

**CLIMATE CHANGE AND SUSTAINABLE TRANSPORT –*the challenge for  
transport professionals***

**THE INSTITUTION OF HIGHWAYS AND TRANSPORTATION  
TRANSPORT POLICY BOARD**

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## ACKNOWLEDGEMENTS

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## **FOREWORD**

For transportation professionals the increase in the demand for transport represents a major challenge at a time when society is beginning to acknowledge and come to terms with the global impact of 'climate change'. Consequently, with growing road usage and increasing congestion on the UK highway network already being seen as unsustainable, there is a clear opportunity for members of the Institution to take the lead in helping to deliver sustainable transport systems.

In this context it is also recognised that the promotion of sustainable transport systems and developments requires that we do things in a way that does not damage our environment for future generations.

Scientific evidence has clearly linked global warming with the increasing emission of greenhouse gases, with much of the increase in developed countries coming from transport. Because emissions from transport are increasing whilst emissions from other sectors are at constant or reducing levels, transport attracts much attention. This is of particular relevance for the UK where transport-related emissions represent about a quarter of the total produced.

IHT understands the importance of a high performing transport system to the economic prosperity of the UK, whilst also recognising that the demand for travel derives from complex interactions. Factors involved in this include economic issues, behaviour choices, and availability of travel options to meet the demand for travel to work, school, shopping and leisure, as well as the movement of goods and provision of services.

To address these issues and work towards mitigating the causes and impact of climate change, IHT has produced this report to help its members to achieve these objectives.

On behalf of the Institution, I am pleased to commend "*Climate Change and Sustainable Transport - the challenge for transport professionals*". I am sure it will make a worthwhile contribution to professional practice and assist all disciplines involved in the transport sector to address the consequential impacts of climate change.

David Tarrant, IHT President 2008 - 2009

## PREFACE

The UK Climate Change Programme (2006) sets out the Government policies to reduce carbon footprint and greenhouse gas emissions in six sectors: transport, agriculture, energy, business, domestic, and public sector.

The Climate Change Bill was introduced in Parliament on 14 November 2007 and completed its passage through the House of Lords on 31 March 2008.

The Committee Stage of the House of Commons was completed in July 2008.

The aim is to receive Royal Assent in Autumn 2008. The Bill will create a new approach to managing and responding to climate change in the UK through: setting ambitious targets, taking powers to help achieve them, strengthening the institutional framework, enhancing the UK's ability to adapt to the impact of climate change and establishing clear and regular accountability to the UK Parliament and devolved legislatures.

The Government announced on 18 February 2008 that a review of the target to reduce the UK's CO<sub>2</sub> emissions by at least 60% by 2050 will become a statutory duty under the Climate Change Bill and has provided details of the terms of reference for that review.

In considering the transport sector and to bring these issues to the attention of members, the Institution of Highways and Transportation Transport Policy Board has undertaken this assessment by identifying transportation issues that are considered to be affected by, or assessed to have an influence or direct impact on, a changing climate. Five themes have been identified, within which the transport issues are set out in separate chapters.

In each chapter, consideration is given to the issues within the wider sustainability discussion and either the action which is being developed to mitigate the impact affecting climate change directly or indirectly or, in the absence of such action, the promotion of a way forward which will help to achieve the objectives of the Climate Change Bill.

The five themes are as follows: -

- Managing Demand

- Changing Behaviour
- Accessibility and Social Equity
- Technology and Safety
- Administration and Finance

Chapters within each theme attempt to provide background knowledge and information on current initiatives, with ideas and recommendations to address sustainable transport and to assist all disciplines involved with the transport sector.

For the wider population and consumer there is a real need for an appreciation of the impact of climate change on everyday life and activities.

It is considered that for all transportation and associated professionals this need now provides a real challenge and an opportunity to take the initiative and facilitate such an appreciation.

This document has been prepared to help transport professionals meet that challenge and to support their mission to promote and achieve sustainable transport systems and practices, with the overall objectives being to assist in reducing the causes of climate change and to minimise its impact.

John Parry  
Chairman  
IHT Sustainable Transport Panel

## 1. INTRODUCTION AND CURRENT POSITION

### Introduction

For transportation professionals the increase in the demand for transport represents a major challenge at a time when society is beginning to assess the global impact of 'climate change'. Growing road usage, congestion and casualties from road collisions are already being seen as unsustainable.

Scientific evidence has clearly linked global warming with the increasing emission of greenhouse gases, with much of the increase in developed countries coming from transport. The Stern Review<sup>1</sup> confirmed that emissions have been, and continue to be driven by economic growth, yet stabilisation of greenhouse gas concentrations in the atmosphere is feasible and compatible with continued growth. The report concludes that with strong deliberate policy choices it is possible to 'decarbonise' developed and developing economies on the scale required for climate stabilisation while maintaining economic growth in both.

### 1.1 Sustainable Development and Transport

To reinforce the optimism in "Our Common Future", the World Commission on Environment and Development (Chairman Gro Harlem Brundtland)<sup>2</sup> stated that humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organisation on environmental resources and by the ability of the biosphere to absorb the effects of human activities.

But technology and social organisation can be both managed and improved to make way for a new era of economic growth. The Commission believed that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfil their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes.

Meeting essential needs requires not only a new era of economic growth for nations in which the majority are poor, but an assurance that those poor get their fair share of the resources required to sustain that growth. Such equity would be aided by political systems that secure effective citizen participation in decision-making and by greater democracy in international decision-making.



Sustainable global development requires that those who are more affluent adopt lifestyles within the planet's ecological means - in their use of energy, for example. Further, rapidly growing populations can increase the pressure on resources and slow any rise in living standards; thus sustainable development can only be pursued if population size and growth are in harmony with the changing productive potential of the ecosystem.

Yet in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. It can therefore be concluded that by definition sustainable transport is transport operating in a way that can go on being used for ever.

The process of moving towards sustainable development and sustainable transport is not easy, nor will it be straightforward; difficult choices will have to be made. Thus, in the final analysis, sustainable development must rest on political will.

## **Background**

At present, powered road transport is not sustainable, primarily because it is depleting a finite reserve of fossil fuel and emitting a rising amount of carbon dioxide and other gases, but also because of the number of casualties from road collisions, which are particularly large and rising rapidly in developing countries such as China, India and Brazil. Following the development of low-cost travel, which helped to generate the industrial revolution, there is a real need to address its environmental impacts such as noxious emissions and noise, encouraging unsustainable land development that causes extended journey patterns, and of course the casualties of road traffic.

## **Key Issues**

Sustainable transport is a phrase established in the late 20<sup>th</sup> century to describe primarily all forms of transport, which minimise emissions of carbon dioxide and pollutants.

As interest in the sustainability of the various modes of travel has grown, the issue has also become more complex. Cycling and walking remain demonstrably quite sustainable travel modes but they will not replace the mobility provided by the motor car.

An initial enthusiasm for biodiesel, electric and hybrid fuel sources has become tempered by an appreciation that even here there are sustainability issues, such as the impact of growing crops for biodiesel on world food markets. Further questions are raised over the unsustainability of some means of electricity generation, the environmental impact of manufacturing

vehicles and providing the roads on which they operate all of which add uncertainty to an otherwise commendable rush for these alternatives.

There is a growing understanding of these issues with an increasing certainty of how best we can still meet mankind's continuing appetite for mobility, while reducing the resultant impact on the world's irreplaceable resources.

To respond to these demands it is considered that the transition to an environmentally sustainable transport system involves a combination of technological and demand-side transport policies and practices. Regulatory, educational and economic instruments can be used to encourage the development of cleaner transport technologies as well as the shift from road-based towards more environmentally benign modes of transport.

To address the delivery of effective sustainable transport, including infrastructure and associated activities, this report will examine the key issues and risks in terms of environmental and economic impacts, including social equity.

## **1.2 Current Position - Greenhouse Gas Emissions**

The earth's climate is being changed by the emission into the atmosphere of a number of gases that alter the balance between heat reaching the earth from the sun and the radiation of heat from the earth into space. These gases are called 'greenhouse' gases because they increase the extent to which the atmosphere acts as a greenhouse, trapping heat.

The atmosphere has always acted as a greenhouse, and makes life possible by raising the temperature of the earth's surface about 33°C from the -18°C it would average without the atmosphere. The most important of the natural greenhouse gases is water vapour. Others are carbon dioxide, methane and nitrous oxide. As a result of man's activities, additional carbon dioxide, methane and nitrous oxide are being emitted, plus a number of industrial gases such as the CFCs. All of these are greenhouse gases.

The average temperature of the earth has been rising for at least the past century, though with a period of cooling in the 1960s and 1970s. Figure 1 shows the average annual temperatures for Central England since 1664 and for the whole world since 1861 (Hadley Centre for Climate Prediction and Research).

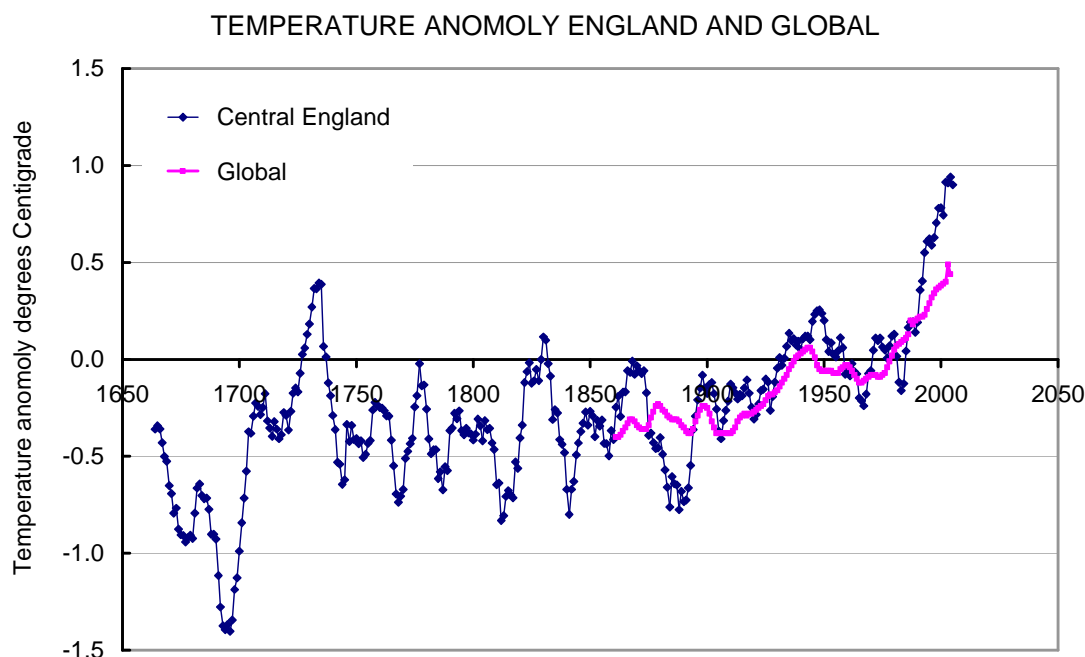


Figure 1  
 Average annual temperatures in Central England and globally

The inventory of greenhouse gases emitted as a result of man's activities in the UK consists of 84% carbon dioxide (CO<sub>2</sub>), 8% methane and 6% nitrous oxide. The remainder of this chapter will concentrate on the emission of carbon dioxide.

#### Greenhouse Warming Potential (GWP) for UK Emissions of Greenhouse Gases in 2004

Direct GHG	Emissions (kt) in 2004	GWP (100 years)	Global Warming Equivalence (equivalent kt of CO <sub>2</sub> )
CO <sub>2</sub> (as carbon) <sup>1</sup>	153,601	3.7	568,322
CH <sub>4</sub>	2469	21	51,857
N <sub>2</sub> O	132	310	40,794
HFCs <sup>2</sup>	5.4	140 - 11,700	8,867
PFCs <sup>2</sup>	0.05	6,500 - 9,200	352
SF <sub>6</sub>	0.05	23,900	1,127

<sup>1</sup> The emissions given here are on a United Nations Economic Commission for Europe (UNECE) basis and do not include emissions due to land-use change

<sup>2</sup> A range of GWPs are used as this refers to a group of compounds.

Source: UK Emissions of Air Pollutants 1970 to 2004  
 UK Emissions Inventory Team, AEA Energy & Environment

## Carbon Dioxide in the Atmosphere

As a result of man's activities, the concentration of carbon dioxide in the atmosphere has risen from around 280 ppm (parts per million) in pre-industrial times to 383 ppm in 2007, and is currently rising at about 2 - 3 ppm per year. Carbon dioxide emissions are rising in most countries and in the world as a whole<sup>3</sup> (Figures 2a and 2b).

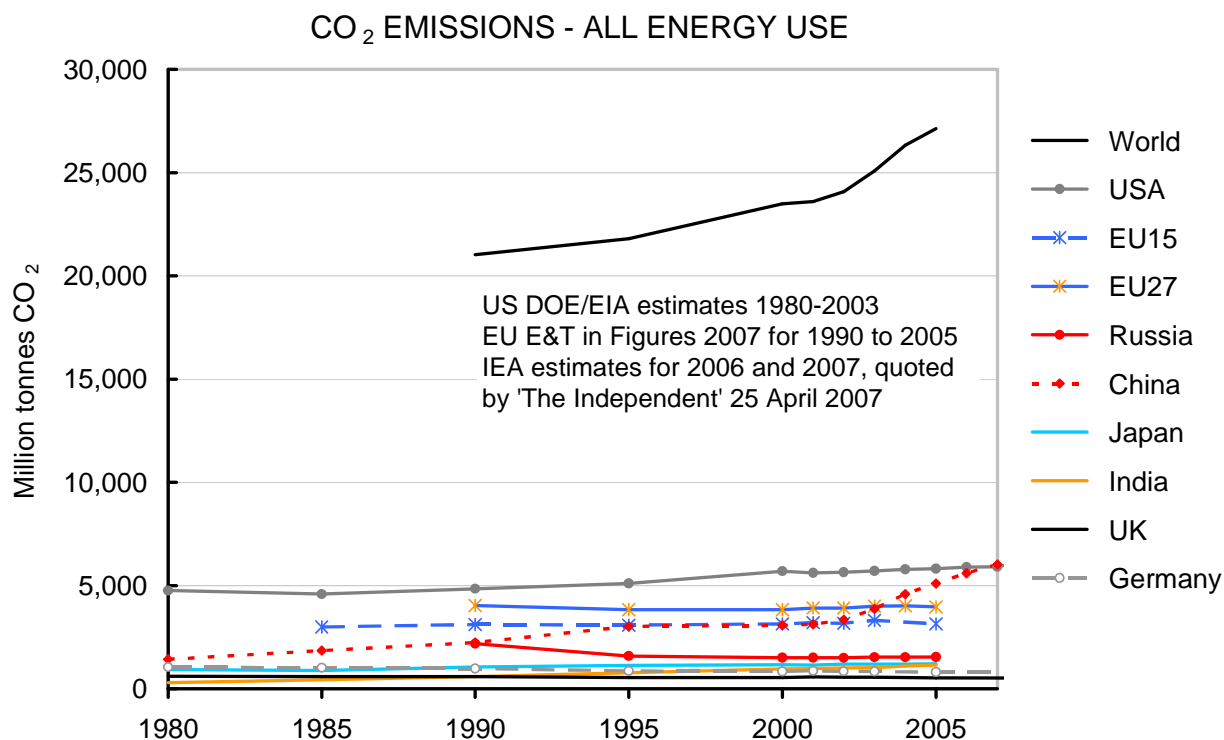


Figure 2a Carbon dioxide emissions from energy use – World, E.U., and selected large countries

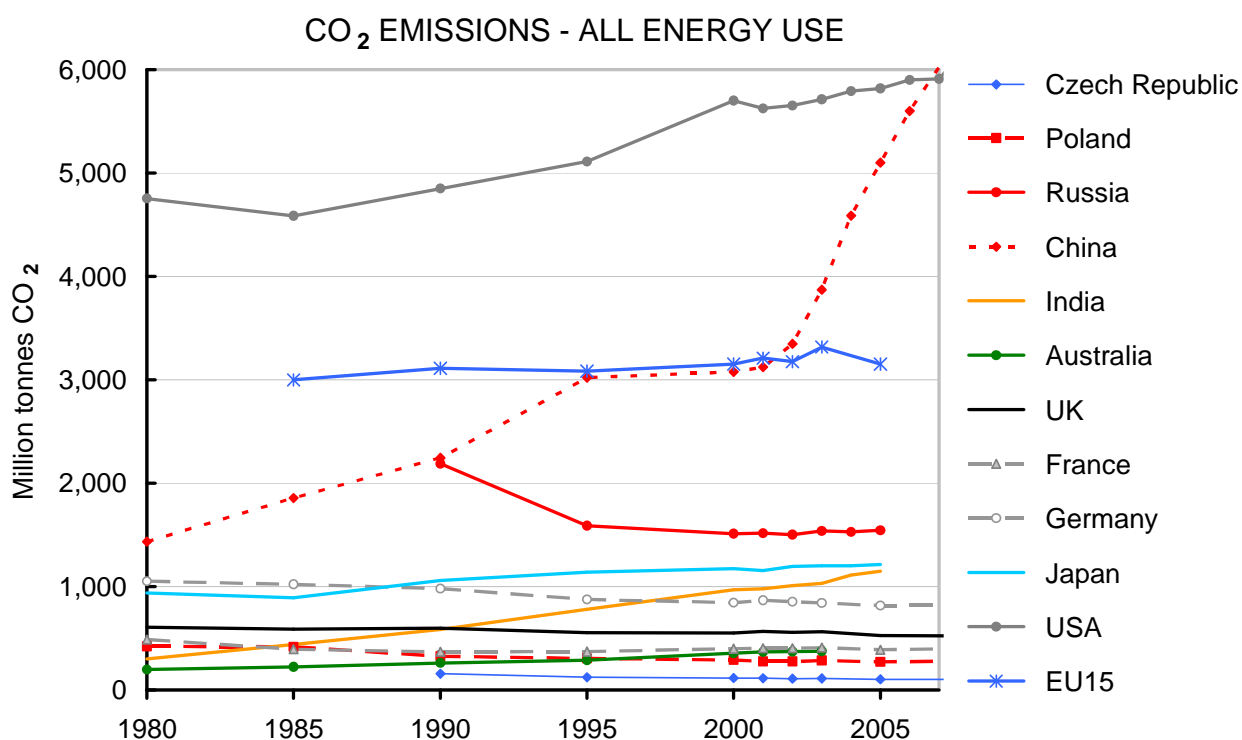


Figure 2b Carbon dioxide emissions from energy use – E.U. and selected countries

The Intergovernmental Panel on Climate Change (IPCC) considers that it would be wise to avoid the concentration of carbon dioxide and other greenhouse gases exceeding about 550 ppm CO<sub>2</sub> equivalent, and many scientists recommend a lower safe limit of 450 ppm CO<sub>2</sub> equivalent. This is to limit the anthropomorphic temperature rise to about 2°C. To achieve this limit, the worldwide emission of carbon dioxide needs to be reduced by at least 60% from current levels<sup>3</sup>. This will require changes in the ways that almost all the activities of the developed countries are performed.

If rising prosperity in the developing world means that the emission of carbon dioxide per person becomes more equal between developed and developing countries, then the reduction in CO<sub>2</sub> emissions in the UK, and other developed countries, will need to be *much more* than 60%.

The Climate Change Act 2008, enacted on 26 November, sets the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline. The Committee on Climate Change published its first annual report on 1 December 2008, in which it recommends intermediate targets for the periods 2008 - 2012, 2013 - 2017, and 2018 - 2022. It also suggests that deep emissions cuts in road transport can be achieved through improved fuel efficiency of new cars and vans in the first three budget periods.

## UK Emission of Carbon Dioxide

The total UK emission of carbon dioxide in 2004 was 153.6 million tonnes of carbon (563.2 million tonnes of CO<sub>2</sub>). Of this, 35.2 million tonnes (22.9%) was from all domestic transport, of which 32.7 million tonnes (21.3%) was from all road transport and 19.1 million tonnes (12.4%) from cars<sup>3</sup> (Figure 3). The biggest single domestic source is public electricity and heat production, at 56.8 million tonnes, with residential heating and manufacturing industry almost equal at about 23 million tonnes each. However, emissions from transport are increasing, while emissions from all other sectors are reducing or steady, which is why transport attracts so much attention from policy-makers and environmentalists.

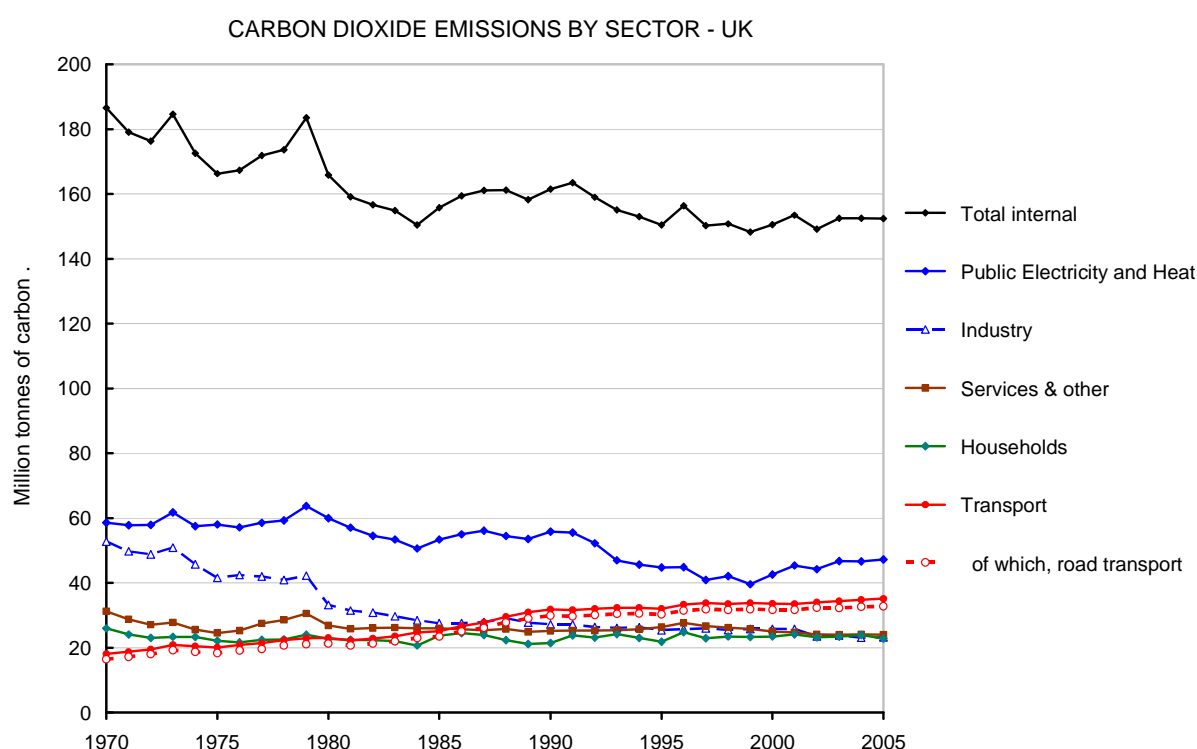


Figure 3 Carbon dioxide emissions by sector – United Kingdom

Emissions from international aviation and international shipping do not count as part of the UK emissions total, but in 2005 the quantities involved were 9.5 million tonnes from aviation and 1.6 million tonnes from shipping. Thus emissions from international aviation departing or arriving in the UK are about 6% of total UK emissions (but additional to that total).

As can be seen from Figure 4, total emissions from car traffic have not increased significantly since the early 1990s, and by 2005 were falling slightly. This shows that the fuel efficiency of the car fleet is improving as rapidly as traffic is growing. Emissions from goods vehicles, both light and heavy, are growing.

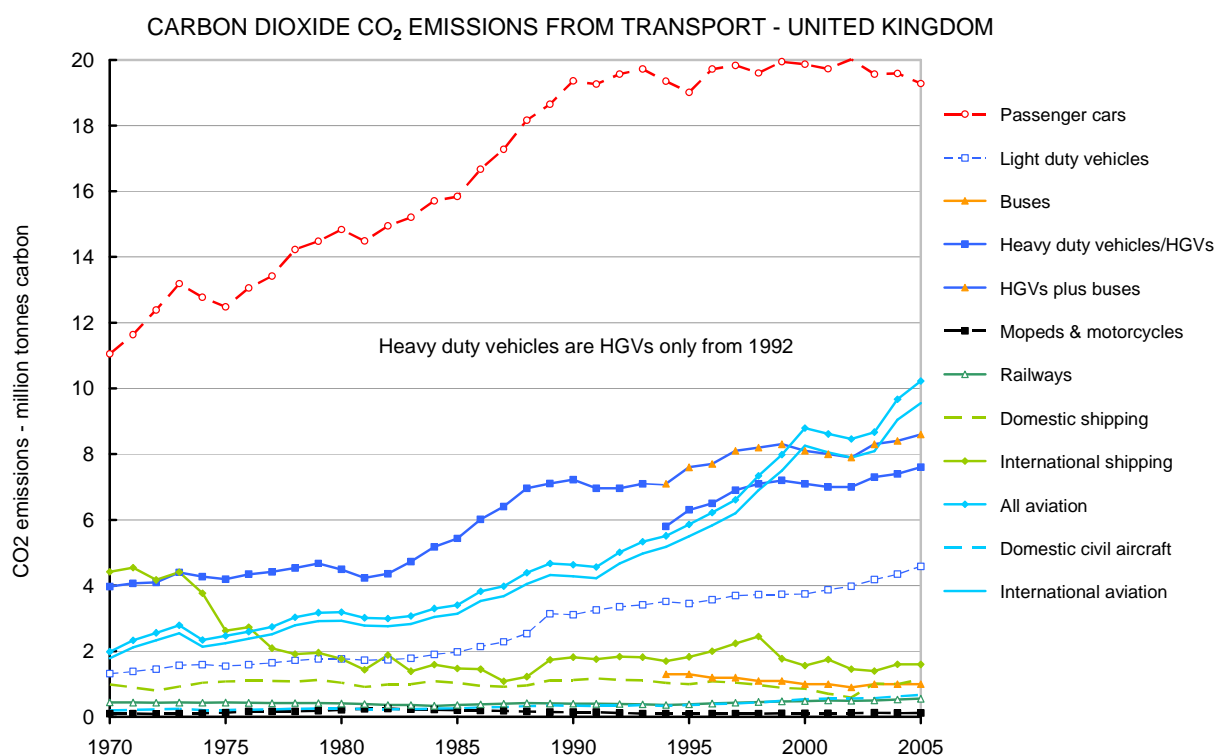


Figure 4 Carbon dioxide emissions from transport – United Kingdom

Emissions from the car fleet could be much less, if cars were smaller and more fuel efficient. Fuel consumption increases very approximately with engine capacity and vehicle weight. This, and the implications of moving to alternative fuels, is considered in more detail later in the paper in the chapters in Technology.

## Conclusions

Emission of anthropomorphic greenhouse gases has raised the concentration of carbon dioxide in the atmosphere from around 280 ppm before the industrial revolution to 383 ppm in 2007. In the last century the global average temperature has increased by about 0.9°C and the average temperature in central England by about 1.4°C (Fig 1). Emission of carbon dioxide is rising in many countries, though in EU27 it is falling.

In United Kingdom, production of public electricity and heat is responsible for 31% of total emissions of CO<sub>2</sub>; all transport produces 23% of emissions, and car traffic 12.7% in 2005. Industry, households and services each produce about 15% of total emissions.

Emission of carbon dioxide from all car traffic was almost constant between 1993 and 2003, and is now falling. This implies that the fuel economy of the average car in service is improving faster than traffic is growing. Carbon dioxide emissions from road traffic are growing, but this growth is due to growing emissions from freight transport.

## References

- 1 "Stern Review: The Economics of Climate Change", Sir Nicholas Stern, HM Treasury, 2006.
- 2 Report of the World Commission on Environment and Development (Chairman Gro Harlem Brundtland), "Our Common Future", Oxford University Press, Oxford, 1987
- 3 "THE HOT TOPIC: How to tackle global warming and still keep the lights on", Gabrielle Walker and Sir David King, Bloomsbury 2008, ISBN 978-0-7475-9395-9
4. Building a low-carbon economy - the UK's contribution to tackling climate change. The first report of the Committee on Climate Change, TSO, London, 2008.



## 2. MANAGING DEMAND

### General Introduction

Growing demand for travel threatens to cause unsustainable requirements for energy and for the capacity of transport systems, resulting in unsustainable emissions, congestion and casualties from transport collisions. Some of these consequences can be mitigated by improvements to technology but, to achieve a sustainable situation, it is inevitable that steps to manage and limit demand for travel will have to be taken.

Demand for travel can be managed by measures that persuade people not to travel, or to travel at times and in ways that are sustainable. These are called 'soft' measures, and in order to be successful require the options that they are persuading people to adopt to be convenient, easy to use and affordable. In addition, and more usual at present, are so-called 'hard' measures, that deter or prevent people from travelling at times or in ways that are not sustainable.

