air pollution: literature review - Environmental Transport Association, 1997.

Climate Change

Climate Change and its Impacts (First report) - The Meteorological Office and Department of Environment, Transport and the Regions, 1997.

Climate Change and its Impacts (Update) - The Meteorological Office and Department of Environment, Transport and the Regions, 1998.

EP65: Energy Projections for the UK - The Stationery Office, 1995.

UK Climate Change Programme: consultation paper - Department of Environment, Transport and the Regions, 1998

CO2 emissions from Cars: the EU implementing the Kyoto Protocol (Booklet) - ACEA/European Commission, 1998.

Further information about the environmental impacts of road vehicles can also be found at the following web-sites:

www.dft.gov.uk for information and documents published by the Department of Environment, Transport and the Regions

http://www.netcen.co.uk/ for details of the Government's air quality modelling and projections from the National Environmental Technology Centre

www.oced.org/cem/ for background papers on transport and environment published by the European Council of Ministers of Transport

www.rcep.org.uk for the Royal Commission on Environmental Protection

www.foresightvehicle.org.uk for the Foresight Vehicle Programme

http://europa.eu.int/comm/environment/ for the European Commission's Directorate General XI

www.met-office.gov.uk/research/hadleycentre/index.html for information on the Met Office's climate change research programme

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