The great majority of journeys are made to access an activity, product or service, not for the pleasure of travelling for its own sake. Therefore the need to travel is generated by the activities, products and services that people require, and by their locations relative to each other. Land-use planning is fundamental to the generation of demand for travel, and sustainable transport will require land-use patterns, and the provision of transport options, that allow people and goods to move in sustainable ways.

The reasons that people travel and goods are moved can be classified into a small number of general headings. For people, the main purposes of travel can be expressed as the average number of trips per year per person for various activities, and the average distance a person travels (Table 1). The figures are averages for the whole population, and should be read in the context of the percentage of people who go to work, go to school, and participate in the other activities listed.

Commuting only accounts for 15% of all journeys and 19.5% of the total distance travelled. The activity that generates most travel is visiting friends, at 20% of total mileage, with shopping and leisure activities each generating 13% of the miles travelled. The travel generated by commuting has fallen slightly over the past decade.

Of course, commuting and education trips happen at peak times and contribute disproportionately to congestion and to demands for increased capacity for transport systems.

**TABLE 1 Travel per person per year by purpose – Great Britain 2006**

Journey purpose	Trips per year	Distance per year, miles	Average trip length, miles
To/from work	160	1,391	8.7
In course of work	35	682	19.4
To/from shopping	219	926	4.2
Personal business	105	488	4.6
Education	62	205	3.3
Escort	141	588	4.2
Visiting friends	168	1,414	8.4
Leisure and sport	137	914	6.7
Holiday	11		

	525
	47.7
All purposes	
	1,037
	7,133
	6.9
Source:	National Travel Survey 2006

This chapter considers approaches to strategic planning for sustainable development. This includes planning policy for urban and rural developments, design of residential areas and the locations of activities, and responses to population growth. Demand for the movement of goods is considered later.

A key element of sustainable developments is access to consumer goods and services. Shopping accounts for around 20% of all trips made in Britain. Shopping is changing, with the development of out-of-town retail centres over the past forty years and the current growth of on-line shopping. At the same time globalisation has increased the viability of supermarkets providing 'out of season' goods throughout the year and, more generally, an increasing percentage of consumer goods are imported. All these trends affect travel for shopping by consumers and the movement of goods.

The chapter considers how transport can either take a reactive role in responding to the consumer demands for goods and services, or work more proactively with the retail sector to influence future patterns, including the need for a proper evaluation of the impacts of making food products available out of 'local' season.

The final section of this chapter considers the efficiency of freight transportation in terms of fuel use and operation. The cost of fuel is a very significant part of the cost of freight operations, so anything that can be done at a reasonable price to reduce the amount of fuel used will be done for commercial reasons. On the other hand, transport costs are a small part of the costs of the manufacture and retailing of goods, so an efficient distribution system is a higher priority than minimising the cost of transporting goods. This

may militate against making changes to manufacturing, distribution and retailing arrangements, to reduce vehicle kilometres and fuel used by goods vehicles.

## **2.1 Planning Polices, Residential Standards and Strategic Assessment of Infrastructure and Resource Needs**

### **Introduction**

As a densely populated country, transport planning and land-use planning are inextricably linked. In fact, it could be argued they are the same thing. In simple terms, everyone needs a home, many people need a job, some need access to education, and all need access to shopping, health services, friends and leisure activities. Planning the best locations and layouts of residential developments and the activities that people need to access has to recognise and assess the availability and affordability of transport choices, both those existing and those that could be secured as part of the development process. Travel to work and school has particular impacts on peak travel flows, so that once these two primary drivers are established, services such as health, retail and leisure provision can follow.

Considering how the availability and affordability of transport can be improved in the context of existing and emerging planning frameworks is a challenge to both the land-use and transport planning professions. Wider fuel and environmental factors will undoubtedly colour this picture increasingly over the coming decades, and it is necessary to be open, responsive and innovative to ensure that UK Plc continues to compete in an increasingly global economy. Professionals are continually seeking to resolve the problems caused by planning mistakes made over the previous 30 years or so and attempting to avoid the repetition of such mistakes.

### **Availability**

Historically, concentrations of people, markets and services converged organically around our early towns and cities. The need for local transport improvements was self-evident, and generally driven without Government intervention. Following the turnpike operators and the canal builders, the Victorian railway companies developed major strategic inter-urban transport networks and many of their investment decisions continue to have very real impacts upon the competitiveness of our towns and cities today.

There are signs that the way in which competition has been introduced to travel modes over the past 20 years is being reconsidered. The Rail Regulator is struggling to ensure that acceptable standards of customer satisfaction are being achieved on the rail network. Outside London the efforts of the major bus operators to achieve high levels of customer satisfaction and to arrest the underlying decline in bus use would appear to have failed in many areas, although there are examples of success in cities such as Cambridge, Brighton

Nottingham and Reading, where quality services have led to increased patronage.

Many of our transport networks and services are still currently operated as commercial activities. Although the safety net of tendered bus services represents a significant proportion of registered mileage, the bus super groups have delivered many more miles of services operated than pre-1985, albeit not with the levels of patronage growth the Government of the day might have desired.

Recent growth in bus patronage as a result of the introduction of free travel for older people masks the decline of fare-paying passengers. This is creating major funding issues for local authorities with an accelerating decline in funds available for supporting uneconomic but socially desirable bus services. Discussions continue as to whether increased control of bus services by local authorities will increase the attractiveness of bus travel.

The role of the Traffic Commissioners is also under review for their part in the operation of the country's bus networks. There is little doubt that increased bus services offer the potential for a highly cost-effective and significant instrument of modal shift away from private car use.

A constrained national rail market mechanism has delivered some benefits alongside some difficulties such as overcrowding and spiralling unregulated fares.

Market factors have not played a full part in road network provision, although cost-benefit analysis seeks to test the financial value of road investments, and schemes such as the M6 Toll and some bridges provide tentative models which could be applied on a wider basis, maybe alongside new congestion charging schemes.

However, these transport networks and services are only one part of a two-sided situation. To what extent have developers of housing, employment sites, schools, health, retail and leisure sites over the last 20 years contributed to providing, supporting and sustaining transport services?

Certainly Section 106 Contributions have delivered many local enhancements (usually highway improvements) directly attributable to a relevant development. In areas where development pressures are strongest or political governance is straightforward (London) the negotiation process can secure wider, more innovative, prizes. The challenge of achieving sustainable transport infrastructure for cyclists and pedestrians and complementary pump-priming bus services with revenue funding or capital support through vehicle purchase and subsequent contract price suppression can be met, but only with persistence and a reasonably responsive developer.

Differences over priorities can occur in two-tier authority areas or in the former Metropolitan areas where Passenger Transport Authorities might have different objectives (or political control) to those of the planning authorities.

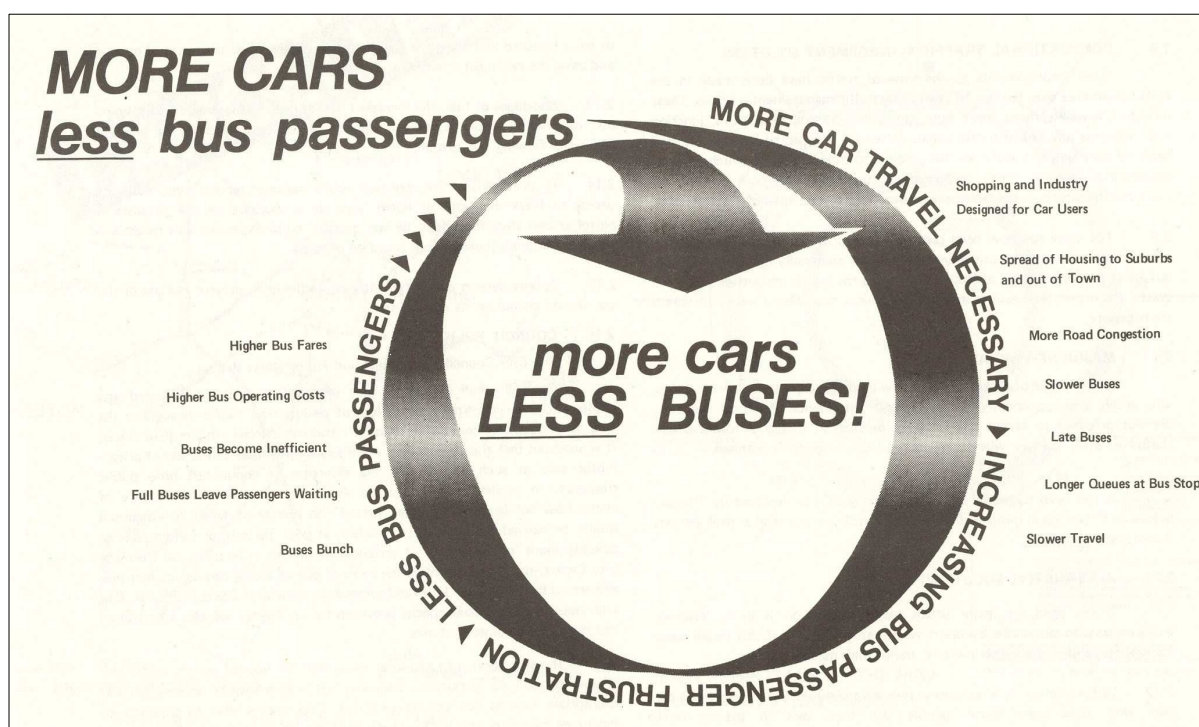
Debates over the appropriate structure of local governance as prompted by the Sub-National Review and the Transport Bill are covered in the theme Administration and Finance. However, resolution of some of these conflicting priorities should not be shelved, particularly in the context of emerging new mechanisms and policies of the Government, set out further below.

## Affordability

The sustained economic growth of the last ten years or so has been enjoyed in the context of low but volatile and highly-taxed fuel prices. The cost of travel by car has remained constant up to 2008, while the costs of bus and rail travel have increased. On these trends, assuming car use is unconstrained, public transport will remain an option of last choice.

But, despite the abandoning of the fuel duty escalator, car use is not unconstrained. Whilst national politicians may be uncomfortable with admitting to policies which discourage the use of the car, local government applies a variety of measures such as reducing the number of parking places, charging for parking and, in London and Durham, road pricing.

Where car use is constrained, public transport not only survives, but also thrives. Back in the heady days of the 1970s, this was understood. The vicious circle of public transport decline set out in Nottingham's 'Zone and Collar' Prospectus remains as true today as it was then.



National Planning Guidance dictates how local authorities should balance development pressures, consider the transport implications of developments

and set the level of parking provision, but to some people (including some planners) it is still a black art, summarised in four highly simplified steps as shown in the box.

### **How does Residential Planning Work?**

#### **Step 1**

A 'black box' demographic formula, driven by population trends and projections and balanced with the demands for homes as evidenced by household formation and house prices, is employed by Government statisticians and associated advisors to come up with national housing targets.

#### **Step 2**

These numbers are disaggregated to the Regional Planning Bodies (currently the Regional Assemblies, from 2010 the Regional Development Agencies) who through extensive negotiations between constituent planning authorities come up with a proposed level and distribution of housing across the respective local authority areas. This proposed distribution is tested at:

#### **Stage 3**

A Public Examination where authorities, agencies and interest groups can all have their say in whether the housing numbers are correctly identified and allocated. It is at this stage the extent and robustness of supporting plans and programmes for transport infrastructure, foul drainage, waste, energy and education can in theory be tested. The report of the Examination Panel is then passed to the Government who come up with a final distribution of housing numbers, which is then apportioned to District levels or Unitary Councils in the form of of Statutory Planning Guidance.

#### **Stage 4**

Local Planning authorities then allocate sufficient sites within their Local Development Frameworks to accommodate the required housing numbers. New Guidance requires that authorities without a defensible five-year supply of available land with housing allocations will face difficulties resisting speculative residential development proposals in the planning appeal system.

In assessing the four stages Step 3 is an interesting one. In theory, existing or proposed road, rail and public transport investment schemes should be assessed to determine how the travel demands caused by developments could be served or supported.

In reality, the uncertainties over transport scheme delivery beyond the approved 3-year Regional Funding Allocation (RFA) mean that decisions need to be based on many assumptions and assertions rather than firm commitments, particularly in the case of rail initiatives.

Major schemes within Local Transport Plans are becoming costlier to design and develop, and less likely to gain approval within constrained RFA Budgets. If they do get approved, councils now need to find local financial contributions towards the schemes, in the context of decreasing available budgets and increasing budget pressures.

The Highways Agency (HA), is also in an invidious position; new schemes are now required to secure endorsement via the RFA process, overcoming the twin obstacles of local authority self-interest promoting their own schemes, and the inadequacy of the regionally devolved RFA Budgets to handle the scale and cost of traditional HA projects.

Step 4 is proving a real problem, not yet fully recognised by the Government. The new planning process is very prescriptive, and much more prone to legal challenge and delay than the previous one. It requires the ability to coordinate a vast range of spatial plans and programmes of agencies, most of which are at very different stages in their approval cycles. Developers are becoming increasingly frustrated by the lack of adopted planning documents to guide the development process.

### **A Brave New World?**

Times however are changing, and fast. The Government has responded to the increasing price pressures in the housing market with a raft of new policy initiatives. The Housing Green Paper sets new, more ambitious, housing delivery targets. More houses, more quickly. Local authorities stand the chance of losing planning appeals for residential schemes if they fail to demonstrate a robust and available five-year supply of land. The Government's main tool for managing planning performance, the Planning Delivery Grant, has to date been applied to encourage authorities to determine applications within the 8 week Best Value Performance Indicator, (BVPI) target. It is now to become the Housing Planning and Delivery Grant, focused instead on housing delivery.

The Sub-National Review on Economic Development trails an aspiration for devolution of funding via the Regional Development Agencies, with more effective local scrutiny. Bringing transport into Local Area Agreements (LAA) in theory means more local control over allocation of funding, with fewer national targets to constrain local decision-making. The abandonment of Planning Gain Supplement and development of a new form of the Development Charge tariff system will offer a potentially huge boost to support housing delivery. The Treasury and Department for Communities and Local Government (DCLG) are reviewing the implications of these changes.



The Comprehensive Spending Review, (CSR), 2007 was not as bad for transport as some predicted, but there is still incentive for local politicians to hold their nerve on Congestion Charging, which could unlock significant new funding for transport via the Transport Innovation Fund, (TIF), (and more importantly the borrowing that the revenues from potential schemes will deliver?). TIF can provide revenue as well as capital funding, and potential could overcome the problem of local authorities unable to provide schemes that require revenue support.

But perhaps the most immediate, biggest wave of change about to flow over and through the development process could be the Growth Point Programme<sup>1</sup>. To date there are already significant numbers of authorities across England who have 'volunteered' to become Growth Points and more are due to follow: they will take responsibility for delivering more houses, more quickly. They aspire to access new Government Growth Point funding, and gain priority access to existing programmes, including the next RFA round.

The new concept of 'Eco-towns' is also generating a very heated debate, with vocal concerns being expressed about large-scale new settlements being encouraged 'outside' the planning process. There is scepticism about whether the Government's expectations of high environmental standards and challenging modal split targets will prove deliverable, particularly in the current uncertain housing market conditions.

Many of the substantial sites proposed for eco-towns and those emerging within many Growth Point programmes have no formal planning status, yet do have real significance for existing and developing transport programmes not least those of the Highways Agency. Many of the sites advanced will be highly profitable urban extensions on land released from Green Belts across the country.

Developers holding options on such sites are already lining up applications and courting the HA and local authorities with offers of substantial inducements to support this new wave of suburban expansion. And herein lies a very real and present danger.

## **A New Residential Standard**

Planning of previous waves of suburban development has not proven to be without its mistakes. Large estates on the urban edge, designed around cars rather than people, with low densities, high levels of parking provision and dispersed or disconnected services have proved to be attractive to affluent, middle-class, and 2/3 car owning families, largely at the expense of higher density inner city areas.

Declining levels of bus patronage, cycling and walking reflect the lack of an integrated approach, and patterns of social exclusion have been compounded and exacerbated by much of the housing development built in the 1970s, 80s and 90s. In the 1950s and 60s, attempts at higher density urban development

failed at an even more basic level with catastrophic social breakdown and riots in some inner cities.

Regeneration and reuse of Brownfield land is disadvantaged by high levels of reclamation costs and/or the land assembly challenges of multiple ownership, as opposed to the convenience of open green field sites, easily accessed and often easily obtained with one or two simple transactions. Developers have tried to rebalance returns in the inner cities with high numbers of single- and two-bedroomed flats, often driven by 'off-plan' investment funding. Yet the patterns of occupancy of such developments often do not seem to be able to deliver the balanced, sustainable mixed communities sought by local authorities.

'Affordable Housing' quotas can be desirable objectives but can sometimes play against balanced community objectives. In deprived inner city areas the planning system may well aspire to deliver less affordable homes to regenerate the area.

The current situation presents a dichotomy in that the incentives provided by the Government to deliver more houses will be very strong and powerful, and local authorities will be chasing these incentives keenly. Those that succeed in the short term may in the long run regret hasty decisions unless the development conceived and delivered is of an appropriate quality, and this is the real challenge facing land-use and transport planners.

For the proposed development of eco-towns, such challenges will be particularly relevant for the design of street networks and the strategic opportunity in influencing travel behaviour through the provision of smarter travel choices. However, growth is not just about urban expansion. There is a need to transform existing neighbourhoods within cities and towns, shaping places in ways which attract and retain families as well as the single-person households encouraged by the current 'black box' formula.

In terms of design we have a once-in-a-generation opportunity afforded by Manual for Streets<sup>2</sup> and Guidance on Transport Assessment (GTA)<sup>3</sup>, with the new Government emphasis on design quality and place shaping. Exemplars are emerging but they are far from the norm.

## **Conclusions on Planning Issues**

The new economic drivers are considered, in the medium term, likely to work with, rather than against, integrated transport where it can serve new developments. Sustaining integrated urban and suburban living patterns will become even more of a priority as fuel prices increase.

Reducing the need to travel will not be just an environmentalist objective, but it will become one necessitated by daily and weekly household budgeting. It will play an increasing role in choices about where to buy a house or where to seek work.

If this is recognised as we pursue the Government's new agenda for growth, will we prove capable of delivering new residential standards of which we can be proud in 30 years time, rather than yet another failed attempt at intervention?

## References

- <sup>1</sup> "Partnership for Growth", Ministerial Announcement, Department for Communities and Local Government, June 2006
- <sup>2</sup> "Manual for Streets" (MfS), Department for Transport, March 2007. This supersedes 'Design Bulletin 32', and its companion guide, 'Places, Streets and Movement' which have now been withdrawn in England and Wales
- <sup>3</sup> "Guidance on Transport Assessment (GTA)", Department for Transport, March 2007. The guide is for England only and should be read in the context of relevant Government policies

## Issues and Recommendations

- In areas where development pressures are strongest, the negotiation process through Section 106 Contributions can secure wider sustainable transport infrastructure for cyclists, pedestrians and complementary pump priming for bus service enhancements.
- Local Planning Authorities can benefit from a defensible five-year supply of land as part of their Development Framework in order to avoid speculative residential development pressures in the planning appeal system
- Many of the substantial sites, emerging within many Growth Point Programmes, have no formal planning status. However, they do have real significance for existing and developing transport programmes, especially those of the Highways Agency. Moreover, integrated transport provisions should be used by transportation and planning professionals for the planning and design of new housing estates (many of which will be suburban extensions). This can be achieved by adopting the principles of the DfT's Manual for Streets and Guidance on Transport Assessment (GTA).

## 2.2 Measures for Managing Travel Demand

### Introduction

Demand for travel can be affected by measures that rely on persuasion and by measures that deter travel in a variety of ways. The effect of so-called 'soft' measures is reviewed in the next chapter "Changing Behaviour". The conclusion is that, provided attractive alternatives to the car are available, soft measures can be more effective than is appreciated by most transport planners.

### Hard and Soft Measures

'Hard' measures depend on making car use less attractive at times or in places where good alternatives exist. Measures frequently employed are:

- Reducing the number of parking spaces in city centres;
- Increasing the cost of parking;
- Transferring road space to bus lanes;
- Providing direct bus routes with priority lanes while forcing cars to take tortuous routes;
- Closing residential roads to block through routes;
- Creating pedestrian or no-car areas; and
- Road pricing or congestion charging.

Measures such as those listed above should be combined with improved provision of public transport, park and ride schemes, additional parking to serve railway stations and tram stops, car clubs, cycle lanes and cycle parks and improved conditions for pedestrians. Many schemes in continental Europe provide excellent examples of packages of measures that have achieved transfer from car to public transport, cycle or walking.

'Soft' measures are reviewed in detail in the next chapter, "Changing Behaviour". These include:

- Workplace travel planning;
- School travel planning;
- Personalised travel planning;
- Public transport information and marketing;
- Car clubs and car sharing; and
- Teleworking, teleconferencing and home shopping.

Studies show that workplace travel plans typically reduce commuter car driving by between 10% and 30%, school travel plans cut school run car traffic by between 8% and 15%, and personalised travel planning achieve

reductions in car use of 7% -15% in urban areas and 2% - 6% in rural and smaller urban areas.

## 2.3 The Retail Sector and Transportation

### Introduction

Shopping accounts for around 20% of all trips made in Britain. In 2006, the Commission for Integrated Transport, (CfIT) produced a report "Sustainable Transport Choices and the Retail Sector"<sup>1</sup>. The aims of this research can be summarised as:

- To assess the nature of the relationship between mode of travel and retail spending in various retail sectors;
- To compare patterns of expenditure and mode of travel between different retail sites at town centre, edge-of-centre and out-of-town sites;
- To establish spending levels among those who travel by car compared to those who travel by bus, taking account of income levels;
- To identify the effect of local transport policy on shopping locations; and
- To establish the main transport priorities of shoppers in various locations.

The study examined spending patterns in various types of shop, at various types of location, by customers who travelled in various ways. In general, public transport users are slightly more likely to spend over £10 per visit than private transport users in the city centre, but unsurprisingly spend less at less convenient locations and in general are still less likely than private transport users to spend over £30. Those who walk and cycle are likely to spend less than car users in any location. In general, however, the differences are modest and do not suggest that the contribution of public transport users to the local economy on an individual basis is of a different order of magnitude to that of private transport users.

Public transport users are both more dependent on town centres and also more likely to spend more of their income there. Trips to supermarkets are dominated by car usage, as much because of the limited alternatives as by the need to have a car in order to convey shopping. Overall, the average public transport user contributes more to the local economy in the shape of local convenience stores and town centre stores whereas private transport users are more likely to patronise supermarkets and out-of-town locations. The availability of public transport services to the former and free parking at the latter mean that this is not an unexpected outcome.

In a study of six cities, car users spent more per trip than public transport users, but the difference was on average no more than 20%. Public transport

users do, however, make slightly more shopping trips, and are more likely to make their purchases in their local shops and city centres.

Parking is the main policy issue of concern to the retail sector. The cost of parking in the city centre is considered to be a threat, yet the provision of Park & Ride is viewed positively although its implementation can be problematic<sup>1</sup>. The one residual concern with Park & Ride is that it is less attractive for those with heavy goods. Home delivery services overcome some of these concerns, but availability is not universal.

*“People are willing to drive further if they are getting cheaper or free car parking like to Portslade or Lewes. People will also have day-trips to Bluewater because it has the same shops and is undercover.”*

*“I have lost customers because there’s not enough car parking outside the shop...customers can’t stay and look because their [parking] tickets will run out.”*

Some larger retailers seemed more aware of the benefits that sustainable transport policies bring to both the city and the retail sector, for example, by putting in measures that reduce traffic and that are beneficial to the environment. Congestion on the highway network is also a concern but appears to be considered as less of a determinant on choice of destination than the problems of parking. Public transport was recognised as being beneficial, notably in Nottingham and Brighton where a step change in service quality has been recently achieved.

## **Retail Shopping Trends**

Over the past decade, the average number of shopping trips per person per year has declined from 237 to 219, and the distance travelled has fluctuated between 879 and 963 miles. The average trip length has fluctuated between 3.9 and 4.4 miles, but the percentage of shopping journeys that are by car has risen from 54% to 62%. Journeys on foot for shopping have reduced from 33% to 25% of all shopping trips<sup>2</sup>.

The impact of on-line shopping also looks set to continue, changing transport demands, particularly the increase in ‘white van’ movements.

Annex A2.3, “Retail Sector Impact on Transport”, considers in more detail how transport can either take a reactive role in responding to these demands, or work more proactively with the retail sector to influence future patterns. This includes the need for a proper evaluation of the ability to receive food products out of ‘local’ season against the global environment health and influence on climate change.

## Conclusions

Retail activity has changed over the past 20 years and retailers are continuing to adapt to the changing demands of consumers as technology advances, lifestyles change and as local and national government policies are changed and introduced.

Key drivers for successful retailing are accessibility and consumer choice. Transport therefore plays a significant role either directly or indirectly in the future success of retailing in the UK and policies should reflect this.

The cost of parking is a significant issue, and local authorities have an unenviable balancing act to perform. Parking charges levied to deter all-day parking for employment can improve journey reliability and reduce journey times for public transport, but equally could deter retail customers. The availability of free parking at out-of-town locations and the reliance on the private car to access them are significant factors that show little sign of change.

Current trends suggest that e-shopping will become increasingly popular over the coming years, and while this may not reduce the number of trips to be made, it may change the type of trips that are made, with greater numbers of home deliveries.

Transport is only one element that influences decisions to undertake some or all production in non-local locations. It may be argued that if the public was prepared to pay the higher costs associated with more local production, or only consume goods in season, transport emissions could be reduced. The downsides to this approach may be loss of choice and the impact on developing countries whose economies depend on such business.

Overall, retail patterns have, do and will change to adapt to consumer demands. It is necessary therefore to adopt policies that can adapt and cater for changing demand, or adversely, adopt policies which will push, and shape where future demand is desired by authorities.

## References

- <sup>1</sup> "Sustainable Transport Choices and the Retail Sector", Commission for Integrated Transport, 2006
- <sup>2</sup> "Future of Retail Transport: Access, Information and Flexibility", British Council of Shopping Centres, 2006
- <sup>3</sup> "Motoring Towards 2050, Shopping and Transport Policy", RAC Foundation, 2006
- <sup>4</sup> "The Validity of Food Miles as an Indicator of Sustainable Development", Report for Defra by AEA Technology, July 2005

- 5 “The Sustainability of Food Transportation and Production, (food miles)”, Foodaware; the Consumers’ Food Group, Jan 2007, <http://www.foodaware.org.uk/index.htm> - accessed July 2008
- 6 “A Recipe for Change”, Greenpeace, October 2006, <http://www.greenpeace.org.uk/media/reports/a-recipe-for-change> - accessed September 2008

## **Issues and Recommendations**

- In the UK, agriculture and food accounts for nearly 30% of goods transported by road and food miles rose by 15% between 1992 and 2002. In 2002, food transport accounted for 25% of all HGV vehicle kilometres in the UK. Of imported produce, 95% of the fruit and 50% of the vegetables sold in the UK is grown abroad and the amount of food being flown into the UK doubled in the 1990s. The direct environmental, social and economic costs of food transport are over £9 billion each year and are dominated by congestion.
- In addition to the reliance factor of UK imported produce, it would be an advantage if Governments would also address the wider implications of the above facts, in terms of the unsustainable transportation impact.
- In the planning and assessment of proposed new retail and shopping outlets, which includes the establishment of Farmer’s Markets, a priority should be given to the accessibility and servicing by sustainable forms of transport such as good public transport, walking and cycling links with appropriate facilities.
- The introduction of other traffic management policies and improvements to public transport could improve the accessibility of town centres. Following the Traffic Management Act, if implemented effectively, travel around urban areas should be more efficient for consumers and thus potentially make the urban centres increasingly accessible. It is important to understand the value that consumers place upon time and that congestion is a major factor in influencing the time taken to access retail facilities.

## **2.4 Potential for Demand Management in Freight Transportation**

### **Introduction**

Over the past decade, the annual consumption of diesel fuel has increased steadily to 9 million tonnes by Heavy Goods Vehicles (HGVs) and 5 million tonnes by light goods vehicles. The cost of fuel represents around 30% of the total cost of operating a goods vehicle<sup>1</sup>.

Fuel consumption has increased because the total mileage travelled by goods vehicles has increased (Figure 1). The fastest growth has been for light vans, followed by articulated HGVs; traffic by rigid HGVs has not increased.



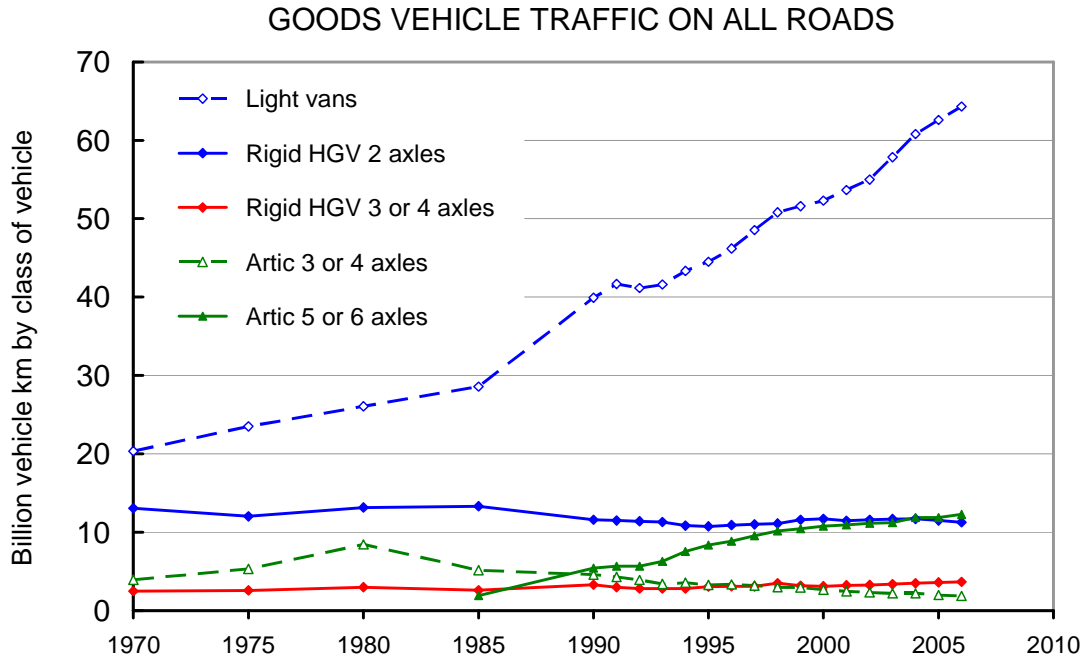


Figure 1

Fuel consumption of individual HGVs has not increased, and remains steady at about 7 or 8 miles per gallon.

Freight distribution is a wholly commercial activity. The cost of fuel is a very significant part of the cost of freight operations, so anything that can be done at a reasonable price to reduce the amount of fuel used will be done for commercial reasons. On the other hand, transport costs are a small part of the costs of the manufacture and retailing of goods, so an efficient distribution system is a higher priority than minimising the cost of transporting goods. This may militate against making changes to manufacturing, distribution and retailing arrangements, to reduce vehicle kilometres and fuel used by goods vehicles.

### Freight Activity

Freight traffic is generated by the activities for which the goods are moved. For Heavy Goods Vehicles, these activities can be classified as:

- Moving goods, almost all in containers, to and from sea ports as exports and imports;
- Moving materials and goods as part of the manufacturing process;
- Moving materials for building and other construction;
- Distributing manufactured goods, food and drink to retail outlets and hotels and restaurants, often via one or more distribution centres; and
- Moving documents and packages for the long haul 'trunk' leg of their journeys.

For vans and light goods vehicles, the activities are somewhat different:

- Collecting and distributing documents and packages from and to individual addresses, often as the final stage of shopping by mail or email;
- Collecting and delivering smaller goods items, often for a manufacturer, food producer or retailer; and
- Supporting a tradesman, including carriage of tools and materials.

The Department for Transport, (DfT) Survey of van activity 2004 estimates that 32% of van mileage is for the collection and/or delivery of goods, 32% is travelling to and from work and 24% is travelling between jobs<sup>2</sup>.

## Haul Lengths by Road

The total mileage of HGVs has increased because the haul length of most classes of goods moved by road has increased steadily until about the year 2000<sup>1</sup>. Figure 2 shows the average haul lengths by road for food, petrol and chemicals, miscellaneous manufactured goods, and bulk materials (minerals, timber and building materials). The haul length for food increased substantially from 1980 to 2000, but has since dropped back a little. Similarly for manufactured goods, for which the peak haul length was in 1999. These trends may reflect increases in the cost of road freight, and the increasing pressure on supermarkets to provide local/organic produce.

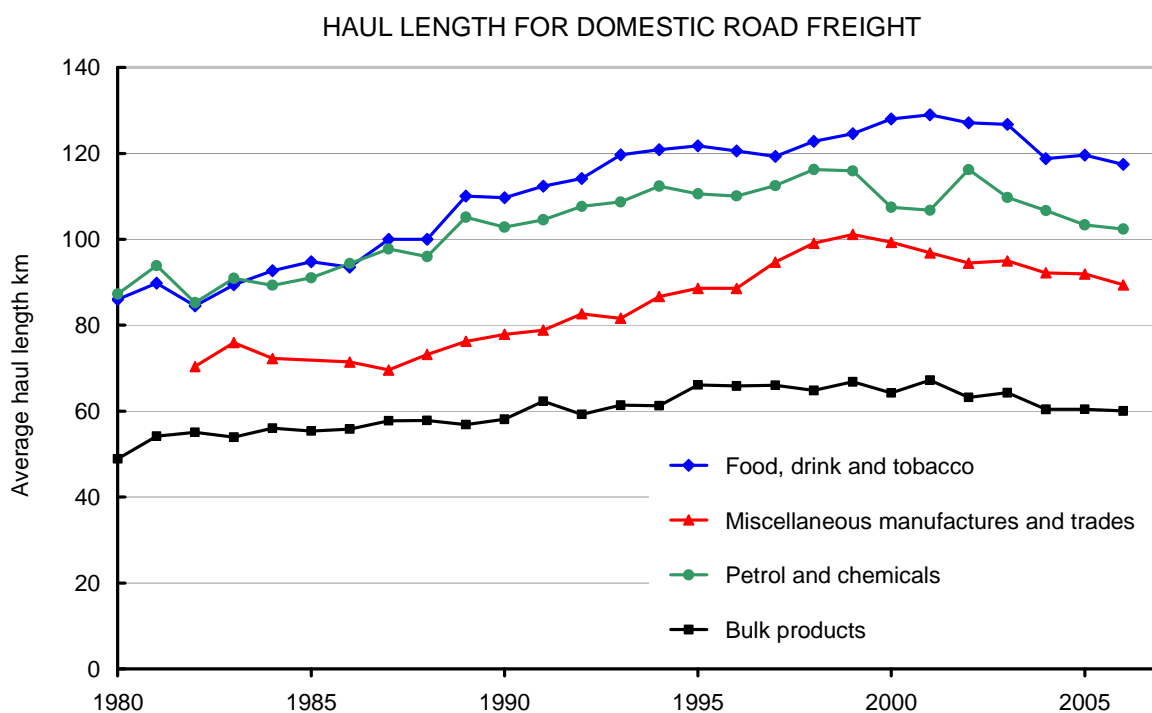


Figure 2

The total mileage by vans has increased because of the steady increase in the economic activities served by vans - courier services, mail and email shopping, visits by service engineers and tradesmen of all kinds.

### The Impact of Foreign Freight

In 2006, of the 2,045,000 thousand tonnes of domestic freight in Britain lifted by road and rail, about 20% was imports or exports being moved from or to ports. The tonnage of imports and exports by sea in 2006 was 439,477 thousand tonnes, of which 168,142 thousand tonnes was liquid bulk traffic, some of which would have contributed to the 159,100 thousand tonnes lifted domestically by pipeline (another 69,428 thousand tonnes of liquid bulk cargo was moved coastwise, and 14,506 thousand tonnes brought ashore as one-port traffic - i.e. oil extracted offshore landed in the UK from tankers, as opposed to pipelines from production platforms).

Figure 3 shows the total tonnage of foreign freight as a percentage of domestic freight lifted. The percentage has increased from 10% in 1965 to 22% in 2006, demonstrating the extent to which goods for use in the UK increasingly come from overseas. Figure 4 shows how the tonnage of foreign trade has grown steadily since 1965, though the balance between exports and imports has varied. Between 1965 and 2006, the tonnage of foreign trade more than doubled, demonstrating both the globalisation of economic activities and the increase in the extent to which goods are moved around the world.

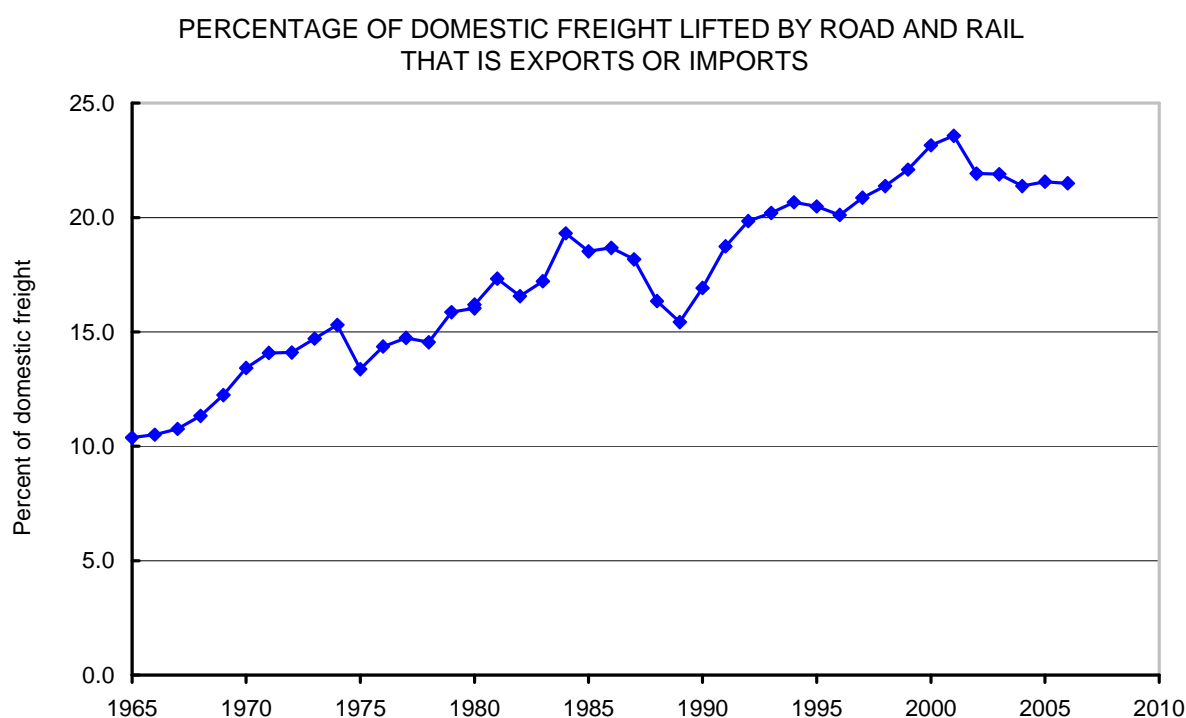


Figure 3

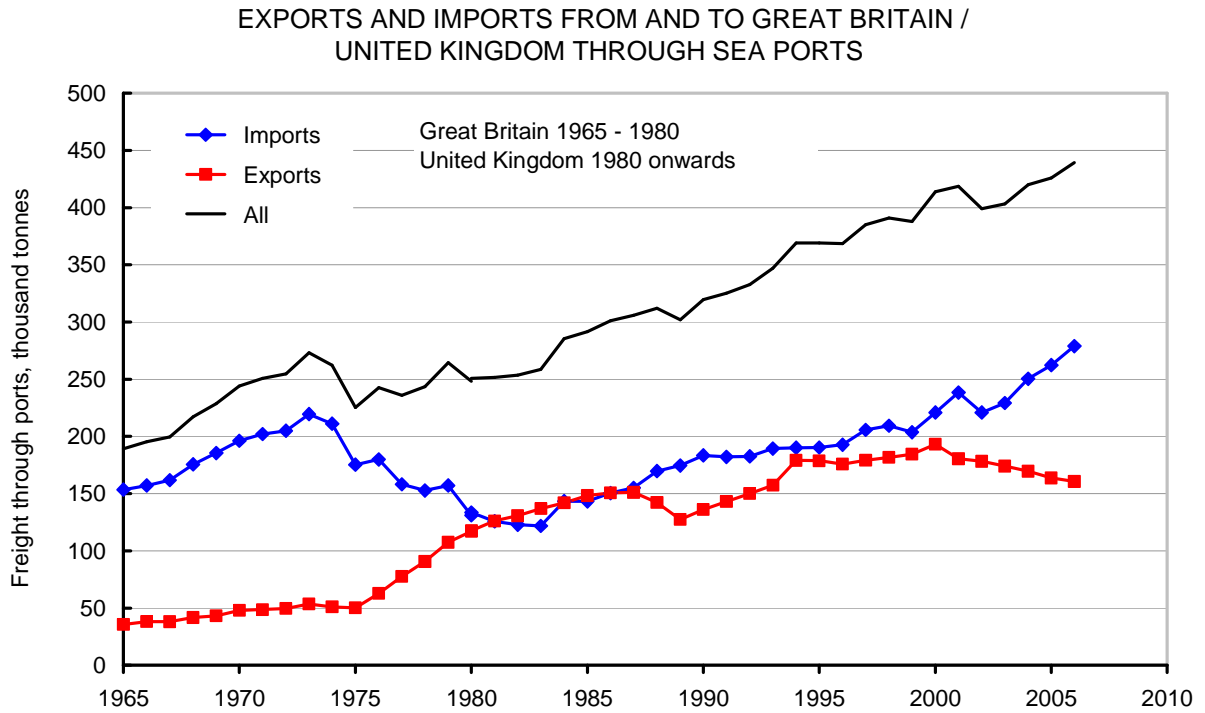


Figure 4

Manufactured goods tend to be shipped in containers. Figure 5 shows the tonnage of goods moved in containers since 1992. In fourteen years the tonnage of goods in containers through UK ports has increased by 72%, again indicating the trend to globalisation of manufacturing industry.

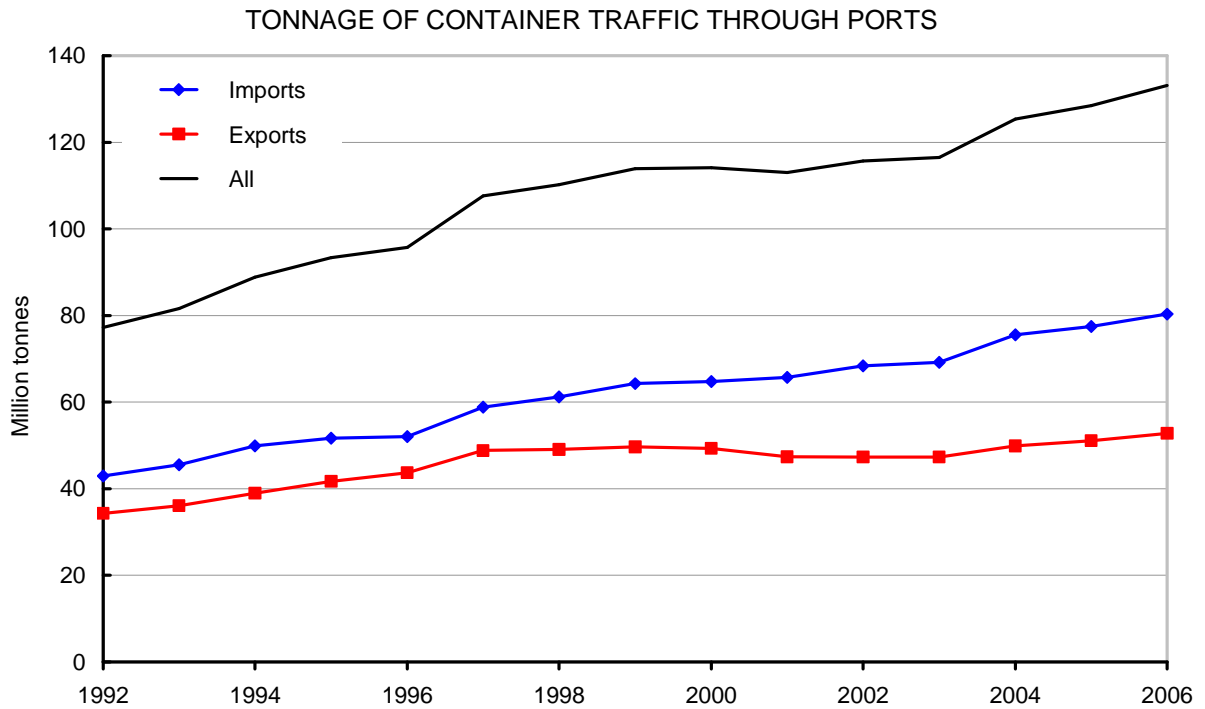


Figure 5

## Reducing the Movement of Freight by Road

There are a number of complementary actions that could in theory reduce the movement of freight by road. These are being promoted by the Freight Best Practice programme<sup>3</sup>, and a number of case studies are showing significant savings.

- Reduce empty and part-loaded running by the better utilisation of goods vehicles. Empty running of HGVs for particular commodities has reduced slightly, particularly for the movement of manufactured goods and petrol, but the changes are small (Figure 6). Trips by numerous goods vehicles to service retailers located close together are being reduced by combining loads onto a single vehicle.
- Transfer goods from road to rail or water. Pilot projects in the food distribution industry have shown that long-distance road freight can be transferred to rail for the trunk stage of a journey. Most freight origins and destinations are not rail served, and rail is most suitable for goods that can fill a complete train, that is easy to load and unload, and that is moved long distances on a regular schedule. This considerably limits the potential for transfer from road to rail.
- Reduce the distances that goods are moved. This would require major changes in the supply chains and manufacturing processes that are served by road freight. This is not impossible, although supply chains, distribution arrangements and depot locations have been optimised, and the disincentives to change them are great. However, the reduction in average haul length since 2003 for food and drink may well reflect a real change in consumer's preference for local produce, which would lead to changes in supply. Also, as fuel prices increase, it may become more efficient to reduce the distances that goods are moved during manufacture and distribution.

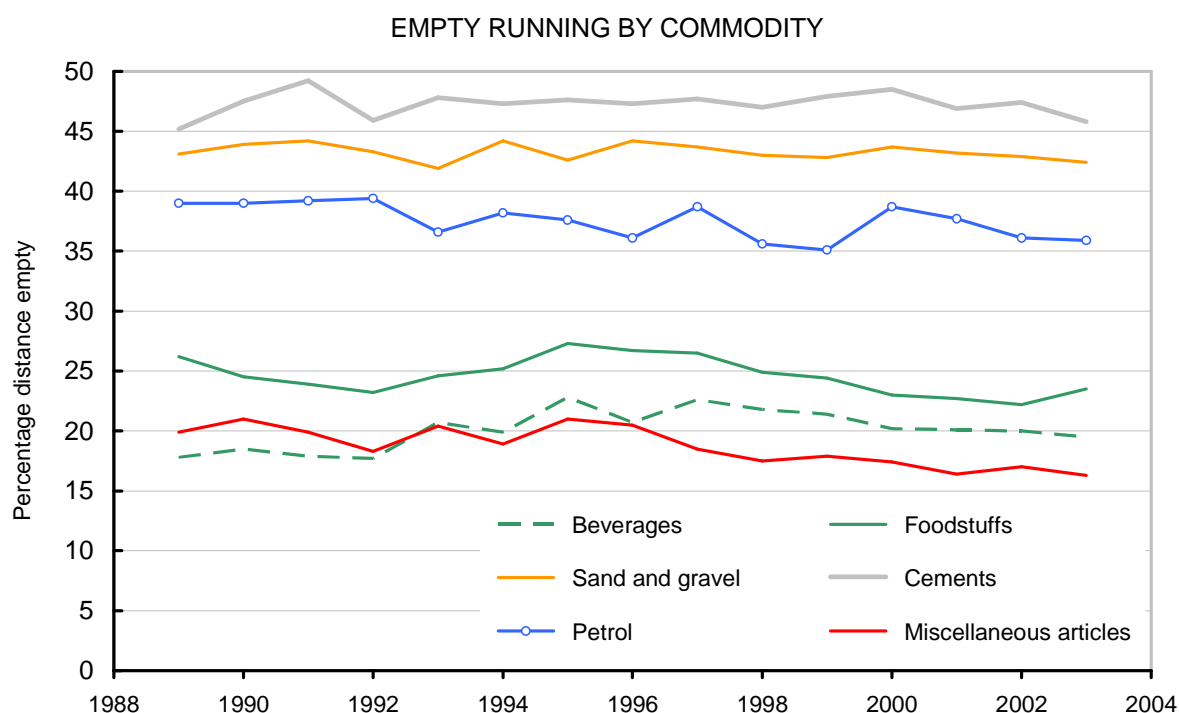


Figure 6

- Overall, there is scope for some reduction in the movement of freight by road, but much less than is popularly perceived. Transfer to rail or water is most viable for long-haul traffic – say over 300 km – and this only accounts for 5% of the tonnes lifted and 21% of the tonne km moved. For the 43% of tonne km moved less than 150 km, using rail or water would probably require a greater distance on roads for access to rail heads than would be required for the direct journey. However, several large freight rail/road transport terminals are now in the planning process in the East Midlands and North West representing positive initiatives in support of this objective.

## Conclusions

Fuel consumption by road freight has increased because the total mileage by goods vehicles has increased. The fastest growth has been for light vans, followed by articulated HGVs; traffic by rigid HGVs has not increased.

Fuel consumption of individual HGVs has not increased, and remains steady at about 7 or 8 miles per gallon.

Freight distribution is a wholly commercial activity. The cost of fuel is about 30% of the cost of freight operations, so anything that can be done at a reasonable price to reduce the amount of fuel used will be done for commercial reasons.

The total mileage by vans has increased because of the steady increase in the economic activities served by vans - courier services, mail and online shopping, visits by service engineers and tradesmen of all kinds.

About a quarter of the total tonnage of domestic road freight are goods travelling to or from ports as imports or exports.

Empty running of HGVs for particular commodities has reduced slightly, particularly for the movement of manufactured goods and petrol, but the changes are small.

Reducing the distances that goods are moved would require major changes in the supply chains and manufacturing processes that are served by road freight. This is not impossible, although supply chains, distribution arrangements and depot locations have been optimised, and the disincentives to change them are great.

Transfer of freight from road to rail or water is most viable for long-haul traffic – say over 300 km – and this only accounts for 5% of the tonnes lifted and 21% of the tonne km moved by road. For the 43% of tonne km moved less than 150 km, using rail or water would probably require a greater distance on roads for access to rail heads than would be required for the direct journey.

## References

- 1 “Study in Freight Tonnage and Emissions”, A M<sup>c</sup>Kinnon, Commission for Integrated Transport, 2007
- 2 “Light Goods Vehicles Survey”, Department for Transport, 2004
- 3 “Freight Best Practice Programme - (HGV Fleets in the Public Sector)”, Department for Transport, <http://freightbestpractice.org.uk> – accessed Sept 2008

## Issues and Recommendations

- Improved operation management leading to the better utilisation of goods vehicles can reduce empty and part-loaded running.
- Pilot projects in the food distribution industry have shown that long-distance road freight can be transferred to rail for the trunk stage of a journey. Therefore, it is recommended that Freight Managers would consider strategic transfer of goods from road to rail or water.
- It is possible to reduce the distances that goods are moved by engaging with Manufacturers and supply chain operators at an early stage particularly where development planning processes are required. This would require major changes in the supply chains and manufacturing processes that are served by road freight.

## ANNEX A2.3

### Retail Sector Impact on Transport

Historically, towns and cities developed and grew as “central places of trade for the benefit of the members living there.... benefits included reduced transport costs”. Trading developed in those areas that were most accessible.

Today, trading, and in particular retail outlets are still located in areas that are most accessible, and this has tended to mean the most accessible by car (often at the expense of accessibility by other sustainable modes). The car dominates travel to and from retail outlets at present. A British Council of Shopping Centres (BCSC) study estimated that cars currently account for 60% of all shopping trips and over 80% of shopping mileage (BCSC, 2006)<sup>1</sup>. National Travel Survey gives 62% of journeys and 82% of distance travelled. The average length of trips to access retail outlets has increased since the mid 1990s despite the average number of retail trips per person falling by 13% over the same period.

While the most accessible location has historically been the urban centre, a more recent trend has seen the demand for, and development of, out-of-town and edge-of-town locations that are more accessible by car. Since 2001, edge-of-town retail locations have become the most successful retail location with sales growing by over 40% to £72bn (RAC Foundation, 2006)<sup>2</sup>. Despite a tightening environment for land-use and transport policies, this trend is expected to continue as the number of hypermarkets is expected to increase from 637 in 2005 to well over 800 by 2010 (RAC Foundation, 2006)<sup>2</sup>.

On the other hand, many town centres have lost market share to the new developments. The key reason for this is accessibility, “success of retail is dependent on good accessibility” (Sarah Winterton, British Retail Consortium quoted in “High Street Britain”)<sup>3</sup>. It was suggested by Bernard Hughes of Asda that “schemes aimed at cutting congestion and making town centres more attractive places for pedestrians can have unintended consequences for the accessibility of the car-borne consumer”. He continued, “It is self defeating to make it difficult to park; customers simply go elsewhere”. Such views go some way to explaining the reason behind retail developments in recent years. The RAC Foundation put forward four key reasons for the decline of town centre retail locations:

- Congestion;
- Difficult parking;
- Environmental problems – town centres can be unwelcoming and threatening at certain times of the day; and
- Poor high street management by local authorities – more concerned with control than with customer care.



It is not all negative for town centre locations. One recent trend that has resulted in investment in town centre retail locations has been the introduction of smaller 'metro' formats of supermarkets catering for the change in consumer lifestyles. This 'convenience' style of shopping is meeting demand from young, small, urban households who want to buy small amounts on a daily basis (rather than large amounts on a weekly basis) and is often linked to the renaissance of fashionable urban neighbourhoods. This growth in inner-city residential floor space is often in developments that provide limited car parking provision, which tend to be associated with very low levels of car ownership, further increasing the demand for local services accessible by more sustainable forms of transport. This change in consumer lifestyles is one factor that has led to a change in retail development and future lifestyle changes could put different demands on retailers. What is not known are the lifestyle trends that will shape future demand for retail and future demand to travel to retail locations.

Aside from the traditional retail formats, internet shopping is gaining an increasing share of the retail market. According to Verdict Research, e-shopping is growing 15 times faster than the overall retail sector and now accounts for 3% of all retail sales. It is predicted that this sector will continue to grow further as developments in IT make e-shopping easier. In addition, with increasing numbers of the population gaining access to broadband internet services they are becoming increasingly able and willing to shop online. While online shopping results in the consumer not having to travel to the retailer, the goods still have to be delivered. However, if e-shopping requires more than one delivery from more than one delivery company, there could be more trips made than one return car journey to, say, a town centre location to access numerous retailers in one visit.

There is also evidence that some consumers, despite purchasing the goods online, actually travel to the retailer to view the goods beforehand and then compare prices online and purchase at the cheapest price, thus creating two trips. Research undertaken by B&Q suggests that consumers still want to choose their purchases in store despite the information available online. This suggests that while e-shopping will grow in terms of market share, it might not have the same impact on travel as it first appears.

### **The Global Market Influence on Food Miles**

Within the UK, agriculture and food accounts for nearly 30% of goods transported by road. A recent report by Department for the Environment, Food and Rural Affairs (Defra)<sup>4</sup> stated that food miles rose by 15% between 1992 and 2002. In 2002, food transport accounted for 25% of all HGV vehicle kilometres in the UK, and produced 19 million tonnes of carbon dioxide, representing 1.8% of the total annual UK CO<sub>2</sub> emissions, and 8.7% of the total emissions of the UK road sector.

Transport of food by air has the highest CO<sub>2</sub> emissions per tonne, and is the fastest growing mode. Although airfreight of food accounts for only 1% of food

tonne kilometres and 0.1% of vehicle kilometres, it produces 11% of the food transport CO<sub>2</sub> equivalent emissions. The direct environmental, social and economic costs of food transport are over £9 billion each year, and are dominated by congestion.

The increase in food miles has been attributed to a number of factors:

- The centralised systems of supermarkets have increasingly taken over from local and regional markets. This can result in goods being shipped from where they are sourced to be centrally processed and packaged, and then to be returned for sale close to their point of origin;
- Imported produce, for example 95% of the fruit and 50% of the vegetables sold in the UK are grown abroad, with the amount of food being flown into the UK doubling in the 1990s;
- Comparative labour costs, for example some British fish is now sent to China (where labour costs are much lower) for processing, then sent back to the UK to be sold; and
- Changes in consumer tastes and demands. Not only have consumer tastes changed to demand seasonal products year-round, encouraging the air transshipment of seasonal fruits but they also travel further and more often by car, for the weekly shop. Each year, the average UK adult travels about 135 miles by car to shop for food.

The overall environmental impact of food miles is undoubtedly a complex issue. For example, it is often difficult to determine how far, or indeed how sustainably, food has travelled, due to the complex nature of the shipping in terms of distance, processing impacts and the type of travel.

Environmental impact is further complicated by the fact that there are other aspects which need to be assessed alongside transportation. For example it is suggested that it is more environmentally damaging to source tomatoes in the UK, (out of season), than it is to ship them from Spain. There, the product is grown outdoors without the need for the artificial heating of greenhouses, which outweighs the transport disbenefits.

This global trade has also reached a stage where many goods are no longer imported solely for sale and consumption. They are now imported, processed and re-exported by many economies. Examples include milk, which is produced in the UK and Ireland, transported to continental Europe for processing into dairy products and subsequently reimported. Prawns harvested in the North Atlantic are frozen in Scotland and dispatched to Thailand for shelling before re-export back to Europe for packing and sales.

The concept of food miles also includes waste, for example the average household throws away more than 3 kilograms of food and 14 kilograms of food packaging per week. Buying local British produce in season clearly helps negate the need for artificial heating in glasshouses. Buying organic food can also help, although it is important that this is locally grown, since a typical

basket of 26 imported organic foods may have travelled a distance equivalent to six times around the equator<sup>5</sup>.

Supermarkets and food retailers are becoming increasingly aware of changing consumer demands and understanding of food miles, and responding in positive ways. For example, Marks and Spencer have been commended, (by Greenpeace)<sup>6</sup> for the positive stance they have taken on the catching, processing and sale of seafoods. This includes their approach to ensure the entire supply chain is audited and properly assessed for sustainability and environmental impact.

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### 3. CHANGING BEHAVIOUR

#### Introduction

The need to change travel behaviour to achieve sustainability objectives has been recognised for many years. However, the existence of convenient, affordable and acceptable options is essential. The provision of such options, timely information about travel opportunities, better marketing and advertising have long been advocated by transport planners, with good implementation initiatives such as Travelwise (now ACT Travelwise).

In recent years transport policy has also placed even greater emphasis on encouraging voluntary change to use more sustainable modes of transport by these so-called 'soft measures'. Travel planning for schools, hospitals and other public institutions was soon complemented by requirements for travel plans through planning obligations for all major new developments.

The 'Smarter Choices' Report<sup>1</sup>, published by the Department of Transport in 2004, helped to publicise and promote what could be achieved by these methods. Government funding for transport professionals has also helped encourage greater voluntary take-up of travel plans by commercial and other organisations. More recently personalised travel planning has been trialled in many places and encouraging results suggest that this will be applied more widely in future.

There are still legitimate professional concerns. Monitoring and enforcement of travel plan commitments is often weak and greater continuing attention needs to be paid to ensure initial results are not diluted over the longer term. There is also concern that the outcomes in terms of absolute numbers of vehicles on our streets do not always seem to reflect the cumulative effects of trip reductions reported in various trials.

Since 1998, the DfT has played a leading role in considering behavioural change issues and some of the history of changing travel choices is described. This background leads into the consideration and introduction of soft measures with a brief summary of some of the key and recent findings on travel choice initiatives. To demonstrate the promotion of 'changing behaviour' an account of the trials in Darlington under the Department's 'Sustainable Travel Towns' Initiative with key findings is also provided.

It is believed that these findings will assist IHT members and others seeking to make the case for smarter choice measures to politicians and businesses. Although it is recognised that such decision-makers can sometimes remain sceptical on these matters, it is considered essential that the argument for such initiatives succeeds.

## 3.1 Changing Travel Behaviour and the UK Experience

### Background

The first decade of the 21<sup>st</sup> century has seen a quickening interest in increasing travel choices to include sustainable options, like walking, cycling, public transport, car sharing or indeed challenging the assumption that journeys need to be made in the first place.

The number of initiatives at national and local level has increased to encourage people to travel in a more sustainable way and funding for these has increased radically. Interest has been generated, not least by the media, over issues such as congestion, global warming and health and the impact of Al Gore's film *'The Inconvenient Truth'*. Major reports such as Eddington, Stern and the King Review have raised awareness of the role of transport in our economy, the economics of climate change and the potential for reducing CO<sub>2</sub> from transport.

In 1998, the Government made a commitment through its integrated transport white paper "A New Deal for Transport: Better for Everyone", to encourage local authorities, business, community organisations, schools and hospitals to introduce 'travel plans' to cut down on car use. Measures encouraging people either not to travel or, if they do, to travel in a more 'sustainable' way can be introduced separately. Although, such measures frequently work best when packaged together as a travel plan. For example, a workplace travel plan might include a car-sharing scheme; improved cycling facilities; a dedicated bus service or restricted car parking allocations; flexible-working practices such as remote access and video conferencing.

Initially, travel plans were focused on large organisations at single sites and commuting and business trips (Enoch 2007)<sup>2</sup>. Travel plans have since been developed to deal with different types of situations: for example - school travel plans to overcome congestion on the school run; residential travel plans to mitigate the impact of new developments on local traffic, infrastructure and to improve accessibility; and visitor travel plans to assist access to leisure attractions and sports events.

Recognition of the potential benefits of smarter choices was initially slow to be acknowledged. However, in 2000, the Government encouraged local authorities (outside London) in the first round of Local Transport Plans (LTPs) for 2001-2006 to set out an integrated strategy for reducing car use and improving children's safety on the journey to school and encouraging widespread adoption of travel plans by major employers. The main difficulty was the limited evidence that such measures would work.

For the second round of LTPs, which came into operation in April 2006, the DfT expected all authorities to focus on delivering a smaller set of key outcomes, reflecting the shared priorities agreed between central and local

government. These were improving access to jobs and services, particularly for those most in need, in ways that are sustainable; improved public transport; reduced problems of congestion, pollution and safety. Among the key strategies to help local government deliver these outcomes were:

- Looking at ways to make services more accessible so that people have a real choice about when and how they travel;
- Promoting school, workplace and personal travel plans to encourage people to consider alternatives to using their cars; and
- Creating a culture and improved quality of local environment so that cycling and walking are seen as an attractive alternative to car travel for short journeys, particularly for children.

A boost for the role for smarter choices has also been given through three important studies:

- Sir Rod Eddington<sup>3</sup> in his study of “Transport’s Role in Sustaining UK’s Productivity and Competitiveness” (2006) highlighted the vital role that transport plays in supporting the economic success of the UK. He argued for a targeted approach to the most seriously congested parts of our urban, national and international networks. For urban, regional and local networks, he acknowledged that small local schemes such as promotion of buses, cycling and walking and enhanced local travel networks could often represent excellent value for money.
- Sir Nicholas Stern’s Review<sup>4</sup> on the “Economics of Climate Change” (2006) found that urgent action was needed to tackle emissions of CO<sub>2</sub> and other greenhouse gases and there was an economic case for doing so:

“Climate change is the greatest market failure the world has ever seen, and it interacts with other market imperfections. Three elements of policy are required for an effective global response. The first is the pricing of carbon, implemented through tax, trading or regulation. The second is policy to support innovation and the deployment of low-carbon technologies. And the third is action to remove barriers to energy efficiency, and to inform, educate and persuade individuals about what they can do to respond to climate change.”

(Stern Review<sup>4</sup>: Executive Summary).

- The King Review<sup>5</sup> examined the potential for CO<sub>2</sub> reduction. Part I of the report, published in 2007, set out a positive message about

the potential for reducing CO<sub>2</sub> both in the next few years and in the medium and longer term to bring considerable benefits for the UK. Part II of the report published on 12<sup>th</sup> March 2008, picked up on the challenges set out in Part I and made a series of recommendations. These included “using lower carbon alternatives to the car: promoting public transport, walking and cycling, through increasing their availability and attractiveness and improving information, and encouraging people to make efficient use of cars – for example through car sharing and car clubs – for journeys where this is the best option”.

### 3.2 Travel Behaviour and Effectiveness of Smarter Choices

Overall, smarter choice measures appear to be substantially more effective than many transport professionals originally expected. There was relatively little evidence to show that the measures would work. However, in 2003, the DfT commissioned a major research project that reviewed national and international evidence to assess the overall effect of a combination of such measures on traffic levels under UK conditions as well as 24 case studies across the UK.

The research looked in detail at:

- The impact of workplace travel planning in Buckinghamshire, Birmingham, Bristol, Cambridgeshire, Merseyside, Nottingham and York;
- School travel planning in Buckinghamshire, Merseyside, York and Milton Keynes;
- Personalised travel planning in Gloucester, Bristol, London and Nottingham;
- Public transport information and marketing in Brighton and Nottingham;
- Car clubs in Edinburgh and Bristol and car sharing in Buckinghamshire; and
- Teleworking, teleconferencing and home shopping.

The final report, entitled ‘*Smarter Choices – Changing the Way We Travel*’<sup>1</sup> was published in July 2004 in tandem with the DfT’s new white paper ‘*The Future of Transport*’. It provided evidence of the impact that, what were now to be called, ‘smarter choices’, could have on traffic.

The key findings were:

Applying smarter choices with a high intensity, nation-wide all traffic could be reduced by about 11%. With a low intensity, there could be a nation-wide reduction in all traffic of 2%-3%. Workplace travel plans typically reduce commuter car driving by between 10% and 30%.

School travel plans, on average, cut school run traffic by between 8% and 15%, with high-performing schools commonly achieving reductions of over 20%, and sometimes considerably more.

Personal travel planning initiatives typically report reductions in car use of 7% -15% in urban areas, and 2%-6% in rural and smaller urban areas.

Public transport information and marketing has delivered clearly recorded increases in bus use, with evidence suggesting that it can cause patronage increases from service improvements to double. City-wide budgets for such work of £60,000 - £300,000 per year (including public and private sector investment) have helped to deliver city-wide increases in bus use of 1.5%-5% a year, when combined with other improvements.

Travel awareness campaigns vary in nature, from relatively general campaigns to closely targeted intensive approaches. Both types report evidence of car use reductions, although intensive approaches tend to achieve higher levels of individual change.

Car clubs have been associated with a reduction of about 5 private cars per car club vehicle, with car club members significantly increasing the amount they walk, cycle and use public transport.

Organised car-sharing has effects on overall car use, but these depend on other factors, including parking regimes, the balance of users drawn from car driving or from other modes, and the amount of informal car-sharing already taking place. Subsequent research for the DfT 'Making Car Sharing and Car Clubs Work' demonstrated that well-planned closed community car sharing schemes reduced the number of single occupancy cars on site by an average of 21%.

Teleworking is growing rapidly, and at present typically results in a reduction of between 2 and 6 homework journeys per teleworker per week. Evidence suggests that changes in car use for other purposes, or by other household members, or due to changes in home location, do not substantially offset these reductions and, in some cases, there may be further cuts in car use. Costs are likely to be offset by business savings.

Teleconferencing typically reduces business travel by between 10% and 30% in organisations that promote its use.

Home shopping currently accounts for less than 5% of the grocery market, but is estimated to reach 10%-15% over the next decade, leading to potential reductions of 7%-11% of all food shopping traffic

Cost-effectiveness of smarter choices measures are:

- The public expenditure cost of reducing car use is estimated as 1.5 pence per vehicle kilometre saved for a well-designed package of



different soft initiatives, i.e. £15 for removing each 1000 vehicle kilometres of traffic; and

- Current official practice calculates the benefit of reduced traffic congestion to be about 15p per car kilometre removed, and more than three times this level in congested urban conditions.

Thus, every £1 spent on well-designed soft measures could bring about £10 of benefit in reduced congestion alone, more in the most congested conditions, and further potential gains from environmental improvements, provided that the tendency of induced traffic to erode such benefits is controlled. In *"Managing Our Roads"*, Dft 2003 it stressed the importance of 'locking-in' the benefits of congestion reduction policies by demand-management measures to control induced traffic. The Smarter Choices study found that this was also vitally important for delivering the full potential of soft measures. It argued that without this, smarter choices could still succeed in changing which individuals were using cars but may have much less impact on area-wide traffic levels, congestion or environmental impacts.

### **Personal Travel Planning (PTP)**

In 2007, the DfT published the report "Making Personal Travel Planning Work"<sup>6</sup>. This brought together the latest thinking on 'personal travel planning' (PTP) which is a targeted marketing technique, involving raising awareness of travel decisions and provision of information, advice, motivation and incentives. It seeks to overcome habitual use of the car, enabling more journeys to be made on foot, bike, bus, and train or in shared cars.

Although PTP can be applied in a number of contexts, e.g. schools, workplaces and residential communities, this report considers residential-based PTP. It contains evidence collated from 12 in-depth case studies, 10 smaller vignette case studies and contributions from a panel of 17 experts in the field of PTP and smarter choices measures. The case study sites provide extensive evidence, collectively accounting for PTP programmes that have targeted 229,000 households.

Within the UK, PTP has been reported to typically reduce the distance travelled by car by 12%. As a result of, and in addition to, reduced car use, successful PTP projects also deliver:

- Increased walking and cycling, with associated health benefits;
- Increased public transport use, making services more feasible and profitable;
- Increased viability of local shops and businesses;
- More sociable and 'liveable' neighbourhoods;
- Stronger partnerships between the agencies and organisations involved;
- Improved local air quality; and

- Reduction in carbon emissions.

PTP programmes typically cost between £20 and £38 per targeted household, or in the order of £0.02 to £0.13 for each vehicle kilometre travelled reduced in the first year. International experience of cost-benefit analysis of PTP has demonstrated that over a 10-year period PTP offers a £30 return for every £1 invested. Increasing the scale of a project makes it more cost effective.

- Two cases in Darlington, involving 10,744 and 11,470 people, reduced car travel by 6% and 11% at a cost of £0.03 and £0.09 per vehicle kilometre saved.
- In a case of 6,500 persons in Peterborough, car travel was reduced by 15% at a cost of £0.02 per vehicle kilometre saved.

## **Sustainable Travel Towns**

In 2003, the DfT decided to set up a project to *demonstrate* what could be achieved through smarter choices and provide an opportunity to *communicate* the results to others. This would involve building on and pulling together previous programmes, as well as drawing on the experience of local authorities that had invested the most in smarter choices.

The aim was to create three showcase sustainable travel demonstration towns<sup>7</sup> to act as models for other local authorities by showing what could be achieved through combined packages of measures to increase sustainable travel. From invited expressions of interest for the project, over 50 towns across England responded with Darlington, Peterborough and Worcester being chosen. Between them, they would provide a range of scenarios with resonance for as many other local authorities as possible.

The project formally began in April 2004 with the DfT providing £10m in revenue funding to assist the towns in introducing intensive, comprehensive and strategic packages of smarter choices and hard measures to promote safe and pleasant walking, cycling and bus use for all kinds of trips on a town-wide basis. A key element of the plans of each of the towns was the use of the personal travel planning technique known as 'individualised travel marketing' (ITM), which tailors travel information to the needs of each household.

Although the DfT is overseeing the project, the towns themselves were responsible for developing their proposals and implementing them, drawing in relevant experience as necessary. An important component is the monitoring and evaluation of the results. The project began with baseline studies of all three towns with interim results produced regularly. The project will formally conclude in March 2009.

The DfT has commissioned a study to analyse what has happened and been achieved in the three towns. The research is being formatted to provide a

follow-up study, albeit on a smaller scale, to the 2004 Smarter Choices research and carried out by the same researchers.

For all three towns, in order to fully involve the local communities, communications played a vital role in their plans to introduce radical changes. A brief description follows of the communication campaign being run by Darlington Borough Council to support their programme of sustainable measures.

### **Darlington's 'Local Motion'**

When the project started in April 2004, the first communication campaign was called 'Darlington a Town on the Move'. This was developed into a new campaign launched by a Kylie Minogue look-alike in June 2006 called 'Local Motion' under which all their activities could be branded.

The campaign connected with Darlington's place in history through the use of the locomotive on the first public railway (Stockton & Darlington) and called upon that pioneering spirit to think about new ways to travel locally. 'Local Motion' was therefore the ideal choice. Kylie's hit song '*Do the Locomotion*' revamped to '*Do the Local Motion*' tied perfectly into the campaign to inspire real action among the residents of Darlington.

As part of the project promotion, much effort was given to communication initiatives with particular emphasis on working with children.

The brand was marketed heavily to incorporate all types of sustainable travel activities taking place in the town and generate ongoing interest and participation. Ten thousand residents joined the Local Motion Club and are kept involved in and informed about the campaign through regular news-sheets.

#### Initiatives rolled out under the Local Motion campaign include:

- An individualised travel marketing programme targeted at 40,000 households;
- 8000 cycle maps, bus maps and other travel-related leaflets personally distributed to householders;
- Local Motion travel centre located within Darlington Information Centre, opened in April 2006;
- A range of family bike and walking events;
- Journey share web site;
- Journey planner web site;
- Range of guidance documents on walking and cycling around Darlington;
- Free cycle loan scheme for residents;
- Cycle delivery of the Council's internal mail; and
- Launch of Local Mover multi-operator bus ticket.

#### Working with Schoolchildren.

- By March 2008, school travel plans had been completed in 78% of schools;
- Cycling levels had increased by more than fourfold, with some schools seeing levels of cycling of between 10 and 15%;
- Cycle and pedestrian training in all Primary Schools;
- 'Medal Motion' campaigns involved 8000+ primary school pupils where children receive medals for walking or cycling to school, 26 out of the 30 primary schools in Darlington taking part;
- 'Safe routes to schools' provided, including new cycle paths, dropped kerbs, cycle storage, 20 mph zones;
- Organised events including Wheelie Wednesdays, Bike to School week, bike maintenance classes and assemblies and Biker Breakfasts; and
- Highly successful 'Walking on Wednesdays' 'WOW' schemes in two schools.

## Darlington



So has the campaign worked? Between 2004 and 2006, Darlington has produced results for the whole town, which show an increase in walking of 15% and a 65% increase in cycling! The 2006 household travel research, which took place in the area visited by Team Local Motion Travel Advisers in 2006, (one third of all households in the town), shows that overall car mileage fell by 12.8 million km. This is equivalent to over 2000 tonnes of CO<sub>2</sub> per year. This would offset the domestic emissions from heating around 800 homes per year.

## Outcomes – Travel behaviour research



The interim results from Peterborough and Worcester have also been impressive. These figures cover the targeted populations for their individual travel marketing initiatives:

Peterborough - covering 18,250 households

Walking: +15%	Bus: +8%
Car: -11%	Cycling: +23%

Worcester - covering 14,900 households

Walking: +18%	Bus: +15%
Car: -12%	Cycling: +32%

### Cycling Demonstration Towns

The dramatic increase in cycling in Darlington reflects its role as one of the six cycling demonstration towns (along with Aylesbury, Brighton, Derby, Exeter and Lancaster (with Morecambe) which have been funded since 2005).

Due to the success of their achievements, Ruth Kelly, Former Secretary of State for Transport, announced on 19 June 2008, 11 new cycle demonstration towns and small cities together with the first large city of Bristol. The new towns are: Blackpool, Cambridge, Chester, Colchester, Leighton-Linslade, Shrewsbury, Southend, Southport, Stoke, Woking and York.

The Cycling Demonstration Towns programme will be provided with £47million of DfT funding until March 2011. The local authorities are required to at least match-fund the grant. Therefore the total investment in cycling in these places will be around £100 million - in other words, £16 per head of population. This will mean that throughout England over 2.5 million people will experience a level of spend only seen in the very best European cycling cities.

## Conclusions

Since the realisation that the philosophy of 'predict and provide', to keep pace with traffic growth, was not sustainable, a healthy awareness by transport professionals has emerged to consider alternative strategies and apply innovative measures to manage demand. However, to complement such rethinking the case for accepting such measures and achieving behavioural change by the travelling public needs to succeed.

Provided sustainable measures are implemented within a supportive policy context, smarter choices can be sufficiently effective in facilitating choices to reduce car use. They offer sufficiently good value for money that they merit serious consideration for an expanded role in local and national transport strategy.

While personal travel planning projects have demonstrated effective outcomes based upon area-wide approaches, there is a long-term opportunity to support this work by building upon existing networks and communication channels. Appropriate opportunities to target people would include during life-changing moments, when individuals may be most likely to deliberate about travel behaviour and break established habits. These could include when moving house or school, applying for a new job, obtaining an over-60 public transport pass and changes in public transport provision.

Darlington is now planning its strategy for ensuring that work on promoting sustainable travel across the town will continue. It sees the Local Motion campaign as an important way of achieving this. It is to be hoped that the initial success continues, is itself sustainable and can be replicated in other towns.

The need to change travel choice behaviour to achieve sustainable objectives and project the existence of convenient, affordable and healthier acceptable alternative options is a priority. The provision of such options, timely information about travel opportunities, better marketing, advertising and good implementation initiatives have long been advocated by transport professionals. It is therefore considered appropriate for transport professionals to take the initiative, where possible, to engage with society to establish and promote such communication schemes.

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## Issues and Recommendations

- Travel plans should be developed to deal with different types of situations including school, hospital, residential and commercial business travel plans to mitigate the impact of new developments on local traffic and infrastructure to improve accessibility. Such schemes are considered essential particularly for new developments and implemented using the guidance provided by DfT.
- If the benefits accrued by the schemes delivered to date are to be sustained across the country, greater and more sustained investment of smarter choice measures at the local level, combined with a programme to lock-in the benefits can be considered.

## **4. ACCESSIBILITY AND SOCIAL EQUITY**

### **General Introduction**

For this theme, consideration is given to assess how the provision of fundamental accessibility, as required in a modern society, can be achieved in a sustainable manner. Four 'modal' chapters are considered, followed by a further chapter on social sustainability generally and review the current and potential performance of the modes that are often called "sustainable".

A review of the promotion of walking and cycling is undertaken including the introduction of new policies and guidance to facilitate these healthy modes of travel.

An assessment is made of initiatives to gain better use of existing networks, considering current trends, the policy context and likely future. The third modal chapter is an overview of the sustainability of public transport performance, both rail and bus, noting that their "green" credentials are not always justified. The argument is made for essential improvements in the provision of quality services, particularly for buses.

The fourth chapter further considers the issue of highway demand management and describes the task of getting the most out of our existing road space including by congestion charging. This covers both congestion charging and road pricing generally, including the use of parking controls as a demand management tool.

The final chapter on this theme takes a rather different perspective with an assessment of social sustainability, reviewing some of the ways in which transport can influence the wider social objectives of achieving a safe, healthy, just and fair society. This includes the issues concerning equity, the distribution of transport costs and benefits between different groups of people, recognising what the United States of America transport planners now call "environmental justice".

### **4.1 The Promotion of Walking and Cycling Journeys**

#### **Introduction**

There has been an overall decline in cycling trips since the 1950s, with cycling trips declining by 20% in the last decade (National Travel Survey: 2006<sup>1</sup>). The cumulative cost of this decline in terms of health, pollution and congestion has been estimated at £600m. However, if by 2015 cycling trips returned to 1995 levels the value that could be generated in savings to health, pollution and congestion is approximately £500m<sup>2</sup>.

The average number of walking trips also fell by 16% between 1995 and 2005; however the average distance walked remained the same, which indicates an increase in average trip length from 0.6 to 0.7 miles.



The average car trip length data, (all purposes, 8.44 miles), demonstrates scope to encourage modal shift from the car to walking and cycling for some shorter journeys. This is substantiated by the recent intensive work undertaken through the baseline travel surveys for the Sustainable Travel Town (STT) initiatives. These consistently show that (across the three towns of Darlington, Peterborough and Worcester) there is a high prevalence of local trips across all modes (less than 5 miles in length). Nationally, more than half of all trips (56%) are less than five miles long and 23% are less than two miles – approximately the same distance as the average cycle trip<sup>2</sup>.

The STT research also identified that a significant proportion of these local trips could be undertaken by sustainable modes without significant changes to infrastructure or service provision. The Cycle Demonstration Towns, (CDT) of Aylesbury, Brighton, Darlington, Derby, Exeter and Lancaster, have seen dramatic increases in cycling levels. As a consequence many of the changes made to the infrastructure have simply improved permeability to the town centre, and increased access to employment centres and leisure facilities.

## **Policy Environment**

Over recent years there has been a shift in policy to encourage the improvement of conditions for walkers and cyclists. Walking and cycling policy came to the forefront in the Government's White Paper on Transport (DETR) published in July 1998. This had a stronger emphasis on sustainability than previous policy documents. Planning regulations (PPS6) have also been altered to give greater emphasis to walkers and cyclists in town centres.

In February 2008, the Department for Transport (DfT), announced a significant investment package for cycling of £140m, which also includes a contribution from the Department for Health in recognition for the role that cycling plays in increasing daily activity. This will result in further investment for the Six Cycle Demonstration Towns, and the establishment of a Cycle City and eleven new Cycle Towns (Greater Bristol, Blackpool, Cambridge, Chester, Stoke, Colchester, Leighton and Linslade, Shrewsbury, Southend, Southport and Ainsdale, Woking, and York).

The Government publication, "Walking and Cycling: an action plan", DfT, (2004) cites survey findings which noted that around a third of people would walk and cycle more if the facilities on offer were improved. Improvements that would encourage walkers included safe walking routes and, as a slightly lower priority, better maintained footpaths. For cyclists they included on- and off-road cycle lanes and the provision of better bicycle parking facilities. Now that the Six Cycle Demonstration Towns have proven that relatively small changes to infrastructure can bring about increased cycling levels, the challenge is set for the next three years to showcase best practice on a much wider scale.

The promotion of walking and cycling is further supported through the package of measures considered under the 'smarter choices' agenda (for example workplace and school travel plans, which deploy a range of tools to promote alternatives to the private car). Good examples of this can be found in Darlington and Aylesbury.

Aylesbury in particular has provided some of the smallest changes to infrastructure of the Six Cycle Demonstration Towns, but their innovative colour coded route branding (the Gemstone Cycleways) system is supported by individual route marketing, targeting residents living within 500 metres of a cycleway. People using a bicycle as a main mode of transport are reported to have tripled in the first two years of the Cycle Demonstration Towns project (<http://www.cycleaylesbury.co.uk>).

### **Cycling specific guidance**

Whilst planning and designing high-quality infrastructure involves developing localised solutions in close consultation with local people, there are some basic requirements that need to be satisfied. The underlying principle is that measures for cyclists (and pedestrians) should offer positive provision that reduces delay, diversion and danger (as defined in draft Local Transport Note 1/04 Cyclists and Pedestrians)<sup>3</sup>. The basic principles of good cycling infrastructure design, approved by the Department for Transport, are:

1. Coherent
2. Direct
3. Attractive
4. Safe
5. Comfortable

The Institution of Highways and Transportation have published specific guidance<sup>4</sup> targeted at planning for cycling, notably:

- "Cycle Friendly Infrastructure", which is currently being updated, and will be issued as a Local Transport Note.
- "Guidelines for Cycle Audit and Cycle Review".

Through the Cycle Towns' projects, Cycling England is keen to ensure effective continuity and quality of route. This will require a more proactive approach to increasing priority for cyclists and pedestrians at road junctions, particularly where off-road cycle routes cross the road highway. Quality can be defined in many ways and reflects the cycling environment just as much as a well-maintained surface.

Cyclists and pedestrians can operate in harmony, and the Cycling England Design Checklist has the following advice on the subject: "Allowing cycling

through vehicle-restricted (pedestrianised) areas should be the rule rather than the exception". The recently released Manual for Streets<sup>5</sup> provides a platform for good design, to create more people-orientated places.

The improvement of existing shared cycling and walking facilities and the development of new cycling and walking facilities should also ensure compliance with the Disability Discrimination Act (DDA) 2005. This now includes providing safe access to transport services. Where shared surfaces are implemented, consideration should be given to those pedestrians who have visual or hearing impairment. The use of trapezoid lines along routes and measures to reduce cycling speed at crossings are examples of how conflict might be minimised. A visually impaired pedestrian may not be able to see or hear an approaching cyclist and therefore is likely to believe it is safe to change direction unless forewarned by infrastructure measures.

### **The barriers**

The risks, real and perceived, sensed by walkers and cyclists can have a constraining effect upon efforts to promote these modes of travel. While Health Professionals<sup>6/7</sup> are increasingly appreciating benefits that result from these forms of activity, efforts to address these fears are showing positive results with cycle use increasing in locations where priority measures have been provided, for example in Nottingham, London and the Six Cycle Demonstration Towns. However, heightened fear of crime, both to the person as well as cycle theft, is a powerful force which can keep car use as a chosen travel option.

When considering opportunities to encourage walking and cycling there are a number of areas that warrant consideration, these include:

1. prioritisation of walkers' and cyclists' safety, mobility and access needs over those of car users, in particular when increasing permeability to town centres and employment centres;
2. design of roads and surrounding areas where the mobility issues for walkers and cyclists take precedence over those for car users;
3. sympathetic treatment of situations where walking and cycling modes meet and interact with all motor vehicles, particularly within public transport priority improvements;
4. better cycle parking which is both secure and well located with consideration of the promotion of multimodality-bike racks at transport interchanges such as bus shelters and train stations where cycle use can be associated with onward travel;
5. better enforcement of cycle and pedestrian zones; and

6. education / promotion / direct marketing campaigns to raise awareness of the benefits of active travel modes.

## Conclusions

Walking and cycling have strong contributions to make in creating sustainable places, increasing accessibility, enhancing neighbourhood cohesion, improving individual fitness and well-being, and reducing the environmental impact of transport.

Increases in cycling can also result in significant savings in relation to health, pollution and congestion. As such, they must be placed at the top of the transport hierarchy, and actively promoted through a range of infrastructure and 'smarter choices' measures.

The challenge would not appear to be insurmountable, where as many as 31%<sup>8</sup> of schoolchildren would prefer to cycle to school and yet 2%<sup>1</sup> currently do so. Attitudinal surveys supporting the development of school and employer travel plans across the country consistently identify high levels of preference towards cycling and walking, provided safety and accessibility issues are addressed.

These barriers need to be addressed in a safe and coherent way to ensure that conflicts are minimised, and that access to specific destinations such as the town centre, employment centres and leisure facilities is made easier through the development of continuous, quality driven routes.

It is important to ensure that walking and cycling are promoted, as they are also key elements of any journey undertaken by public transport.

## References

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- 2 "Valuing the Benefits of Cycling", SQW Consultants and Cycling England, January 2008
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- 6 “Cycling: towards health and safety”, BMA Publication, Oxford University Press, 1992
- 7 “Take Action on Active Health”, National Institute for Clinical Excellence, 2008
- 8 National Children’s Bureau Young Transnet (website) 2005

### **Issues and Recommendations**

- Measures to promote and develop walking and cycling should take the highest priority for investment in the urban transport hierarchy. Walking and cycling can result in significant savings in relation to health, pollution and congestion and strongly contributes to creating sustainable places, increasing accessibility and enhancing neighbourhood cohesion.
- Survey findings found that around a third of people would walk and cycle more if the facilities on offer were improved. Hence, improvements of facilities that would encourage walkers and cyclists, such as safe walking routes, better maintained footpaths, off road cycle lanes and the provision of better bicycle parking facilities might encourage more people to cycle and walk.
- Measures for cyclists (and pedestrians) should offer positive provision that reduces delay, diversion and danger with good design principles providing coherent, direct, attractive, safe, and comfortable infrastructure facilities.

## 4.2 Better use of Existing Networks

### Introduction

The Eddington Study<sup>1</sup> recommended that measures that make better use of the existing transport network, without changes to the basic infrastructure, should form an important part of the policy for meeting the Government's economic, social and environmental objectives.

In particular Rod Eddington noted that small-scale measures that can be readily implemented offer the potential for good returns in terms of easing congestion, addressing capacity constraints and improving the reliability of the transport system.

### Implementation

Better use of existing networks can be achieved, from small-scale improvements, to the efficiency of traffic signals at isolated junctions, to large-scale Active Traffic Management Systems (ATMs) as delivered on the M25, M42 and M6.

An important distinction also exists between 'demand side' and 'supply side' measures. The former includes schemes designed directly to influence travel attitudes, choices and behaviour, (as demonstrated in this document theme, 'Changing Behaviour') and the latter, schemes that achieve their objectives through adaptations to the existing infrastructure to increase capacity or throughput.

Demand-side measures include incentives and 'soft' measures such as: publicity and awareness campaigns, work and school travel plans, personalised travel planning, cycle training, and car clubs.

Supply-side measures include infrastructure improvements for pedestrians and cyclists including new or improved paths and routes, and improving bus stops. Infrastructure measures designed to reclaim streets and reduce the dominance of road traffic through traffic calming, rerouting and traffic restrictions are of particular relevance.

In terms of design there is now a once-in-a-generation opportunity afforded by *Manual for Streets*<sup>2</sup>, which provides excellent guidance for such schemes.

Infrastructure improvements designed to reallocate road space e.g. High Occupancy Vehicle lanes and bus lanes have been a demand management supply tool for many years. Such schemes are often objected to but they have gained strength, particularly in the last ten years, assisting the enhancement of public transport operations in urban areas.

More recently such ideas have been proposed in rural areas including on the motorway network. However, such initiatives need careful consideration in

terms of overall benefits against implications of lane capacity loss since there are other practical options in terms of capacity improvement on inter-regional road networks.

It is considered that to complement the ATM schemes, now accepted as positive moves to assist congestion hot spots, the legislation and concept of 'undertaking' on highways of three or more lanes should be fully examined. Driver behaviour is a key part of this discussion in that the evidence of consequential loss of lane capacity because of the 'middle lane' misuse by drivers is self-evident throughout the motorway network.

With a projected major motorway-widening programme, which includes several schemes widening to four lanes, such a review is considered essential.

## Conclusions

To facilitate and achieve better use of existing networks has been a particular objective since the realisation that the philosophy of 'predict and provide' for traffic growth was unsustainable<sup>3</sup>. Such acceptance has clearly presented a real challenge, with opportunities for transportation professionals to take the initiative and such action is achieving success.

The agenda is now extended from reducing congestion to the complementary and real need to secure greater benefits to reduce the impact of climate change. The whole network needs to be considered with continued vigour and innovation much in line with Circular 02/07<sup>4</sup>, which includes the formal request to consider Traffic Demand Measures first, ahead of hard infrastructure solutions.

## References

- <sup>1</sup> "Transport's Role in Sustaining UK's Productivity and Competitiveness", Sir Rod Eddington, HM Treasury, 2006
- <sup>2</sup> "Manual for Streets (MfS)", Department for Transport, March 2007
- <sup>3</sup> 'Transport: The New Realism', P Goodwin, S Hallett, F Kenny and G Stokes, Transport Studies Unit, University of Oxford, 1991 and 'Solving Congestion', P Goodwin, inaugural lecture for the Professorship of Transport Policy, University College London, 23 October, 1997
- <sup>4</sup> 'Planning and the Strategic Road Network', DfT Circular 02/07, Department for Transport, 2007

## Issues and Recommendations

- Better use of existing networks can be achieved, from small-scale improvements, to the efficiency of traffic signals at isolated junctions; to large scale Active Traffic Management Systems (ATMs) as delivered on the M25, M42 and M6 should therefore be essential early option considerations.
- Infrastructure measures designed to reclaim streets and reduce the dominance of road traffic through traffic calming, rerouting and traffic restrictions are of particular relevance. In terms of design, there is now a once in a generation opportunity afforded by the DfT Manual for Streets as an excellent guide for such schemes.
- If appropriate, infrastructure improvements designed to reallocate road space e.g. High Occupancy Vehicle lanes and bus lanes can be included as demand management supply tools. Such schemes are of particular value in assisting the enhancement of public transport operations in urban areas.
- In terms of capacity improvement on inter region road networks, it is considered that to complement the ATM schemes, which are now accepted as positive tools to assist congestion hot spots, the legislation and concept of 'undertaking' on highways of three or more lanes should be fully examined by the DfT.
- Better use of existing transport networks can also be achieved by the promotion of publicity campaigns to affect more efficient use of motorways by targeting driver behaviour for improvements in lane discipline.

### 4.3 Public Transport Quality, Accessibility and Integration

#### Introduction

For many people the phrase "sustainable transport" is equivalent to saying "public transport, walking and cycling". Public transport is commonly regarded as a "green" mode with positive environmental credentials over the car and other powered modes. However, whilst generally true, this is a gross oversimplification and sustainability performance varies considerably by mode, by occupancy, by power source and by service type. Sustainability does not just mean environmental performance, but should take into account the other "pillars" of sustainability – economic and social considerations too.

In this chapter basic information is provided on the patronage of public transport in the UK and its comparative performance. This is followed by a look at the influence of public transport on each of the three main components of sustainability: the economy, the environment and society. The chapter concludes with an assessment on what needs to be done for public transport to meet the rising expectation of high quality in all our consumer services.

#### Public Transport Patronage

In 2004, buses and coaches carried 48 billion passenger-kilometres and rail 52 billion<sup>1</sup>. Total movement in GB was some 797 billion passenger kilometres,



meaning that both buses and coaches and rail had a market share of some 6% each. In terms of passenger journeys, national rail and London Underground each carried approximately 1 billion journeys. Buses carried some 4.7 billion and tram and light rail some 175 million. On average, each person in Great Britain made 1044 trips per year of which 63 were by bus and 23 by rail. Other data is shown below.

<b>Mode</b>	<b>Trips / year</b>
Walk	245
Cycle	14
Car Driver	435
Car Passenger	236
Bus	63
Rail	23
Other Public	15
<b>TOTAL</b>	<b>1031</b>

Thus public transport represents only some 10% of trips made in Great Britain, or just 12% of total travel, taking into account the longer average journey lengths by rail.

### **Economic Impacts**

The Eddington Report<sup>2</sup> has drawn attention to the vital contribution of transport to securing the UK's economic productivity and competitiveness. Public transport supports the country's economy by moving people to workplaces, to education establishments, to shopping centres and markets and to places of recreation and entertainment. It therefore facilitates economic exchanges. Public transport is particularly efficient for moving large numbers of people to congested destinations in town and city centres. Indeed London would scarcely be able to operate without the accessibility supplied by the public transport networks to the central area and its business centres. As Britain has moved from a manufacturing to a knowledge-based economy, the centres of our towns and cities have become of increasing importance to the city and regional economies<sup>3</sup>. These centres are served by commuter and intercity rail services and by bus services from more local catchments.

Traditional transport economics looks at the direct user benefits, the externalities achieved by reducing highway traffic to manageable levels and, increasingly, the wider economic benefits such as agglomeration, where businesses operating in close proximity stimulate higher productivities<sup>4</sup>.

Against this must be set the public support for rail and bus. Government support for the railway is running at some £6 billion per annum, including support for Network Rail and to the train operating companies through franchising arrangements. Support to the bus industry is estimated at £2.5 billion in 2007<sup>5</sup>, including fuel duty rebate and supported services purchased by local authorities where insufficient service is provided commercially by private operators.

## **Environmental Impacts**

Climate Change is the most pressing contemporary issue. Emissions from transport sources comprise about 28% of total GB carbon emissions, but bus and rail contribute about 1% each to the overall national statistics, with other road vehicles making up the greatest proportion (24% out of the 28%).

Transport emissions also contribute to poor air quality and several pollutants (CO, Hydrocarbons, NO<sub>x</sub>, PM10, SO<sub>2</sub>)<sup>6</sup> have been identified as causing damage to health. Diesel, a key power source for both buses and rail, is a strong contributor to PM10 and NO<sub>x</sub>. However, the introduction of ultra-low sulphur diesel (ULSD) allows the use of exhaust treatments that can substantially reduce these emissions and road-based emissions using Euro 3 and Euro 4 specifications are substantially cleaner. Rail is currently trialling ULSD with a view to making its supply universal.

The usual comparative statistics on carbon and other emissions looks at emissions per passenger-kilometre. In general, public transport is more energy efficient and less polluting than the private car and this provides the fundamental justification for its environmental credentials. This effect is most pronounced when occupancies are high. But overall sector-based analysis can be misleading and, for example, the emissions per passenger-kilometre from electric powered high-occupancy commuter rail services produces one-tenth of the emissions from a diesel powered rural rail service with relatively low occupancy.

Rail has also suffered some poor comparisons since the relatively long asset lives means slower progressive introduction of less polluting technologies, particularly compared to the highway private vehicle fleet. Further details on comparative emissions and rates are shown in Figure 4 in the “Introduction and Current Position” section of this document and in the Rail Industry Report “The Case for Rail”<sup>7</sup>.

## **Social Impacts**

Sustainable Development must not only secure economic competitiveness and environmental protection but also contribute to the achievement of a strong, healthy, fair and just society (see also the chapter on Transport and Social Sustainability in this theme). Public transport, being available to almost everyone, provides the basic underlying accessibility to goods, services and opportunities that underpins a healthy society. Communities experiencing social exclusion and deprivation are particularly dependent on public transport accessibility.

Using public transport is a sociable experience. Passengers have to share space with each other and to respect their needs and interest. While this interaction can sometimes be the cause of conflict and dispute, for the most

part travelling by public transport helps to train young people to have regard for their fellow citizens.

Treating people with dignity and respect is a key aspect of a fair and just society and it is important that transport operators treat their staff well, avoiding any unfair discrimination in terms of recruitment, training and promotion. Transport staff should treat passengers with respect and similarly help and expect passengers to show similar courtesy.

Another aspect of a fair and just society is the right to be consulted on decisions that affect the well-being of individuals and communities. Those commissioning and providing transport services are now expected or required to consult with those who may be affected by service changes, including both new provision and service withdrawal. Some operators go further and publish corporate social responsibility reports, showing how they administer fairness to their staff, customers and the communities they serve, including, for example, charitable activities undertaken in the area.

### **Quality in Delivery of Public Transport Services**

Customer expectations of quality have grown across the myriad of goods and services that are supplied commercially. This expectation applies to public transport services particularly where a majority of the population has direct access to the use of a car. Increasing wealth and sophisticated marketing techniques have brought more discerning attitudes in all aspects of our lives, and poor quality products or services are unlikely to be purchased.

If we are to persuade more people to travel by public transport from choice, then the quality of service, the provision of information and ease and simplicity of use are all highly important. These will often be judged against the quality and comfort standards supplied by car manufacturers.

For too long, public transport, most particularly bus services, has been seen as the mode for those too old, too young or too poor to have any alternative. Fares that have risen faster than motoring costs, poor reliability and low standards of customer care for a captive market are not the way to grow patronage and economically sustain a service.

There are increasing examples of organisations procuring exclusive transport services, to meet their specific needs, such as multi-site hospitals and educational establishments being the most common. This has come about primarily because of the loss in confidence and reliance on the general bus service provision in the neighbourhood, which was not supplying adequate capacity, quality and reliability for their purposes.

Some of the University bus services, such as Southampton and Hertfordshire, have become important services for the wider community too. Some cities have established free City Centre Shuttle services, which appear to be very successful (e.g. Southampton, Leeds).

Transport for London (TfL) has been very successful in attracting more passengers to use the bus with some of the factors explaining this rise being high frequencies, flat-rate fares, Oyster cards to reduce boarding times and hence delays and unreliability, extensive bus priorities, and congestion charging in Central London.

Outside London the few towns with successful and growing bus patronage, such as Brighton, Nottingham and Oxford, combine strong limitations on car parking with simplified bus routes, strong route branding and flat-rate fares, all of which contribute to making it easier to use buses, for all sections of the community.

## Conclusions

It is accepted that public transport cannot be a substitute for many journeys – particularly those in less built-up and rural areas with diverse origins and destinations.

As pressure increases for more sustainable transport, whether this arises from reduced availability and increasing cost of fossil fuels or from policies such as carbon rationing to limit climate change, then public transport will have an increasingly crucial role to play. This is particularly important in delivering accessibility in many of our communities.

We should therefore be striving for a high volume, high quality public transport network that meets the needs of discerning customers, if we are to meet the challenges of future mobility.

## References

- 1 “Transport Statistics Great Britain”, Department for Transport, 2006 edition
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- 4 See Web TAG Unit 3.4.12
- 5 Source: Secretary of State for Transport speech to Parliament, 12 December 2006
- 6 “The Case for Rail 2007”, Rail Safety and Standards Board, 2007, [www.rssb.co.uk](http://www.rssb.co.uk) – accessed June 2008

## Issues and Recommendations

- The quality and quantity of public transport can be genuinely enhanced with greater innovation, thought and challenge. Public transport should therefore sit at the heart of local transport policy and practice.
- Sustainable Development must not only secure economic competitiveness and environmental protection but also contribute to the achievement of a strong, healthy, fair and just society. Public transport, being available to almost everyone, provides the basic underlying accessibility to goods, services and opportunities that underpins a healthy society. Communities experiencing social exclusion and deprivation particularly require public transport accessibility. Finally, it is important to note that where car use is constrained public transport thrives.
- If more people are to be persuaded to travel by public transport from choice, it is essential that the quality of service, the provision of information, ease and simplicity of use will need to outweigh the quality and comfort standards supplied by car manufacturers.
- Treating people with dignity and respect is a key aspect of a fair and just society and it is important that transport operators treat their staff well, in terms of recruitment, training and promotion. It will also be an advantage if transport staff treat passengers with respect and similarly help and expect passengers to show similar courtesy.
- It is advisable that those commissioning and providing transport services would consult with those individuals and communities who may be affected by service changes, including both new provision and service withdrawal.
- It is considered that if the challenges of future mobility are to be met, then public transport has a crucial role in delivering accessibility in many communities. To achieve this, local transport organisations should strive for a high volume and high quality public transport network that meets the needs of discerning customers.

## 4.4 Road User Charging and Parking Demand Management

### Introduction

The potential scope of transport demand management (TDM) measures to influence travel behaviour has been recognised for some time. There are a wide variety of TDM measures including those that improve transport options, those that offer incentives to reduce driving, parking control measures, land-use planning measures and policy reforms.<sup>1</sup> This chapter specifically examines the role of road user charging and parking control measures.

### Road User Charging

The concept of road user charging has been present in economic literature stretching back to 1844<sup>2</sup>. It has also been on the Government agenda for

some time. In 1964 the report *“Road Pricing: The economic and technical possibilities”*, was produced by a panel set up by the Ministry of Transport (now the Department for Transport). The issue of road user charging of some kind has been raised again and again at decreasing intervals ever since.

For example, the 1993 report *“Paying for better motorways: Issues for discussion”* identified two benefits of charging for road use pertinent to this chapter: firstly it was suggested that any scheme may contribute to lower emissions from motorised transport and secondly that there would be an element of landscape protection due to a reduction in necessary road capacity.

The Transport Act 2000 contained the enabling legislation for charging in the UK. It offered two charging options for local authorities: road user charging – direct charging for road use; and workplace parking levies – charging businesses for provision of workplace parking.

In 2002, the DfT’s *“Managing our roads”* report stated that *‘any scheme of nationwide road user charging should deliver environmental benefits’*. There have been numerous other reports concerning road user charging (specifically urban cordon based schemes) as a TDM measure, indicating that it could be a highly effective tool to address some of the country’s current transport issues.

However, to date this evidence has only led to the establishment of two schemes in England, the London Congestion Charge (an area licensing scheme) and the congestion-charging scheme in Durham city (a barrier based cordon charging scheme).

Figure 1 shows the typical overlapping objectives of charging schemes.

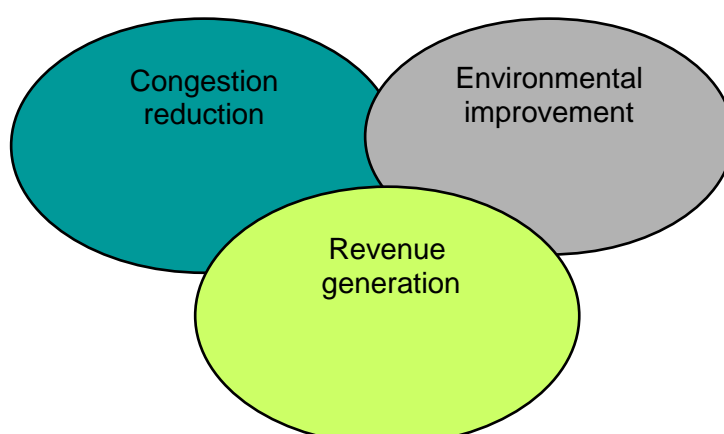


Figure 1: Road User Charging Objectives

There are a number of areas currently involved in the Government’s Transport Innovation Fund (TIF) “pump-priming” studies looking at the potential of TDM

measures to address congestion. Each of these includes examination of the role of road user charging as part of a potential solution. These investigations may in some cases lead to firm road user charging scheme proposals in due course.

The area with the most advanced scheme is Greater Manchester, which has secured Programme Entry status for its package of investment and charging proposals and will undertake formal consultations this year. Other areas considering charging include Bristol and its three adjoining unitary councils making up the West of England Partnership, and Cambridge, Reading and Leeds.

It is important to note that road user charging is not limited to schemes such as those operating in London and Durham. It also extends to include multi-cordon and zonal charging schemes: distance based charging schemes and others such as toll roads (for example the M6 Toll road north of Birmingham) and toll bridges.

Figure 2 shows the predicted impacts of charging schemes, and demonstrates how, in addition to a direct impact on car use resulting from increased cost of travel, they also have potential to raise revenue to support improvements to alternative modes of travel to the private car, particularly public transport services, which in turn enables behavioural change.

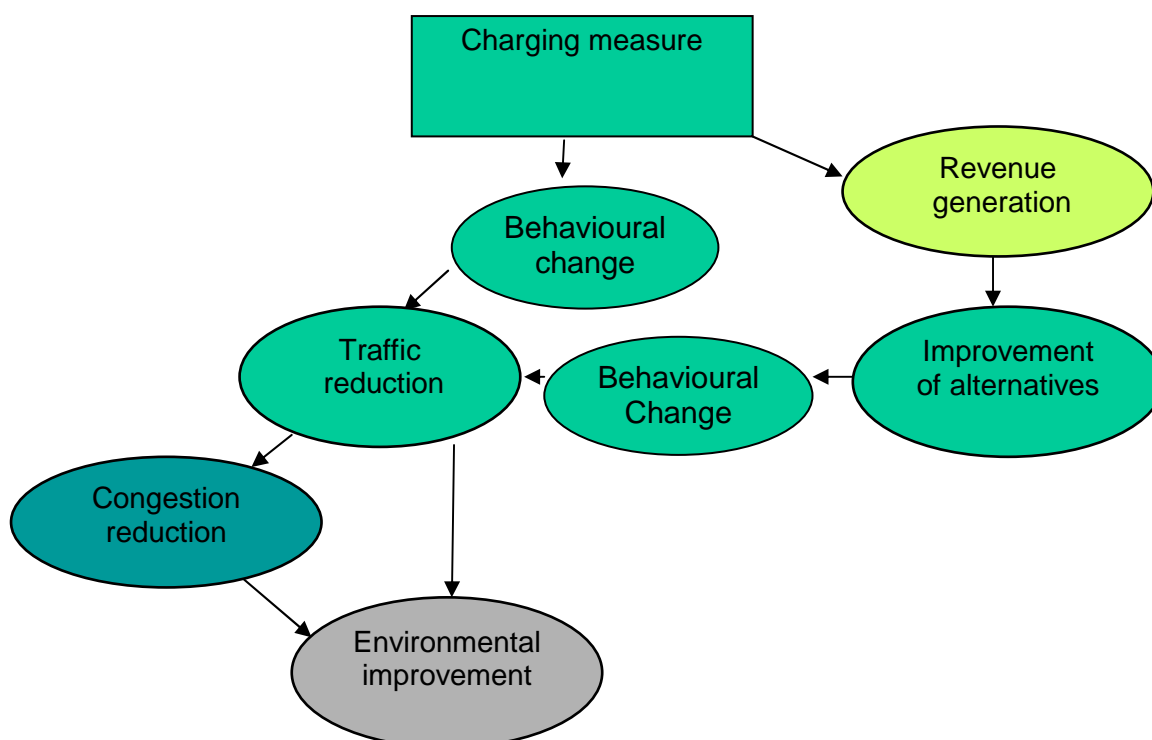


Figure 2: Road User Charging Impacts

There are numerous reasons why, in spite of a growing body of evidence for the benefits of road user charging, few projects have been advanced beyond the planning stage. It is suggested that the primary reason is the negative attitude of the general public towards the suggestion of any road user-charging scheme as a consequence of a range of real and perceived concerns.

The main objections as summarised by Kokac *et al* (2003)<sup>3</sup> include the perceptions that: motorists are being penalised (due to the lack of alternative modes of transport); charging is not an effective means of reducing congestion; charging represents '*just another tax*' and as a tax it is not fair. There are also technology and privacy concerns. That public feeling is considered to be so negative presents a real challenge for politicians who are considering the possibility of road user charging.

One reason, which has been cited for such strong negative public opinion, is the way in which the concept has been publicised. There has been little clarification of exactly what the Government means by road user charging leaving the public and press to define it themselves. In addition, where the TIF pump-priming bids have been detailed in the local press, the terms road pricing or road charging have frequently been used, thus leading the reader away from the more positive connotations associated with terms such as congestion charging. Further, references to associated public transport improvements have been vague or even absent (IPPR, 2006)<sup>4</sup>.



However there is evidence to suggest that these perceptions can be altered if the concept is presented in an alternative way. Where road user charging is presented as part of a package of measures including, for example, improvements to public transport services and reductions in taxation, it is much more readily accepted.

It is acknowledged that cutting congestion can have an impact on the levels of harmful air pollutant and greenhouse gas emissions generated by transport. Further it is recognised that the implementation of road user charging creates a disincentive to travel by car and therefore results in fewer cars on the roads. There is some published evidence which backs up this proposition.

In Stockholm a seven-month road user charging trial was conducted to test the effects such a scheme would have on the city. The scheme was based around 18 control points located at the entrances and exits to the city. The results of the trial indicated that there had been a drop in local air pollutant emissions of between 8% and 14%, with a 40% reduction in greenhouse gas emissions across the city<sup>5</sup>.

There is also some published data on the effects on air quality of the London Congestion Charge. It is estimated that, as a direct result of the scheme, Nitrogen Oxide (NO<sub>x</sub>) emissions have fallen by 8%, particulate matter by 7% and Carbon Dioxide by 16%<sup>6</sup>.

In Durham City an 85%<sup>7</sup> reduction in vehicle traffic (in the congestion charging zone) would suggest an associated decrease in vehicular emissions (although no monitoring has been conducted in this case). Further, in Stockholm a 25% reduction in traffic volumes was reported and in Rome a 10% reduction<sup>8</sup>.

However, there has been some concern that the effect of road user charging on the climate is under investigated. The DfT has suggested that *'the impact upon carbon is not entirely clear-cut'*<sup>9</sup>. This is due to the possibility that such schemes may discourage people from buying more fuel efficient cars, if the charge was the same regardless of emission rating of vehicle and the potential that no reduction in traffic would be achieved if the scheme was cost-neutral<sup>10</sup>. That is if a scheme was implemented alongside reduced fuel duty and/or vehicle excise duty thereby eliminating any overall increased cost to the public).

## **Parking Control Measures**

Limiting the availability of parking spaces, charging for their use or a combination of both is currently one of the most well-known demand management tools used in city centres. However, as discussed earlier, reducing congestion levels in a specific area does not necessarily have the predicted impact on greenhouse emissions.

Car park charging specifically has long been posited as a method of reducing congestion because it increases the overall journey cost. As far back as 1956

it was recognised that allocating pricing structures to car parking could affect demand for parking spaces and thus traffic levels<sup>11</sup>. It is also possible to influence modal choice by removing the opportunity to park at popular destinations (except for groups with the most need, for example those with disabilities).

Although it may appear that car parking TDM measures are a very powerful tool in the reduction of congestion one must also consider the 'ripple effect'. Therefore it is essential that the potential consequences of implementing or altering parking charges should be carefully considered. For example charging high prices in an area may lead to drivers parking slightly further away in a free area but where their vehicles cause greater inconvenience to others. Further, having varying parking charges may lead to an increase in drivers searching for a space, thus increasing congestion<sup>12</sup>.

Literature suggests five potential effects of the implementation of a car parking charge: a change in the journey start time; a change in mode choice; a change in parking location; a change to journey destination; or total abandonment of the trip<sup>13</sup>.

There is evidence to suggest that the implementation of charges (for example at workplaces) can have a substantial influence on mode choice. In 2002 the DfT conducted a review of 21 workplaces that had implemented site-specific travel plans, which included an element of car park management and pricing. This found a 14% reduction in driving alone<sup>14</sup>. A similar study of international employment locations found 19% to 81% fewer employees drive to work alone when they pay for their own parking.<sup>15</sup>

Nottingham City Council conducted a widespread public consultation exercise culminating in a public examination into a proposed workplace parking levy (WPL) scheme for the city in autumn 2007. The council confirmed its approval to submit the legal Order to implement the scheme for Government approval in May 2008. The council considers this approach as a relatively cost-efficient alternative to road user charging and which would have a modest direct impact upon congestion levels in the city. It is also intended to secure the associated investment in public transport expansion, particularly the second and third lines of the City's successful tram system. The scheme has met with considerable opposition from businesses based in the city.

With regard to parking taxation, some methods are more effective than others. A general tax on all spaces tends to encourage urban sprawl and unevenly distribute the burden of the tax; conversely a per space levy encourages the restriction of parking supply and encourages the pricing of parking<sup>16</sup>.

## Conclusions

Road User Charging is not a new concept but the delivery of such an approach remains controversial at both the local and national level. Charging schemes have the ability to influence choices of travel, aiming to reduce

demand on the existing highway network, and improving the environment. It can also provide valuable revenue for the promotion and development of alternative modes. If they are to be successful, action needs to be taken towards promoting the positive aspects of schemes, counteracting the opinions generated through negative press coverage.

Car parking demand management measures have the possibility to significantly influence modal choice, but care needs to be given in particular to the migration of congestion to other areas. As with road user charging, parking control measures can also provide revenue support for improving access to public transport. It is therefore also considered important to ensure that these positive aspects of schemes are promoted to gain acceptance from travellers.

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### Issues and Recommendations

- Road user charging has an important role to play in an integrated and equitable transport network with particular reference to urban areas. However, the arguments to promote such schemes need to be well prepared and that the benefits in terms of reduced congestion, CO<sub>2</sub> emissions, and improved public transport services are clearly demonstratable .
  
- The Transport Act 2000 contained the enabling legislation for charging in the UK, offering two charging options for local authorities and should be considered in the context of the above:
  - Road user charging – direct charging for road use; and
  - Workplace parking levies – charging businesses for provision of workplace parking.

It also extends to include multi cordon and zonal charging schemes, distance based charging schemes and others such as toll roads (for example the M6 Toll road north of Birmingham) and toll bridges.

## 4.5 Transport and Social Sustainability

### Introduction

Sustainable development is commonly regarded as having three constituent elements: environmental, economic and social. While the relationships between transport and the first two “pillars” of sustainability are now generally well known, the connections between transport and social sustainability are less well defined and less well understood by transportation professionals. This chapter sets out to describe and explain some of these linkages.

Definitions of social sustainability generally reflect a concern about the rights of individuals and communities to enjoy the pursuit of healthy and socially rewarding lives, free from discrimination, danger, crime and antisocial

behaviour. Social sustainability often reflects a concern about the distribution across society of non-material goods and well-being. In the United States this has become known as “environmental justice”<sup>1</sup> or, for transport applications, “just transportation”.

The transport issues of most relevance to this discussion are those that affect the lives and well-being of the community including, for example, safety; personal security; accessibility for disabled people; health impacts; community engagement and consultation; social inclusion; equal opportunities and fair treatment for customers and staff. As transport becomes subject to new types of scrutiny, such as health impact assessments and equality impact assessments, such knowledge will become increasingly important to all working in the transport industries.

### **Types of Social Impacts**

Transport impacts on society broadly fall into three categories. First, transport provides access to goods and services, many of which are necessary for achievement of personal social welfare and satisfaction. The facilities that provide opportunities to meet these needs and desires are spatially distributed and access to these facilities requires use of a transport system with particular characteristics and qualities of service. The combination of the spatial location and these service characteristics determines the passenger capabilities and resource requirements necessary to attain access. But as these resources are not equally available between different people, there is a social impact where some people are unable to reach the places they want to visit, or the cost, time or effort is too great. The best single reference source for more detailed descriptions of these issues remains the report on “Making Connections” by the Social Exclusion Unit<sup>2</sup>.

Examples and issues here include:

- physical capabilities of travellers – can elderly or disabled people get to and board the vehicle?
- financial resource – can those on low income afford the fares to reach their destination?
- time – do the transport service routes and frequencies allow the trip to be made at the desired time of day and within a reasonable elapsed time?
- does the transport service offer acceptable conditions – for example in terms of perceived personal safety and avoidance of experiencing anti-social behaviour?
- is information about the transport service available and easily understood by everyone, for example people with learning difficulties or those with limited English?

A number of consequences flow from this definition. First, it is clear that the capabilities and characteristics of the individual traveller are important in determining whether they can utilise the transport system. The issues of

social impacts are inevitably bound up with the distribution of costs and benefits to different groups or classes of people and hence social and distributional issues are often discussed together.

Second, there are considerable knock-on consequences of failure to gain access. If someone is unable to visit an elderly relative then alternative caring arrangements may be required. This not only has a financial cost, but also an emotional cost for both parties. If a healthcare journey is too arduous people may defer a visit to the doctor with consequent impacts on their health and well-being. If people are not able to meet with friends and relatives their lifestyle, quality of life and happiness may be adversely affected.

These can all have real long-term societal and community consequences and financial costs in terms of healthcare, mental health services, social services, etc.

Third it is also clear that access to independent personal means of mobility, such as a car, is an important contributory factor to personal well-being. People without such access are essentially captive to their local facilities and lack the opportunity to travel to reach destinations offering higher qualities of service.

The second group of transport social impacts concerns the externalities of transport systems in terms of the pollution, noise, disturbance, health and safety impacts that they create. Analysis of road safety impacts involves an understanding of the pain, grief and suffering experienced by the victims of road collisions, their relatives and friends. Increasingly there is recognition of the trauma suffered by drivers of public service vehicles who have been involved in an incident, for example train drivers who have been involved in suicide incidents.

The effects on health of prolonged exposure to pollutants caused by transport emissions, or noise levels that affect health and performance of everyday tasks, can also be counted as a social effect. Traffic flow in a street with its potential for creating severance is a key determinant of the amount of social interaction between neighbours, an important indicator of social well-being.

Finally, the third set of issues on transport and social sustainability concerns rights and social justice. Transport passengers should be treated with dignity and respect as they interact with transport service providers, their agents and information bureaux. Transport staff, especially front-line staff, should also be treated well not only by their customers, but also by their employers and management. Fair recruitment and selection procedures are an integral part of a fair and just society and contribute to social well-being and satisfaction.

Increasingly people expect to be consulted about transport proposals that affect them, for example in terms of railway franchise service specifications. Consultation and the way in which it is managed, contribute to standards of social justice that are valued as important to personal and community well-being. Many enlightened organisations are now making voluntary public

reports on their corporate social responsibility performance, including not only environmental performance, but also their wider contribution to society through their treatment of staff and engagement in other external charitable activities that support the local communities on whom they rely for their custom. This community engagement and accountability is a part of the social sustainability agenda “to create a strong healthy and just society”<sup>3</sup>.

## Conclusions

There is an increasing recognition that our intrinsic well-being or happiness is not simply related to economic and environmental welfare, but includes, perhaps more strongly, other influences on life satisfaction. Although material welfare is an important component of personal satisfaction, there are many other influences including personal status and fulfilment, good physical and emotional health, respect from peers, relationships with family and friends and participation in community activities.

As we seek to recognise and take account of these issues in Government investment programmes, awareness of the transport influence on social sustainability are likely to increase in importance. Equality Impact Assessments and Health Impact Assessments of transport policies, projects and schemes seem likely to become more frequent and transport professionals will need to understand better the social impacts of our activities.

However, the evidence would suggest that such considerations of transport influence and consequential social impact importance are still not always recognised. Even for key service organisations such as The Post Office, would so many Post Office closures resulted if Equality and Health Impact Assessments of consequential personal transport implications been included in the considerations?

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- <sup>1</sup> “Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low –Income Populations”, US Department of Transportation, 1994, <http://www.fhwa.dot.gov/environment/ej2000.htm> - accessed August 2008
- <sup>2</sup> “Making the Connections: Final Report on Transport and Social Exclusion”, Social Exclusion Unit, Cabinet Office, 2003
- <sup>3</sup> “UK Sustainable Development Strategy”, DEFRA, 2005

## Issues and Recommendations

- Accessibility is directly related to quality of life, and is influenced by a broad range of stakeholders beyond the transport sector. As such, there is a need for closer co-operation between sectors (in particular transport, health, education, social services, media, culture, and sport) to develop truly sustainable society.
- Definitions of social sustainability generally reflect a concern about the rights of individuals and communities to enjoy the pursuit of healthy and socially rewarding lives, free from discrimination, danger, crime and anti-social behaviour. With regards to transport, transport professionals should particularly consider the issues that affect the lives and well being of the community. These include safety, personal security, accessibility for disabled people, health impacts, community engagement and consultation, social inclusion, equal opportunities and fair treatment for customers and staff.
- It is contended that as transport becomes subject to new types of scrutiny (e.g. health and equality impact assessments), such knowledge will become increasingly important to those working in the transport industries and an understanding of how transport impacts on society will be essential. For example, the social impacts which occur when people are unable to reach the places they want to visit could include high cost, time or effort.
- It is clear that the capabilities and characteristics of the individual traveller are important in determining whether they can utilise the transport system. The issues of social impacts are inevitably bound up with the distribution of costs and benefits to different groups or classes of people and hence social and distributional issues should be discussed together. The knock-on consequences of failure to gain access can clearly be considerable.
- Equality Impact Assessments and Health Impact Assessments of transport policies, projects and schemes seem likely to become more frequent and therefore transport professionals will need to understand better the social impacts of society activities.



## **5. TECHNOLOGY AND SAFETY**

### **General Introduction**

The concept of sustainable development does imply limits, which are set by the current state of technology and by the biosphere's ability to absorb the effects of human activity. With the clear evidence of climate change, using technology to allow economic growth without further detrimental impact on the global environment has become a priority.

A sustainable future will require both technology, to enable activities to be conducted in ways that cause less damage to the environment, and management of the demand for activities, including transport. At the same time, society must adapt to the effects of climate change that cannot now be avoided.

This theme covers what can be done to reduce the consumption of fossil fuel by road vehicles, and the changes that are needed in the construction and maintenance of highway infrastructure to enable it to perform well under the climatic conditions expected in the next few decades. It also summarises the current position on transport safety, concentrating mainly on road safety.

### **5.1 Vehicle Efficiency and Alternative Fuels**

#### **Introduction**

Reducing carbon emissions from road transport will involve demand reduction, but also involves improving the efficiency of vehicles and the use of fuels and energy sources that emit less carbon than burning petroleum. To date, the limitation of carbon emissions by the UK car fleet has been achieved wholly by improvements in vehicle efficiency, which is politically much easier to achieve than reductions in demand for travel.

This paper reviews how road vehicle efficiency can be improved, the value of alternative fuels such as biodiesel and the scope for alternative energy sources. It will consider both freight and passenger transport. In passing, it should be noted that similar improvements have been occurring for other modes of transport. The switch from steam to diesel for railways greatly improved the energy efficiency of trains, and civil aviation has improved its fuel consumption per passenger kilometre very substantially, but not enough to match the growth in demand for air travel.

During 2007 and 2008, a number of studies have been made of ways to reduce carbon emissions from road transport. The most significant of these are from the Commission for Integrated Transport: "Transport and climate change – Advice to the Government from the Commission for Integrated

Transport” (2007)<sup>1</sup>; “The King Review of low-carbon cars – Part I: the potential for CO<sub>2</sub> reduction (2007)<sup>2</sup> and Part II: recommendations for action (2008)<sup>3</sup>”; and “The Gallagher Review of the indirect effects of biofuels production” (2008)<sup>4</sup>.

The Commission for Integrated Transport, (CfIT) report is mainly about policy ways to reduce carbon emissions from transport. For cars, its main advice is to seek to adopt a mandatory target for new car sales in the EU to achieve an average 100 g CO<sub>2</sub>/km by 2020 complemented by a package of supporting measures. It also recommends reinforcing positive driver behaviour through a combination of measures to sustain fuel prices, encourage eco-driving techniques and promote greater adherence to road speed limits. The King and Gallagher reviews provide considerable information on technical topics, and results from these studies will be used in this section.

It is not generally realised how well the fuel economy of new cars has improved in Britain. Excluding 4-wheel drive vehicles, the fuel economy of new cars has improved from 28.9 miles per gallon in 1977 to 37.9 miles per gallon in 2004 (Figure 1). (DfT Transport Statistics GB 2006 Table 3.5)

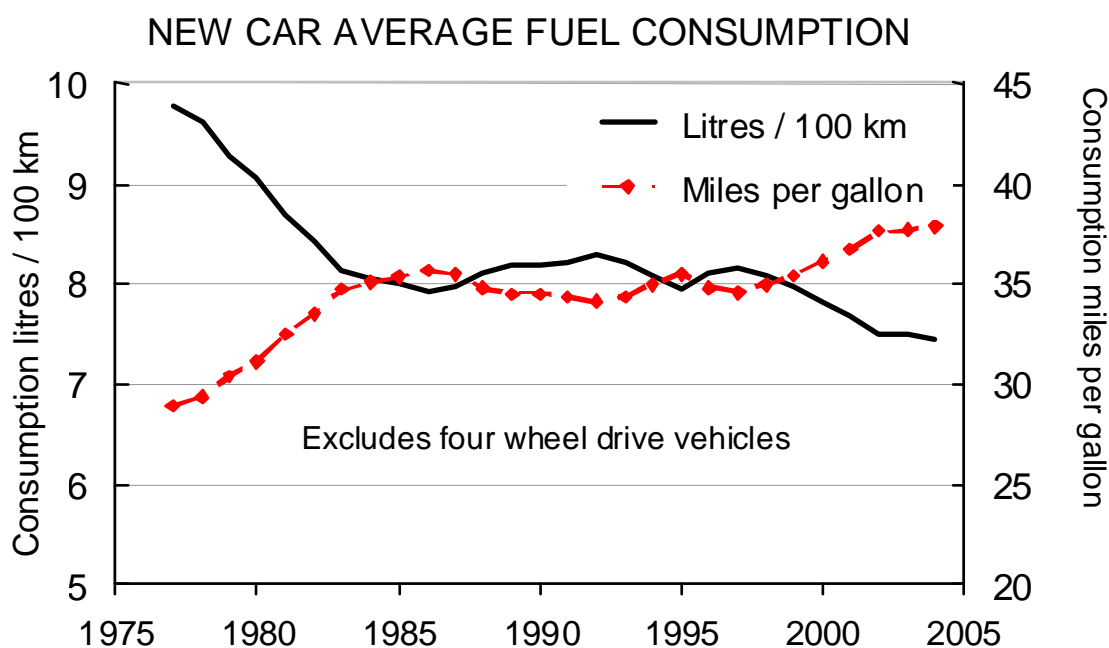


Figure 1 New car fuel consumption, excluding 4 wheel drive vehicles - Great Britain  
Transport Statistics GB 2006 Table 3.5

However, including 4-wheel drive vehicles, the fuel economy of the car fleet in service has only improved from 31 mpg in 1993 to 33 mpg in 2005 (9.2 to 8.7 litres/100 km, about 6%) (Figure 2) (DfT Transport Statistics GB 2006, Table 3.5). This result is based on reports by drivers in the National Travel Survey, and is not consistent with the measured total fuel consumption for the car fleet

that has not increased since 1995 despite an increase in car traffic of almost 15% over the same period.

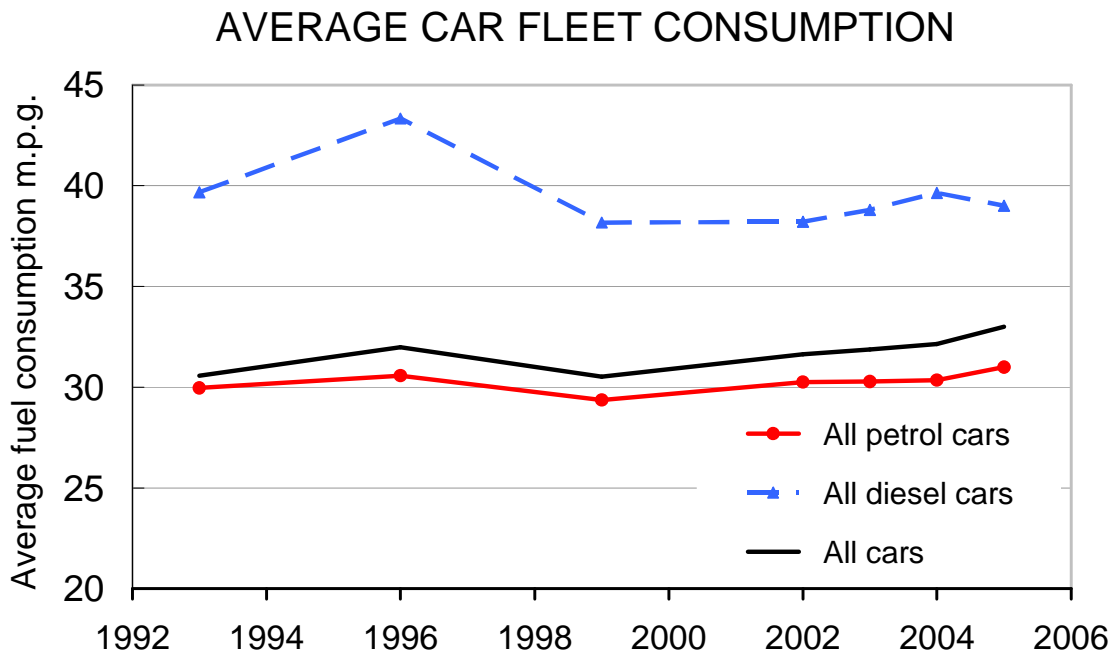


Figure 2 Fuel consumption of car fleet in service, including 4-wheel drive vehicles  
 Transport Statistics GB 2006, Table 3.4

Goods vehicle fuel consumption has also improved, but not enough to match the increased mileage by goods vehicles in service (Figure 3).

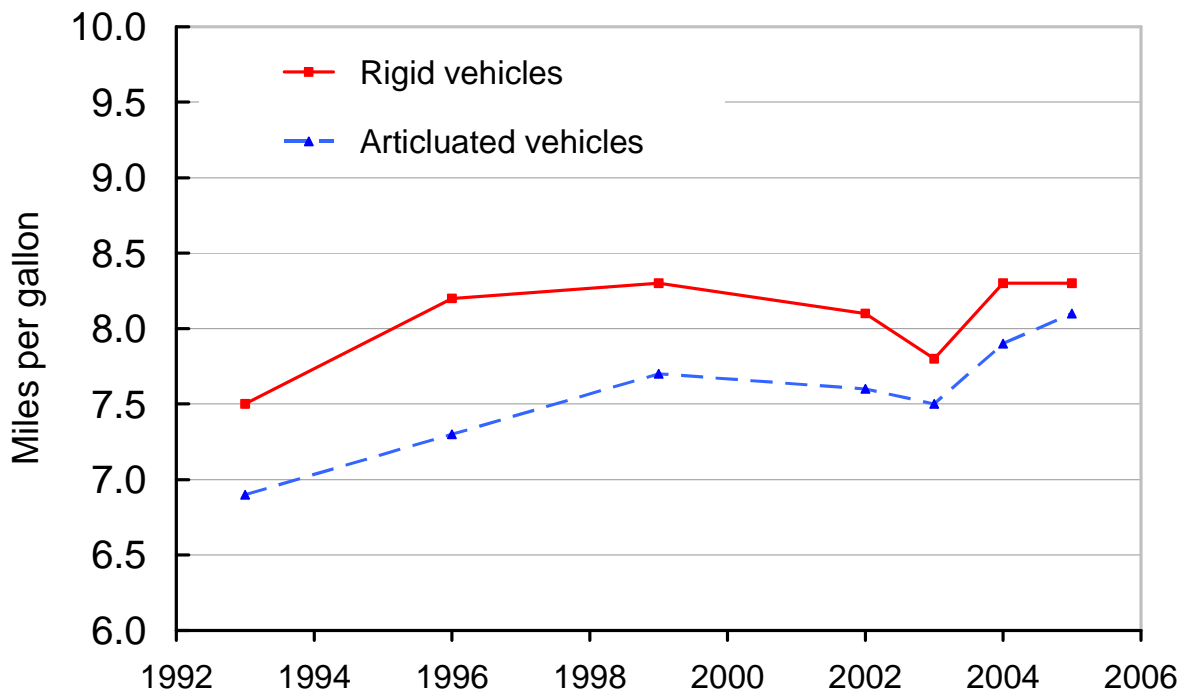


Figure 3 Fuel consumption of heavy goods vehicles in service  
 Transport Statistics GB 2006, Table 3.4

### Factors that Reduce Fuel Consumption-Cars

Despite its age, a good general research report on the efficiency of cars propelled by internal combustion engines is “Research on fuel conservation for cars” by Waters and Laker<sup>5</sup>. This identifies the four factors that affect fuel consumption as the driver, the vehicle, the road system and traffic conditions.

For otherwise similar conditions, drivers can change fuel consumption by about 12% by driving more or less economically. Department for Transport figures from the introduction of safe and fuel-efficient driver training (SAFED) in the freight industry point to fuel savings of between 2% and 12% across 15 case studies (CfIT, 2007). Other research studies show reductions in fuel consumption in the range of 5% to 15%. In addition, because fuel consumption is abnormally high for the first few kilometres after a cold start (double after 1 mile, 65% up after 2 miles, 10% up after 12 miles), a driver can save fuel by not making very short journeys.

Fuel consumption of a car is affected by the mass of the vehicle, the rolling resistance, aerodynamic drag, the transmission and the size and type of engine. Sensitivities to these factors depend on the driving conditions (aerodynamic drag has little effect at low speed in urban areas); indicative sensitivities for urban and rural driving from this 1980 paper are shown in Table 1.

Table 1 Sensitivity of car fuel consumption to design changes  
 (TRRL LR 921)

Factor	Urban driving	Rural driving
Vehicle mass	20% reduction saves 6%	20% reduction saves 4%
Rolling resistance	20% reduction saves 3%	20% reduction saves 3%
Aerodynamic drag	Little effect	20% reduction saves 6%
Final drive gear ratio	Little effect	Overdrive saves 10%
Diesel engine	At least 25 - 30% saving	At least 25 - 30% saving

The report summarises these savings as the following potential gains in fuel consumption for the car fleet.

Reduced weight, drag and rolling resistance 10%

Matching engine and transmission for fuel saving	10%
Change to higher efficiency engine	25%
Reduction of out-of-tune condition	5%

Overall, this would have led to a reduction in fuel consumption from 10 litres/100 km to 6 litres/100 km, which has largely been achieved.

A more recent study considered how the fuel consumption of road vehicles was affected by speed, engine capacity, fuel type and whether the engine was cold ("Methodology for calculating transport emissions and energy consumption" TRL Project Report SE/491/98, 1999, Deliverable 22 for the European Commission project MEET (Methodologies for estimating air pollutant emissions from transport))<sup>6</sup>.

This shows the benefits of smaller engines and the use of diesel fuel (Table 2 and Figure 4).

Table 2  
 Effect of speed and engine capacity on carbon dioxide emissions  
 from EURO 1 cars

Fuel type	Cylinder capacity litres	Speed range km/h	Emission factor g/km
Petrol	CC < 1.4	5 - 130	$157 - 2.07V + 0.0172V^2 + 1835/V$
Petrol	$1.4 < CC < 2.0$	5 - 130	$231 - 3.62V + 0.0263V^2 + 2526/V$
Petrol	CC > 2.0	5 - 130	$294 - 5.50V + 0.0393V^2 + 3513/V$
Diesel	All categories	10 - 130	$286 - 4.07V + 0.0271V^2$

Source TRL Project Report SE/491/98 Tables A.17 and A.19

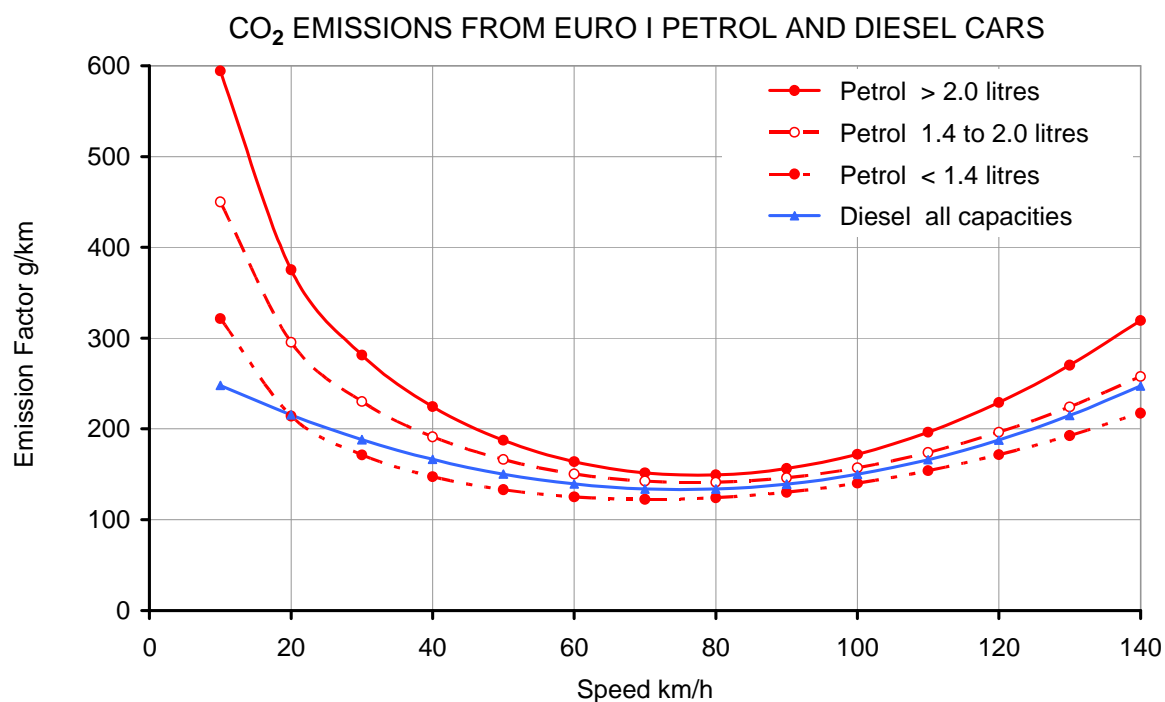


Figure 4 CO<sub>2</sub> emission factors from TRL Project Report SE/491/98

The King Review Part I concludes, that “In the long-term (possibly by 2050 in the developed world), almost complete decarbonisation of road transport is a possibility. If substantial progress can be made in solving electric vehicle technology challenges and, critically, the power-sector can be decarbonised and expanded to supply a large proportion of road transport demand, around a 90 per cent reduction per kilometre emissions would be achievable across the fleet...

...it is also important to start reducing emissions in the short term, through development and implementation of improvements to established automotive technologies... This Review's analysis indicates that, by 2030, emissions per kilometre could be around 50 per cent below 2000 levels. This would be partly offset by the projected increase in distance travelled, implying an overall reduction in UK emissions from car use of approximately 30 per cent by 2030...

To achieve this goal, substantial progress is needed across the board:

- cleaner fuels;
- more efficient vehicles; and
- smart driver choices.”

“In the nearer term, considerable CO<sub>2</sub> savings can be achieved through enhancements to conventional vehicle systems. Technology that can reduce CO<sub>2</sub> emissions per car by 30 per cent (on a like-for-like basis) is already close to market and could be standard within 5-10 years. Despite the likely vehicle cost increases (estimated at £1,000 - £1,500 per new vehicle), many of these

changes are likely to represent good economics to the purchaser, as a result of their impact on fuel economy. However, demand-side and supply-side barriers are currently delaying their deployment. Ensuring these technologies are quickly brought to market constitutes a major policy challenge and will have a major impact on emissions reductions from road transport in the coming years.”

“Technology achieves nothing if it is not adopted. Consumers must be engaged in order to reduce substantially CO<sub>2</sub> from road transport. The Review estimates that savings of around 10-15 per cent could come from consumer behaviour, much of this over the next few years.

Many small things can have a significant cumulative impact:

- demanding new technologies: choosing the most fuel-efficient model in the range or market sector can substantially reduce CO<sub>2</sub> and, critically, ensure low-carbon technologies are brought to market earlier. Downsizing vehicles would save much more;
- making the most of technologies: simple aspects of driver efficiency (for example, keeping tyres pumped up, controlling acceleration and not carrying unnecessary weight) make several percentage points difference to fuel consumption; and
- small reductions from avoiding low-value journeys, use of alternative means of transport, and more car sharing, would reduce emissions as well as congestion.”

Development of higher-powered small petrol and diesel engines, and low resistance tyres, continues. The King Review makes clear that the fuel economy of small cars will continue to improve. One threat to this is the trend to heavier vehicles as a result of improved occupant protection and the fitting of air conditioning, more extensive consumer electronics and entertainment systems, and a whole raft of features to improve comfort and convenience.

Road systems that permit steady running at constant speed reduce fuel consumption. When driving a small car in the range 70 to 110 km/h, at any speed the fuel consumption on a motorway is about 1.7 litres/100 km less on a motorway than on general purpose roads (typically 6.7 litres/100 km compared with 8.4 litres/100 km at 80 km/h) (TRRL LR 921).

Congestion causes the achieved average speed to drop and fuel consumption to increase. On general roads, if average speed is reduced by congestion from 50 km/h to 15 km/h, fuel consumption per km doubles. Traffic management that achieves smoother driving at steady speed can save a few per cent of fuel consumption.

## **Factors that Reduce Fuel Consumption- Goods Vehicles**

There is less scope for reducing the fuel consumption of goods vehicles, partly because they already use very efficient diesel engines and transmissions, and partly because their role means that they cannot be made lighter or physically smaller (they exist to move mass and/or volume of goods). Engine performance continues to improve. A vehicle that used a 10-litre engine in 1980 would use a 7-litre engine today and will soon be using a 5 - 6 litre engine, for the same performance. Air drag is now being reduced by better streamlining, and can save 10-15% of fuel.

Figure 3 shows that fuel efficiency is improving, and will probably continue to improve, but is currently not improving as fast as goods vehicle traffic is growing. However, actions that reduce the total fuel used by HGVs are being promoted by the Freight Best Practice programme<sup>7</sup>. These include technical means such as streamlining, tyres with lower rolling resistance, improved engine efficiency, etc. and also by driver training, which can achieve a 10-15% reduction.

## **Alternative Power Plants**

Alternatives to the conventional internal combustion engine include hybrid propulsion (a vehicle fitted with an internal combustion engine, generator, electric motors and a large battery or fuel cell, so that it can be operated electrically or by internal combustion, depending on driving conditions), and solely electric propulsion using either batteries or fuel cells to store electrical energy.

Hybrid power plants can save energy overall, provided the greater efficiency of the combined propulsion system outweighs the greater mass of the vehicle. At present the benefits are rather marginal. There are also currently concerns regarding the life-cycle carbon impact of hybrids due to the materials required in their construction.

Electric propulsion is limited by the weight of batteries and their limited capacity for energy storage. This tends to limit vehicle range to around 100 - 150 km. Batteries are improving, but only very slowly. Fuel cells offer great potential, but are still in an early stage of development for use in small motor vehicles.

In the longer term, road transport must move towards electrical propulsion to reduce carbon emissions. As the King Review makes clear, this then puts responsibility for low carbon energy provision on to the electrical generation industry. This will inevitably cause the industry to invest in a mixture of technologies, including nuclear, tidal and/or wave power, wind power, and possibly coal-powered generation with capture and storage of CO<sub>2</sub> from the power station exhaust.



However, if the electricity is provided by oil or coal burning power stations, the overall carbon emissions for an electric vehicle fleet can be greater than would be produced by burning petroleum in internal combustion engines. There are also concerns over the capacity of Britain's generating and distribution system to handle the extra demand if the whole fleet of road vehicles were converted to electric propulsion.

## Alternative Fuels

There is current interest in alternative fuels for road transport, to reduce carbon and other emissions. These fall into a number of categories<sup>2</sup>.

- Gas, either compressed natural gas (CNG) or liquefied petroleum gas (LPG). These are slightly different chemically, which has an effect on their emission characteristics. They are used in spark-ignition engines.
- Bio-fuels, including:
  - Ethanol (alcohol), made by fermenting sugar from sugar cane, beet or other crops. Mixed with petrol and used in spark-ignition engines.
  - Biodiesel; fuel usable in a diesel engine made from one of a number of sources, such as oil palm or corn oil, waste cooking oil, processed biomass (food waste, fibrous vegetable matter, etc.). It is usually mixed with diesel fuel for compression-ignition engines.
- Hydrogen, used in spark-ignition engines.

Both the King Review and the Gallagher Review of the indirect effects of biofuels production consider the merits of the various alternative fuels. Comments from these reviews are included in the section that follows. Smith (2007)<sup>8</sup> considers specifically biofuels in terms of the carbon emissions from the complete life-cycle, and possible adverse effects on land-use and food production, and concludes that there are unanswered questions over biodiesel.

King comments "There is a large number of different fuel types (and sub-types) that could be used to power a car. Moreover, there are often several different ways of producing the same fuel (using different primary energy sources and production techniques)..."

"Biofuels can be made from a wide range of feedstocks: food crops (e.g. maize and sugar); non-food parts of crops (e.g. straw); dedicated energy crops (e.g. poplar, switchgrass and jatropha); agricultural waste; municipal waste and even algae. The importance of non-food feedstocks in expanding biofuel production sustainably is discussed later in this chapter."

"Biofuels can offer significant CO<sub>2</sub> savings compared with petrol and diesel. These savings vary widely depending on feedstocks used, farming method

and production technique. While CO<sub>2</sub> emissions from the tailpipe are exactly offset by those absorbed in the growing of feedstocks, there can be significant CO<sub>2</sub> emissions associated with farming (particularly the use of fertiliser) and the production process. Moreover, there are severe adverse climate change impacts if forest or grassland is cleared to provide land to grow feedstocks, because large quantities of CO<sub>2</sub> “locked-up” in the plants and soil are released.”

The Gallagher Review of biofuels<sup>4</sup> concluded that “that feedstock production *must* avoid agricultural land that would otherwise be used for food production. This is because the displacement of existing agricultural production, due to biofuel demand, is accelerating land-use change and, if left unchecked, will reduce biodiversity and may even cause greenhouse gas emissions rather than savings. The introduction of biofuels should be significantly slowed until adequate controls to address displacement effects are implemented and are demonstrated to be effective. A slowdown will also reduce the impact of biofuels on food commodity prices, notably oil seeds, which have a detrimental effect upon the poorest people.”

Overall, the general view could be summarised as supporting the position that first-generation biofuels are not sustainable and probable release as much or more carbon over their life-cycle than conventional fuels. Second-generation fuels are expected to mark a significant improvement in their life-cycle carbon emissions and result in a net benefit.

Ethanol added to petrol has been used successfully for many years in Brazil, where car ownership is low and land for sugar cane growing has, until now, been available.

Gas was used widely in New Zealand, but only when subsidised through the fuel tax system. When the subsidy was removed, use of gas ceased. Gas is being used in buses and taxis in a number of cities, to reduce noxious emissions, usually as a result of regulation. Hydrogen propulsion is being developed by all motor manufacturers. Problems include storage (either cryogenically at very high pressure or in metallic matrices), and the production of hydrogen which requires much electrical power.

## **Conclusions**

The fuel economy of cars has improved by about 24% since 1997, and there is no reason this improvement for cars will not continue. The fuel consumption of the car fleet, including 4 x 4s and MPVs, is reported to have only improved by 6% since 1993, although this is inconsistent with the slight fall in the total fuel used by cars since 1993, despite a 15% increase in car traffic. One reason for the relatively small reported improvement is the fashion for using large, heavy, bluff four-wheel drive vehicles on normal roads, as these have poor fuel consumption.

The fuel consumption of goods vehicles is being reduced, but the scope for savings is less than for cars.

Alternative electric propulsion is in an early stage, mainly because of the need for development of better batteries or fuel cells. Road transport must ultimately move to electric propulsion, but this will only reduce carbon emissions when electricity generation becomes much less carbon intensive.

The benefits of alternative fuels, other than hydrogen, which is in a very early stage of development, are marginal, with only small reductions in carbon emissions and possible adverse impacts on land-use and food production.

However, even if the first generation of bio-fuels are not sustainable and probably release as much or more carbon over their life-cycle as conventional fuels, the second-generation fuels are expected to achieve a significant improvement in their life-cycle carbon emissions and result in a net benefit.

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- 7 Freight Best Practice Programme, Department for Transport, <http://freightbestpractice.org.uk> – accessed June 2008
- 8 “Cars, Trains or Planes? Biofuels – food or fuel?”, Gail Smith, Presentation to the Cambridge Energy Forum, 8th Feb 2007

## Issues and Recommendations

- The fuel economy of cars has improved by about 24% since 1997, and there is no reason to believe that this improvement for cars (excluding four wheel drive vehicles) will not continue. The fuel consumption of the car fleet has improved by 5% since 1993. One reason for the relatively small improvement is the fashion for using high powered cars and particularly large, heavy, bluff four wheel drive vehicles on normal roads, as these have poor fuel consumption. These factors should be considered by fleet managers in order to successfully promote fuel economy.
- The cost of fuel represents 30% of the total cost of operating a goods vehicle. A reduction in fuel consumption per vehicle kilometre driven can be achieved by technical means such as aerodynamic streamlining, the use of tyres with lower rolling resistance and improved engine efficiency.
- Driver training has been shown to achieve a 10% reduction in fuel consumption (SAFED, a one-day course on Safe and Fuel Efficient Driving has been shown to produce a typical reduction in fuel consumption of 10%).
- Alternative electric propulsion is in an early development stage, mainly because of the need for development of better batteries or fuel cells, but should be considered for urban area use. Road transport must ultimately move to electric propulsion but this will only reduce carbon emissions when electricity generation becomes much less carbon intensive.
- The description of Bio-fuels as a single category is over-simplistic. Some bio-fuels offer real savings in carbon emissions over the complete fuel cycle with few adverse environmental effects. Others offer little or no saving in carbon emissions and have large effects on land use and food production. It is necessary to assess the benefits of different bio-fuels separately and promote those that are truly sustainable.

## 5.2 Changes required in Engineering Design Standards and Material Specification

### Introduction

It is only in the last few years that scientific evidence regarding climate change has been gaining wider acceptance. Exceptional flooding and sustained high temperatures have produced devastating results for populations worldwide with the UK experiencing meteorological event maximums since records began.

For engineers and transport professionals it is considered that a new awareness is required to recognise that current design and material specifications must be sustainable and reflect more appropriately the forecast changes in climatic conditions particularly for the UK.

## **Background**

The key issues of higher temperatures and associated events of flooding, wind, drought and storm will therefore need a review of infrastructure design approaches to safety, durability, and sustainability to prepare for these forecast changes and resultant 'severe' conditions projected for the UK. For example it is projected that the June 2006 high temperatures experienced in France and the UK will represent the average summer by the mid 2040s. In addition, predicted changes to UK extremes by the 2080s (UKCIP02)<sup>1</sup> suggest ten to twenty times increase in hot summer days with 50% reduction in frosts and substantial reductions over the whole UK of snowfall totals, but three times the number of heavy winter rainfalls.

The flooding across the UK in July 2007 promoted sustained high levels of media cover with the result that £200M was added to the flood defence budget and for the Environment Agency to decide how to spend it. However, for highway authorities of both central and local government, the need to consider such severe events and their impact on road pavements, bridges, culvert, embankments and earth retaining structures should also be given equal priority.

Particular reference should also be given to design criteria for future infrastructure developments to withstand such forecast severe events. All key elements of the highway and rail infrastructure in such sensitive areas are already at various levels of risk as experienced in the West Midlands, particularly Gloucestershire in the same July flooding and in Devon at Dawlish where the rail line was flooded.

## **Considerations for Construction Design**

Engineers need to recognise that current design and material specifications must be sustainable, reflect the forecast changes in climatic conditions for the UK and manage such risks. To respond to such an agenda, the formulation of appropriate audit procedures is proposed such that the potential impact of climate change on road pavements, bridges, culverts, embankments and earth retaining structures in high-risk areas can be fully ascertained.

Equally, for new infrastructure proposals, particularly involving geotechnical sensitive embankments and cuttings, the design process should include risk assessments against such forecasts of extreme events. To some extent, such risk assessments are already being undertaken based on current guidance. For example, the Environment Agency advises that rainfall intensities, used to calculate design storm flows, must include allowance for climate change of a 20% contingency.

However, investigated 1 in 1, 1 in 5, and 1 in 30 year daily maximum events of medium-high and high emissions indicate that an annual 20% contingency

underestimates the 30-year event by the 2080s. The seasonal 20% contingency is also likely to underestimate, with the one-year event projected to increase by 30-40% in winter by the 2080s. The forecast change to the pattern of rainfall to heavier, more intense, downpours will clearly exacerbate problems with storm water run-off, particularly in urban areas. The events in Greater Hull during 2007 were an example of the worse case scenario.

Such challenges demand high-quality innovative solutions to design and build infrastructure with resilience to meet the impact of a changing climate. For example, to safeguard downstream flooding, the concept of retaining storm water run-off from large paved areas is well understood. Such designs include the use of porous wearing course surfaces with sub pavement retention reservoirs. Such design approaches should now be considered as a priority option and be established as standard practice.

Similarly, consideration should be given to the use of large hydro-brake controlled storm overflow culverts incorporated below and part of new estate roads. Such options can be used instead of using balancing ponds and saving valuable land-take. Consideration should also be given to the concept of roads becoming dual purpose and used as 'shallow canals', the design of roads in flood-risk areas being re-profiled and constructed with resilience to withstand saturation conditions. The aim would be to provide retention capacity, whilst at the same time to concentrate flood water away from adjacent properties with complementary efficient drainage systems.

For pavements, traffic loading and environmental variations are the two main factors known to contribute to pavement deterioration. The environmental variations include temperature, which leads to asphalt rutting in hot weather and cracking in cold weather. Moisture variations during the pavement life also affect the sub-grade stiffness and hence pavement performance. Additionally, thermal stresses due to temperature variations can cause concrete slab cracking.

To date, standard pavement design methods have been calibrated using full-scale pavement monitoring in order to relate the pavement design assumptions to actual performance. The calibration procedure is typically performed to match the predicted distress and pavement observations. The current design methods have all been developed from experience with standard material specifications, pavement thicknesses, environmental condition and traffic loading. Hence, in principle, they are restricted to the conditions for which they were originally developed. The introduction of new materials or higher traffic loading can be considered by using mechanistic/analytical pavement design methods.

However, the impact of climate change on pavement design and materials specification as indicated is now an essential consideration. This includes the higher expected temperatures and their effect on asphalt and concrete layer performance and higher moisture content due to an increase in water table levels and higher density storm events.

Unlike other countries, the UK temperatures are quite uniform with not much variation between day and night. The design standards account for few asphalt mix design. Whereas design standards in other European countries such as France have to account for the project locations to consider, cold, hot, wet and dry climatic conditions. The UK design standard proposes stiff asphalt materials with low penetration binder to improve pavement-bearing capacity or reduce its thickness for the same traffic level. Nationally, no formal design specifications are used to account for differing conditions. However, in practice the local environmental conditions are considered in the design of materials.

Other overseas design standards, such as that adopted in California, use different binder penetration to suit the environmental condition. A compromise between soft mix with good fatigue resistance and stiff mix with good deformation resistance in hot weather is optimised. Asphalt mix modification such as the incorporation of polymer-modified binder is considered in standard highway pavement design.

It is considered that the impact of climate change and resultant global warming on materials specification and pavement design therefore might not be so significant. However, that assumes that in the future environmental conditions are properly assessed in the design of materials. Asphalt mix modification such as aggregate grading, voids content and binder content can be considered to optimise the design. Materials specifications and practice exists in other parts of the world that can inform materials choices for the future conditions expected for the UK.

It is therefore proposed that designing for whole pavement life should be the adopted procedure. When pavement work involves existing pavement materials, recycling represents an important opportunity to achieve several environmental objectives including that of reducing the impact of global warming.

## **Developments in Recycling**

Growth in the utilisation of recycled and secondary aggregates and in recycling techniques over the past 10 years has been particularly noticeable. This is as a result of EU/Government policies encouraging the development of a more sustainable construction industry through legal incentives including the landfill tax, aggregates levy and the Local Authority Agenda 21 targets. The key objectives are to reduce waste generation and disposal through increased reuse. Complementary to the climate change issues the actions also aim to reduce the use of finite materials and material movements.

The recorded growth shows that, from 30 million tonnes in 1989 and 50 million tonnes in 2001, 70 million tonnes of recycled and secondary aggregates were used in 2006<sup>2</sup> representing 26% of the total aggregate market in Britain.

Future potential growth in higher-value applications for recycled aggregates by 2011 shows the following:

- Concrete Aggregates 7% to 17%
- Asphalt aggregates 5% to 14%
- Sub-grade Aggregates 18% to 35%

However, barriers to future growth will still need to be addressed to overcome issues such as confidence and perceived risk, availability of standards/guidance, and Waste Regulation.

With regard to confidence and risk the idea that secondary is 'second best' being a concern can very quickly be dealt with through advice such as that available in HD 35/04 –HD35/95 and BRE 433<sup>3</sup>.

Of the other concerns such as design guidance, performance-based specifications, and difficulties obtaining departures and approvals for new materials, all are now being successfully lifted with Specific Standards and Guidance, (see References)<sup>3</sup>.

Waste Regulation does remain a key issue to future growth success in that new EU case law has affected the definition of when waste ceases to be waste, (when fully reused). However, the term "fully reused" also needs clarification since the EU interprets it as the point of final placement. Representation has been made to the Waste and Resources Action Programme (WRAP), who in turn has raised this matter with the European Commissioner. It would appear that to change its status, as a "waste" will require lengthy legal changes. It seems to be accepted by the Commission that this is an unintended consequence of legislation.

Notwithstanding this, research continues to facilitate the desired growth in recycling processes with several initiatives promoting sustainable road construction.

One such example is that of The City of Edinburgh Council (CEC) which has formed a joint venture company to develop and promote sustainable road construction. It has been facilitated in this venture with financial support from the Waste and Resources Action Programme (WRAP) and the Department of Trade and Industry. The joint venture is collaboration with the Council as client and user, Abertay University for research and Proficio to commercialise the processes and products.

As previously indicated, there is a recognition that the two factors of economy and environment combine to require a step changing in approach to road reconstruction by employing technology to meet required performance criteria. This approach acknowledges the increased traffic loading, especially PSVs, the impact of utility interventions in the road structure and the limit to funding to reverse the net decline in road pavement over the past decade. Additionally it appreciates that aggregate tax is now levied on primary quarry materials as well as landfill tax, which increases the net cost of road maintenance.



Environmentally it is appreciated that the traditional and convenient “dig and dump” approach is neither economic nor environmentally sustainable. Consequently a changed approach is required so as to comply with the Climate Change Framework.

In summary, this is a new approach employing technology, using well-understood principles. However, it does require a change in attitude toward design and construction yet one with assured outcomes. It recognises the changing demands from traffic loadings and provides a design mechanism to enable adequate performance to match site conditions.

The performance-based approach ensures that the “hit and miss” approach in the use of recycled materials is avoided and credibility and repeatability assured. In cost terms the commercialisation of products and systems can be determined to ensure it is fit for purpose over primary materials. Importantly the design approach takes account of the overall structure and consequently the performance criteria required to be met by each layer. Significantly the normal range of acceptable variation of materials and their production is factored into the process to assure required performance.

This is then translated into a method statement, which is then approved by the contractor prior to the commencement of construction, thus providing assured outcomes to specification, plus saving time and money through effective risk management. Environmentally it ensures that the existing road pavement construction material is seen as an asset that can be reconstructed in a manner to meet appropriate standards while minimising the use of primary aggregates and avoiding the need for landfill. The net outcome is economical and environmentally sustainable while meeting the demands for transport and travel.

### **Alternative Pavement Material Strategies**

For many years the discussion and debate on rigid versus flexible pavements has generally focused on economics and noise as the key issues. However, in terms of sustainability and an accepted need to reduce the demand for imported carbon base materials, there is now a strong reason to review the arguments for the wider use of rigid construction pavements through further proactive research. Such research objectives include engineering benefits, economic performance including whole-life costing, and sustainability. For sustainability the assessment should embrace the impact of climate change with particular indirect benefits in terms of carbon emission.

In terms of major road widening and strengthening little use has been made of concrete pavements, even though they are stronger than bituminous pavements for a given thickness. Noise would appear the main concern, resulting in the Highways Agency instigating a resurfacing programme to be carried out on 74 stretches of roads opened since 1988 with a first phase of 26 (costing £77 million)<sup>4</sup>. This is notwithstanding that the Highways Agency, Design Manual for Roads and Bridges provides a design advice guide for rigid

pavement designs<sup>5</sup>, albeit using flexible surfaces. The use of concrete in composite pavement construction is clearly an alternative material and when sustainability arguments are converted into economic evidence it is anticipated that the market would increase with resultant environmental benefits. It is suggested that complementary focused research into surface finishes to mitigate the impact of 'road noise' should be undertaken following that already undertaken e.g. TRL 576 based on the wider agenda to respond to climate change and sustainability.

## Current Developments

Since 2005, research has been undertaken in the use of microsilica to improve concrete strength and hence long-term performance. Microsilica's use in concrete to obtain high strength is not new but recently it has been seen as an appropriate material to use against cement. The former is a by-product and the latter is high on energy hence the carbon footprint is high with high cement content concretes. High strength concrete will improve long-term performance but it will also require higher control against cracking. However, 'repair & maintenance' strategy for these materials is simpler than for less rigid materials'.

Due to the expected increase in air traffic movements around the world and its impact on the environment, the requirement to build more sustainable and low maintenance airfield infrastructures has also become very important. Consequently, the use of new materials in airfield pavement construction has become a priority to provide a better sustainable whole-life cost solution.

As a result the use of high strength concrete as well as improved asphalt materials in UK airfield pavement construction has been investigated<sup>6,7,8</sup> including materials such as; BBA (Bétons bitumineux pour chaussées aéronautiques), a French airfield surface/binder course, and EME2 (Enrobé à Module Elevé 2) base.

According to the findings of the report<sup>7</sup> an average layer thickness reduction of 15% is possible using EME2 compared to Marshall Asphalt without loss of mechanical strength.

Unlike Marshall Asphalt it can also incorporate recycled asphalt plantings -10% in the surface course and 20% in the binder course. It should be noted that following the publication of the UK 'Design Manual for Roads & Bridges' Vol. 7, EME2 has been introduced as a permissible base material for flexible composite design. Transport Scotland has already sanctioned its use following trials on the M876.

Whole-life pavement cost includes the initial cost of pavement construction or rehabilitation, all the costs of routine maintenance and planned strengthening over the pavement life, and the value of the asset at the end of its life. In addition there is a need to add Life Cycle Assessment (LCA) of raw constituents, material production, laying, etc. An inventory needs to be

developed for each material chain (this will include carbon footprint) and an associated cost attributed.

Repair and Maintenance cost should also be included in the LCA. Both Life Cycle Costing (LCC) and LCA are a function of the pavement layout, etc. Pavements today are evaluated on best performance, best value, best constructability and also best LCC and LCA; the latter includes the effect on the environment from the pavement.

Other factors include traffic management cost during pavement treatment and users' cost as a result of delay and increase in aircraft operating cost. In addition, where the cost of traffic disruption during pavement maintenance and strengthening is high, as in the case of the majority of busy airports, constructing a high performance durable pavement will be a major advantage.

## **Conclusions**

The response to the impact of severe meteorological events must be high on the agenda for engineers and highway professionals, but they must also address the wider causes of climate change.

The need to reduce the demand on natural resources where possible and particularly that of finite stocks of fossil fuels must also be seen as an important objective.

Such uses of asphalts, bitumens and tar binders in pavement construction represent important materials for specification review. This includes both the search for alternative suitable materials and the maintenance of progress in the use of recycling in pavement construction.

Industry has been well aware of the need to address whole-life costing. However, with forecast climate change impacts, better knowledge of the causes and recent severe events, infrastructure designs for change, innovation and sustainability must also now be given due agenda priority.

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## Issues and Recommendations

- With current knowledge and understanding regarding the increase in CO<sub>2</sub> emissions by transport and climatic change, impacts on infrastructure, technology research, innovation and reviews of engineering design standards and practice should be an essential priority.
- The key issues of higher temperatures and drought with associated events of flooding, wind and storm requires a review of infrastructure design approaches to safety, durability, and sustainability in order to prepare for these forecast changes and resultant ‘severe’ conditions projected for the UK.
- Considerations should include the early identification of high-risk infrastructure with particular reference to public safety. Highway authorities of both central and local government need to consider such severe events and their impact on road pavements, bridges, culvert, embankments and earth retaining structures. These factors should be given equal priority.
- Particular reference is given to design criteria for future infrastructure developments to withstand such forecast severe events. This would include the use of sub-pavement reservoirs below car parks, storm overflow culverts below estate road networks and using urban roads as shallow canals in flood risk areas.
- The implications for drainage systems and design assessments indicate a clear need to audit current facilities against such event forecasts. Although current Environment Agency guidance suggests an allowance for Climate Change of 20% contingency, the possibility of 30% should also be considered.
- For new infrastructure proposals, particularly involving geotechnical sensitive embankments and cuttings, the design process should include measured risks assessments against such forecasts of extreme events.
- The impact of climate change, with global warming on pavement design and materials specification as indicated is also an essential consideration. This includes

the higher expected temperatures and its effect on asphalt and concrete layer performance and higher moisture content due to increase in water table level and higher density storm events. However, it is considered that under the circumstances, the impact of climate change on materials specification and pavement design might not be so significant providing the future's properly assessed environmental condition is incorporated in the design.

- Asphalt mix modification such as aggregate grading, voids content and binder content can be considered to optimise the design for whole pavement life. For example, in France, cold, hot, wet and dry climatic conditions are considered according to project location. Materials specifications and practice exist in other parts of the world that can inform materials choices for the future conditions expected for the UK.

## 5.3 Safety

### Introduction

Britain can be proud of its position with regard to road safety. Until recently, Great Britain had the safest roads in the world by all the main measures, and Northern Ireland had roads that were very safe, though less safe than Britain's. Even so, over 3,000 people die on Britain's roads every year, and road collisions cost over 1% of GDP (around £13,000 million in 2006)<sup>1</sup>. This cannot be regarded as acceptable or sustainable.

### Current Position

For the world as a whole, there are an estimated 1¼ million road collision deaths each year. Road collisions represent a cause of death, disability and serious injury comparable to a major disease such as malaria, and are becoming the largest single killer of young people at the start of their period of economic productivity<sup>2</sup>.

Sweden has introduced 'Vision Zero'<sup>3</sup> as a road safety policy, based on the concept that while collisions that cause only damage are relatively unimportant, it is not acceptable for anyone to be killed or seriously injured by road traffic. The Netherlands has introduced a policy of sustainable road safety, which is similar but less extreme than Vision Zero. Both countries are investing more per head in road safety than Britain, and both now have roads that are safer than Britain's (as does Switzerland).

Vehicle manufacturers have greatly improved the occupant protection provided by new cars, partially under pressure to achieve '5-star' NCAP ratings for occupant protection. The European Road Assessment Programme (Euro RAP) is focusing attention on providing '5-star' roads to match '5-star' vehicles, based on the concept that all motorists make mistakes (about 1 in 500 decisions are incorrect), so the transport system must be designed to be tolerant of error, and a single mistake should not cause a death.

Notwithstanding, driver behaviour is a constant focus for road safety, with particular reference to the need for regular publicity and education programmes to achieve safer driving techniques and the reasons for it.

Road collision fatality rates for Britain have reduced greatly since the late 1960s, and also vary considerably with age and gender. Figure 1 shows how fatality rates have changed for different age groups. It is notable that the lowest fatality rates, by a large margin, are for those aged under 16. The highest fatality rates are for 16 to 19-year-olds, 20 to 29-year-olds and those aged 80+. However, for the 16 to 19 and 20 to 29 age groups, 72% and 63% casualties are car occupants and 11% pedestrians, while for those aged 80+, 50% of fatalities are pedestrians and only 39% car occupants (Table 1).

Overall, about three times as many males as females are killed in traffic collisions (Figure 2). For males, the total fatalities have reduced only a little since the mid-1990s, from 2,552 in 1992 to 2,401 in 2006. For females, fatal casualties continue to fall, from 987 in 1998 to 771 in 2006.

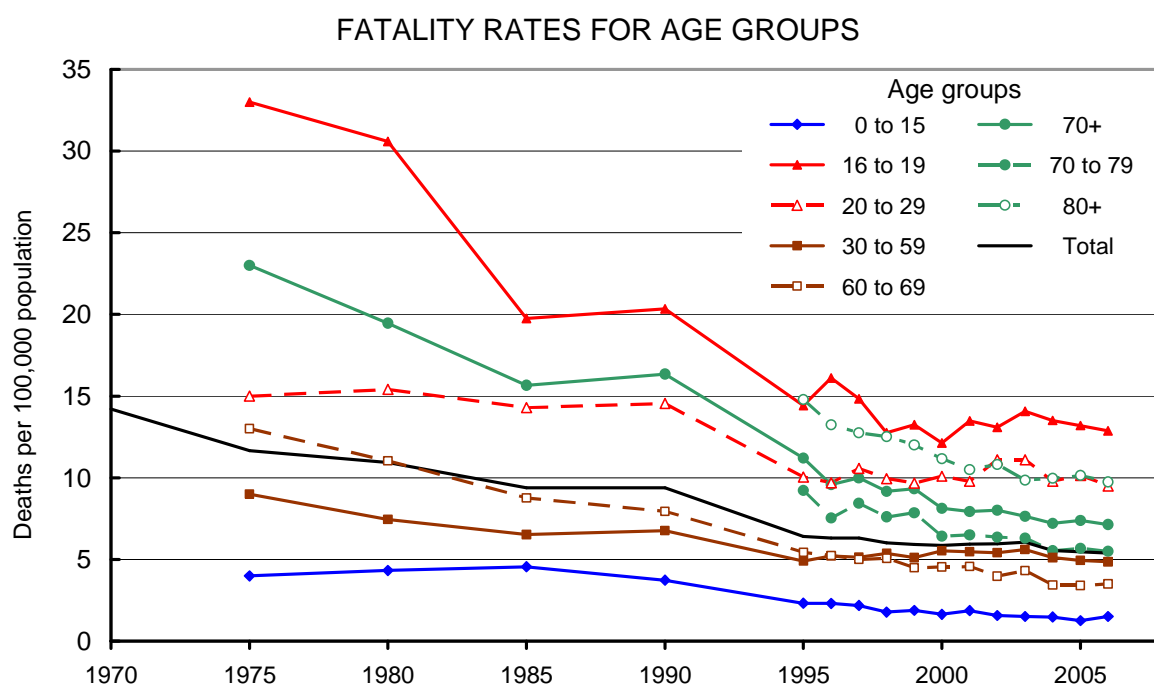
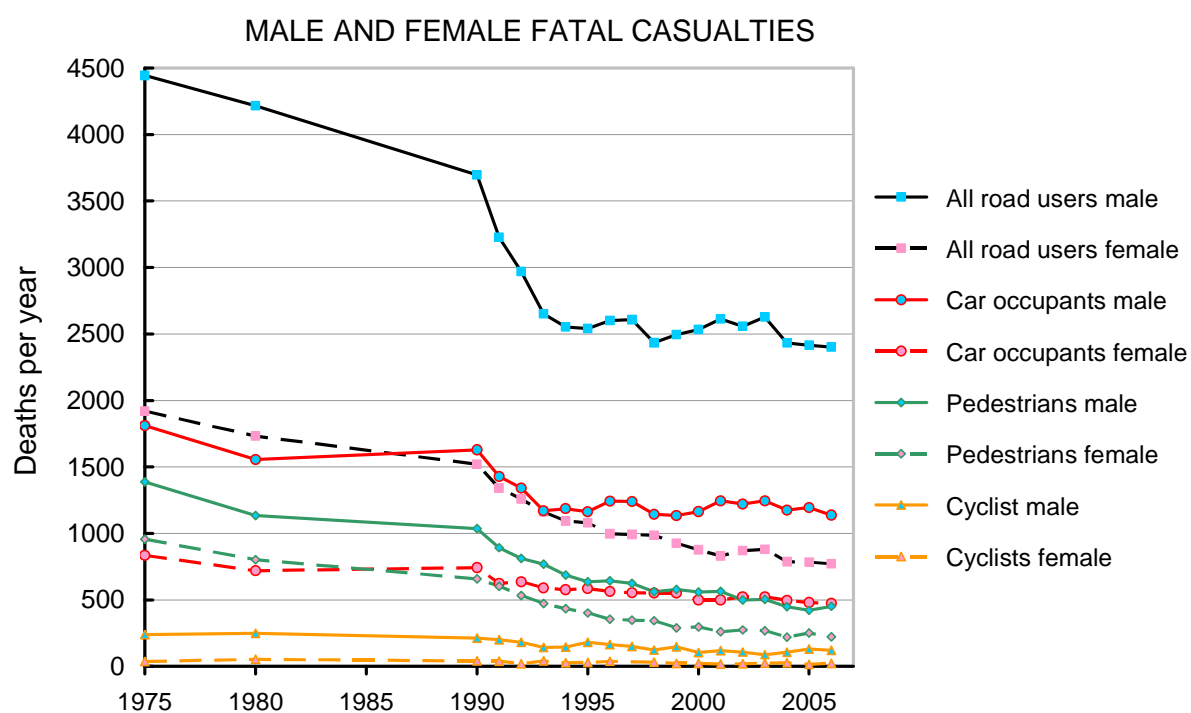


Figure 1

**Table 1 Fatality rates, 2006**

Age group	Deaths per 100,000 population	Percentage of deaths by mode			
		Car occupant	Pedestrian	Motorcyclist	Pedal cyclist
0 - 15	1.5	36	42	3	18
16 - 19	12.9	72	11	15	1
20 - 29	9.5	63	11	22	2
30 - 59	4.8	41	18	30	6
60 - 69	3.5	55	24	8	7
70 - 79	5.5	47	40	3	5
70+	7.1	43	45	2	3
80+	9.7	39	50	1	2
All ages	5.4	51	21	19	5

Source Road Accidents GB DfT 2007, Tables 30a and 31



Figure

**Table 2 Deaths and injuries per billion passenger km travelled by different surface modes.**

	2000			2004			2005		
	Deaths per bn pass. km *	KSI <sup>x</sup> per bn pass. km *	All casualties per bn pass. km *	Deaths per bn pass. km *	KSI <sup>x</sup> per bn pass. km *	All casualties per bn pass. km *	Deaths per bn pass. km *	KSI <sup>x</sup> per bn pass. km *	All casualties per bn pass. km *
<b>Rail</b>	<b>0.3</b>	<b>All injured 13.2</b>		<b>0.2</b>	<b>All injured 12.8</b>		<b>0.1</b>	<b>All injured 11.6</b>	
<b>Bus or coach</b>	<b>0.3</b>	<b>11</b>	<b>195</b>	<b>0.4</b>	<b>9</b>	<b>167</b>	<b>0.2</b>	<b>7</b>	<b>149</b>
<b>Car</b>	<b>2.7</b>	<b>32</b>	<b>335</b>	<b>2.5</b>	<b>25</b>	<b>280</b>	<b>2.6</b>	<b>23</b>	<b>275</b>
<b>Motorcycle</b>	<b>122</b>	<b>1,493</b>	<b>5,712</b>	<b>105</b>	<b>1,194</b>	<b>4,606</b>	<b>97</b>	<b>1,109</b>	<b>4,232</b>
<b>Pedal cycle</b>	<b>31</b>	<b>666</b>	<b>4,953</b>	<b>35</b>	<b>597</b>	<b>4,309</b>	<b>33</b>	<b>533</b>	<b>3,739</b>
<b>Pedestrian</b>	<b>49</b>	<b>543</b>	<b>2,404</b>	<b>37</b>	<b>409</b>	<b>1,907</b>	<b>36</b>	<b>384</b>	<b>1,795</b>

<sup>x</sup> KSI - casualties killed or seriously injured

\* bn pass. km = billion (10<sup>9</sup>) passenger kilometres

Source TSGB 2007 Table 1.7

The table shows how much safer per kilometre bus and rail journeys are than journeys by car, and how much safer per kilometre journeys by car are than journeys by motorcycle, pedal cycle and on foot. However, because car journeys are longer than pedestrian and cycle journeys (typically 8.6 km by car, 2.4 km by pedal cycle and 0.7 km on foot), the risk per journey by car, pedal cycle and on foot are more similar, with risks of death per billion passenger journeys of 22 for journeys by car, 25 for journeys on foot but 80 for journeys by pedal cycle (Table 3). The risk per journey by rail is about 3 deaths per billion journeys, about ten times less than for journeys by car, but about three times more than the risk per journey by local bus.



Table 3 Deaths and injuries per passenger journey

	2000			2004			2005		
	Deaths per bn pass. journeys *	KSI <sup>x</sup> per bn pass. journeys *	All casualties per bn pass. journey *	Deaths per bn pass. journeys *	KSI <sup>x</sup> per bn pass. journeys *	All casualties per bn pass. journey *	Deaths per bn pass. journeys *	KSI <sup>x</sup> per bn pass. journeys *	All casualties per bn pass. journey *
Rail	9.4	All injured 413		5.9	All injured 378		3.2	All injured 375	
Bus or coach	1.4	51	897	1.8	41	768	0.9	32	685
Car	24	278	2,920	22	220	2,460	22	198	2,370
Motorcycle	1,180	14,500	55,400	1,240	14,100	54,400	960	11,000	41,900
Pedal cycle	78	1,670	12,400	84	1,430	10,300	79	1,280	8,970
Pedestrian	29	326	1,440	26	286	1,340	25	269	1,260

<sup>x</sup> KSI - casualties killed or seriously injured

\* bn pass. journeys = billion (10<sup>9</sup>) one-way journeys of average length

Source TSGB 2007 Table 1.7 and National Travel Surveys 1999-2001 and 2005

Risks per kilometre travelled have reduced over time, particularly for car occupants (Figures 3a and 3b). However, the risk for motorcyclists has increased since the 1990s (Figure 3b).

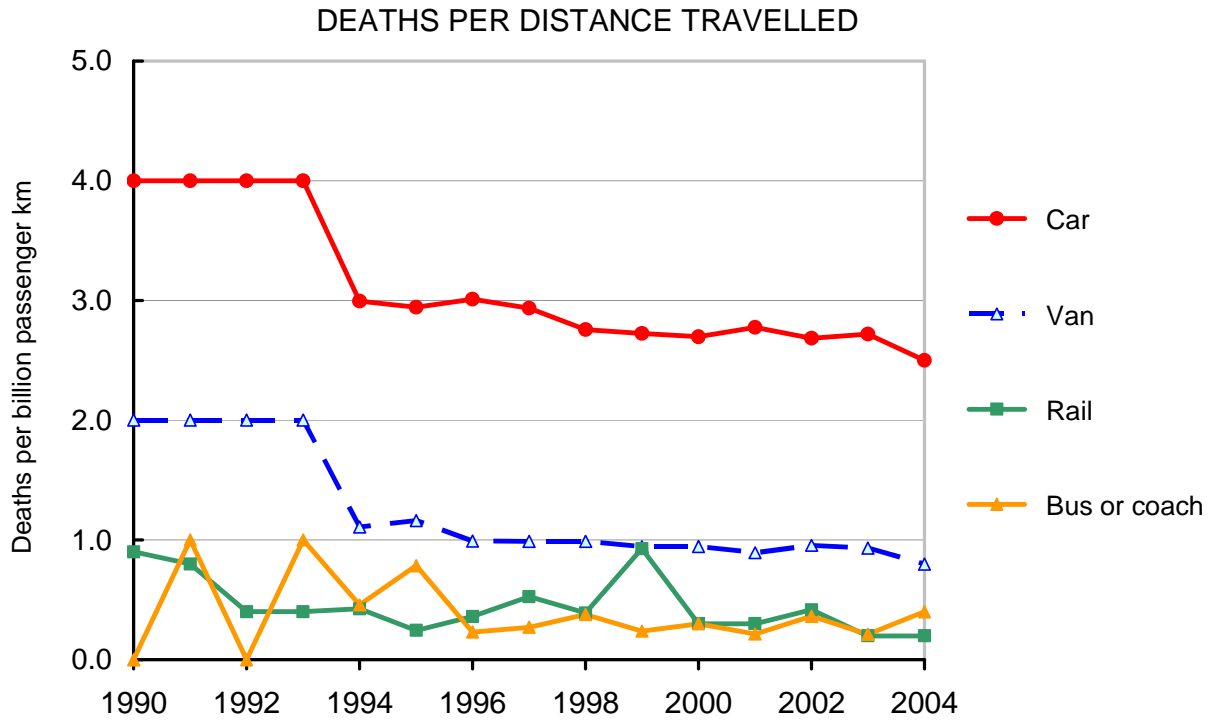


Figure 3a

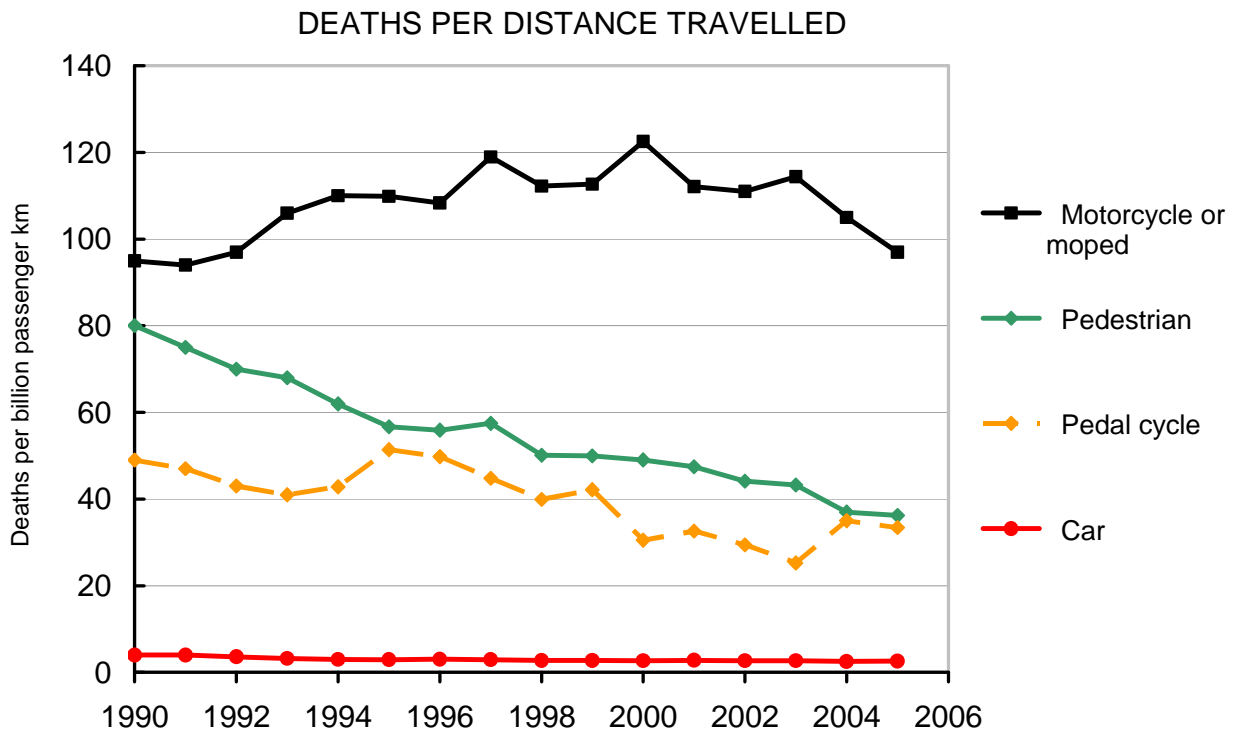


Figure 3b

Britain has one of the safest road systems in the world. Figure 4 shows the fatality rates in the UK and a number of other countries.

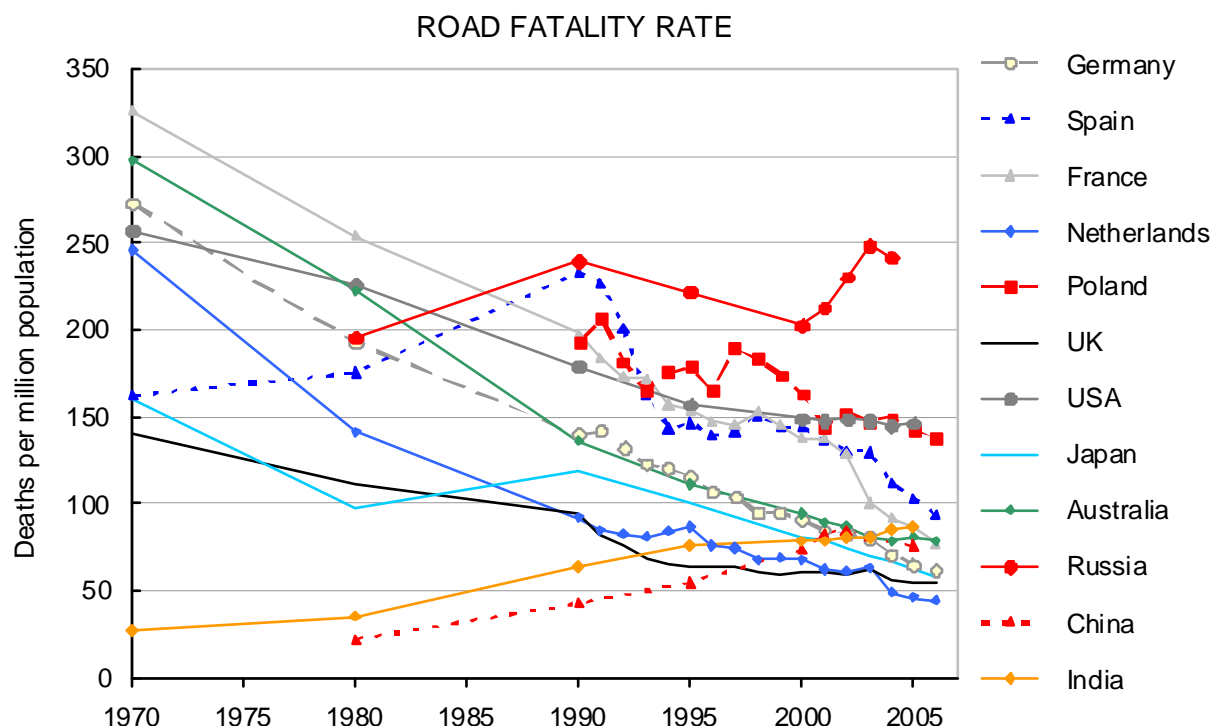


Figure 4

Of the countries shown in Figure 4, the highest fatality rates are in Russia, Poland and USA. Western European countries that did have high fatality rates, have improved moving much closer to the average for western European countries. In the past three years, Sweden and the Netherlands have achieved fatality rates lower than that in Britain. Despite low levels of car ownership, fatality rates in China and India are rising, and are now higher than those in the safer western European countries. Because of under-reporting, it is likely that fatality rates in both China and India are at least double the rates derived from official data.

### Infrastructure Design and Safety

As indicated, the evidence of the UK accident record shows improvement year-on-year since the late 1960s and of particular note, coming at the same time as the introduction and development of the motorway network. Having such well-designed roads with the capacity to carry high volumes of traffic safely clearly demonstrates the importance and benefit of providing 'fit for purpose' infrastructure.

Consequently, transport professionals with the responsibility for the design and maintenance of safe road and street networks should see the introduction and impact of the 'motorway' as a key success, particularly in terms of collision reduction and as a motivator to achieve another step change in road collision reduction through focused data analysis and good design. This is

supported by European Road Assessment Programme (EuroRAP) that has shown that the design of roads can have a major effect on collisions and casualties<sup>4</sup>.

Whilst recognising that fatal collisions can be attributed to a variety of causes, transport professionals must clearly make every effort to create a safe road network for all users. The availability of good recorded data and collision investigation analysis now provides better opportunities for transport professionals to make appropriate improvements and safer conditions.

As an example, an examination of the age grouping of fatal collisions, Table 1, shows that the age group under 15 years are most at risk as pedestrians and cyclists. With the principle of such data-gathering used in a local context, the options to effect focused improvements or introduce safety action initiatives should make the task that more effective and rewarding.

To complement such an evaluation approach to reducing collisions, the recent publication of the DfT 'Manual for Streets' (MfS)<sup>5</sup>, provides designers with an excellent guide to assist in the provision of a safer road and street network.

Designers and funding decision makers must recognise the required change in approach and emphasis to help reduce collisions involving pedestrians and cyclists. As recommended in the MfS, "the street design process needs to apply to a user hierarchy with pedestrians at the top", an objective transport professionals should note.

## **Conclusions**

Until recently, Great Britain had the safest roads in the world by all the main measures. However, over 3,000 people still die on Britain's roads every year which is socially unacceptable. Further reduction in casualty figures needs strong leadership, as has been shown by the successes in Sweden, the Netherlands and France. With road collisions costing over 1% of GDP (around £13,000 million in 2006), these casualties are unsustainable and urgent action is essential to reduce them.

Driver behaviour plays a key part in the potential for reducing road collisions and where appropriate transport professionals should promote publicity and arrange education programmes to achieve safer driving techniques and emphasise the reasons for it.

Transport professionals with the responsibility for the design and maintenance of safe road and street networks should see the introduction of the motorway as a key success in terms of 'fit for purpose' and collision reduction.

The availability of good recorded data and collision investigation analysis now provides the opportunity to achieve another step change in road collision reduction.

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## Issues and Recommendations

- Sweden and the Netherlands have shown that strong leadership can produce substantial improvements even in countries where roads are already relatively safe.
- Whilst recognising that fatal collisions can be attributed to a variety of reasons, transport professionals must clearly make every effort to create a safe road network for all users. The availability of good-recorded data and collision investigation analysis now provides excellent opportunities for transport professionals to make appropriate improvements and safer conditions.
- Designers must recognise a required change in a design process to reduce collisions involving a user hierarchy with pedestrians and cyclists at the top.
- Driver behaviour plays a key part in the potential for reducing road collisions and where appropriate transport professionals should promote publicity and arrange education programmes to achieve safer driving techniques and emphasise the reasons for it.

## 6. ADMINISTRATION AND FINANCE

### General Introduction

Key elements in considering the need to achieve a sustainable transport system include the future plans and policies of Central Government and the funding mechanisms that support its objectives.

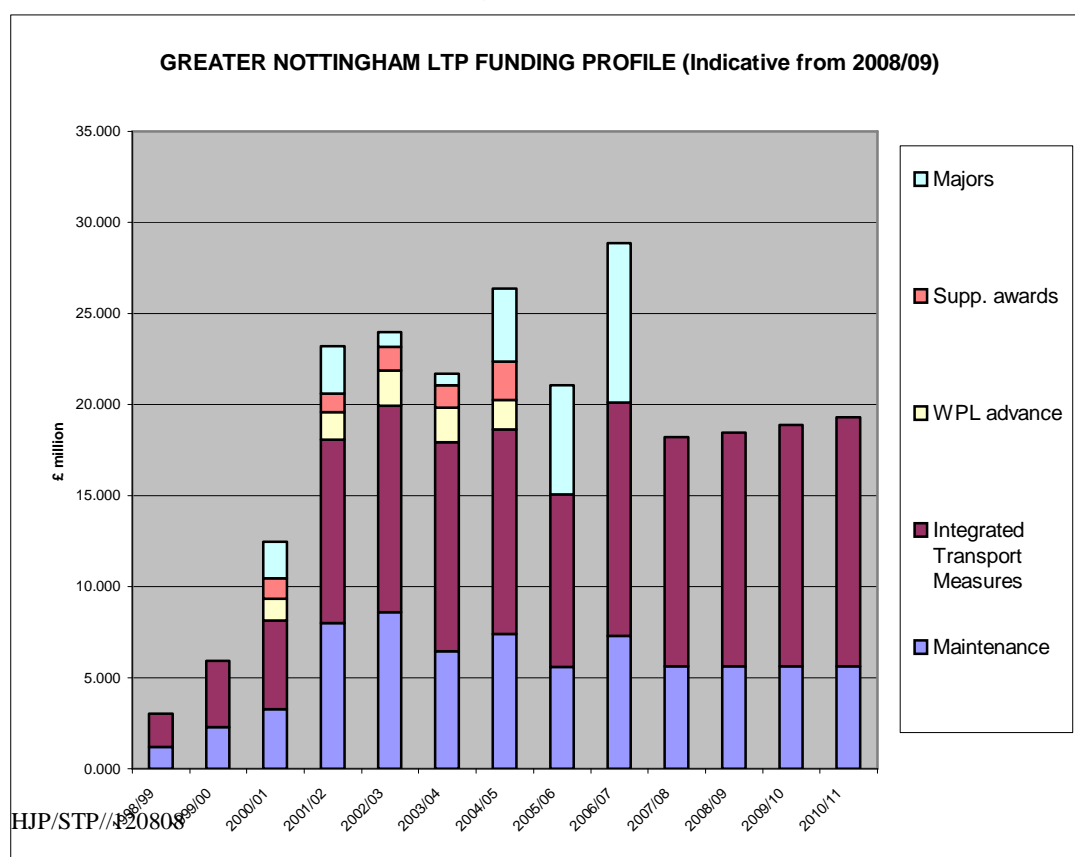
Following the publication of the Stern and Eddington Reports<sup>1,2</sup> there is a clear challenge for Government to review its priorities, particularly taking account of its stated aims of reducing CO<sub>2</sub> emissions and addressing growing levels of traffic congestion in the UK.

To address these issues, consideration is given to current transport funding mechanisms, the changing emphasis of Government funding and delegation of its management and the application of fiscal instruments on road transport.

### 6.1 Investment for the Local Transport Plans process, including funding constraints, and Treasury influence

#### Introduction

The current system of local transport funding has existed for seven years. This has been resourced well by the Government, and all local highway authorities have seen a sustained increase in funding since 1998/99<sup>3</sup>, in some places by as much as tenfold. It could be argued that the Government has also done well out of the Local Transport Plan (LTP), system, as it has a sophisticated performance management system which directs local authority



expenditure and energies into delivering on agreed targets.

This picture is not consistent across the country and as always there are winners and losers, but some of the system's characteristics benefit all authorities, especially when contrasted with the former Transport Policies and Programme (TPP) with its annual bidding focus. Authorities now benefit from planning evidence and indicative funding advice for three to five years, which enables forward planning of schemes with more confidence. The system offers flexibility of funding allocations within and across blocks, allowing local politicians discretion to react to their own priorities, albeit in the context of a performance reward mechanism which tracks outcomes and checks against central Government expectations.

This system does come at the cost of hugely increased expenditure on monitoring and data collection - again contrasting very strongly to the TPP system where very little scrutiny was applied to whether schemes completed met their original objectives. In many case these objectives were not even set out clearly or specified by the Government.

The Private Finance Initiative (PFI) offers a further route for substantial investment in transport schemes including light rail, street lighting and maintenance projects and programmes.

Local authorities who have engaged and embraced the new opportunities of the LTP system can be seen as true partners with Westminster and it is interesting to reflect that authorities rated as 'Excellent' and offered the freedom of not having to prepare an LTP have almost always chosen to continue having one. Clearly, there is some overall consensus in this funding system and an expectation that it will continue in some form.

### **Shared Objectives?**

The Comprehensive Spending Review (CSR) in 2004 challenged us to:

#### **CSR 2004 Objective I:**

Support the economy through the provision of efficient and reliable interregional transport systems by making better use of the existing road network; reforming rail services and industry structures to deliver significant performance improvements for users; and investing in additional capacity to meet growing demand.

1. By 2007-08 make journeys more reliable on the strategic road network.
2. Improve punctuality and reliability of rail services to at least 85% by 2006, with further improvements by 2008.

#### **Objective II:**

Deliver improvements to the accessibility, punctuality and reliability of local and regional transport systems through the approaches set out in Objective I and through increased use of public transport and other appropriate local solutions.

3. By 2010, increase the use of public transport (bus and light rail) by more than 12% in England compared with 2000 levels, with growth in every region.

4. By 2010-11, the ten largest urban areas will meet the congestion targets set in their local transport plan relating to movement on main roads into city centres. The target will be deemed to have been met if, on target routes in the ten largest urban areas in England, an average increase in travel of 4.4% is accommodated with an average increase of 3.6% in person journey time per mile. The local targets on which this is based include:

In London, accommodate an increase in travel of 3% with an increase in journey time of 1.5%;

In Manchester, accommodate an increase in travel of 1.5% with no increase in journey time; and

In the West Midlands, accommodate an increase in travel of 4% with an increase in journey time of 5% (the target is expected to change-possibly to 3%-if full funding is granted for the Urban Traffic Control system in 2006 07).

**Objective III:**

Balance the need to travel with the need to improve quality of life by improving safety and respecting the environment.

5. Reduce the number of people killed or seriously injured in Great Britain in road accidents by 40% and the number of children killed or seriously injured by 50%, by 2010 compared with the average for 1994-98, tackling the significantly higher incidence in disadvantaged communities.

6. Improve air quality by meeting the Air Quality Strategy targets for carbon monoxide, lead, nitrogen dioxide, particles, sulphur dioxide, benzene and 1,3 butadiene. Joint with the Department for Environment, Food and Rural Affairs.

7. To reduce greenhouse gas emissions to 12.5% below 1990 levels in line with our Kyoto commitment and move towards a 20% reduction in carbon dioxide emissions below 1990 levels by 2010, through measures including



energy efficiency and renewals. Joint with the Department for Environment, Food and Rural Affairs and the Department of Trade and Industry.

**Objective IV:**

Improve cost-effectiveness through sound financial management, robust cost control, and clear appraisal of transport investment choices across different modes and locations.

The CSR in 2007 set out further National Transport objectives in Public Service Agreement 5:

**Journey time on main roads into urban areas**

By 2010-11 minimise increases in journey time, accommodating an average increase in travel of 4.4 per cent within an average increase of 3.6 per cent in person journey times per mile.

**Journey time reliability on the strategic road network, as measured by the average delay experienced in the worst 10 per cent of journeys for each monitored route**

**Level of capacity and crowding on the rail network**

By 2013-14 increase capacity to accommodate an expected increase of 14.5 per cent in rail passenger kilometres from 2008-09 while achieving the train load factors specified in the Government's High Level Output Specification (HLOS) for the railway.

**Average benefit cost ratio of investments approved over the CSR07 period**

These were, and in some cases still are, challenging objectives. However the LTP system has delivered on key targets such as reducing road casualties and many towns and cities can demonstrate positive outcomes which make a real difference to people's lives. The Annual Monitoring Report requirement might have been relaxed in the past two years, but ongoing reporting of many local transport objectives across the country continues to demonstrate progress on tangible things.

In cities like Nottingham, for example, through LTP investment subways have been filled in, a city centre 'Clear Zone' introduced, and a whole range of bus investment programmes for services, infrastructure and information developed. In residential areas home zones, footway enhancement programmes and street scene improvements have been rolled out.

Elsewhere, many rural authorities have been able to address the backlog of maintenance on main roads, though minor roads remain a big problem. There has also been good support from Government for innovative solutions to

public transport in rural areas, though time-limited funding has been running out recently and sustainable solutions have not always emerged.

In many places LTP contributions now form part of area allocations where spending decisions are delegated to local committees, giving local people a real voice.

### **An Agreed Way Forward?**

This last point highlights a dilemma. The Government is torn between retaining the ability to manage performance and investment and trying to release authorities from the burden and constraints of reporting to a huge number of centrally imposed targets.

An emerging transport funding arena is the Local Area Agreement (LAA) process. LAAs are agreed via partnerships of local authorities, police, health and Government agencies with the objective of aligning or pooling resources and effort to tackle locally specified priorities over a three-year period. Whilst the jury is out on the success of the first round of LAAs, their scope and extent was broadened significantly, including transport in 2008.

Whilst in the end LTP capital was not incorporated in the LAA process and will still come from the Department for Transport (DfT), the prioritisation of transport will be in a wider Sustainable Community Strategy and LAA context. This could pull resources toward more local objectives than currently directed by the well-developed performance management LTP machine.

This may prove to be a welcome return to localism - authorities with the ability to secure senior political buy-in and support to transport plans and priorities will be best placed to maintain progress on the ground on local rather than national objectives. If Local Strategic Partnership (LSP) partners can be engaged and motivated to support transport investment plans for social, economic and environmental reasons, all the better.

There should be some easy wins. Health promotion objectives sit well with investment in walking and cycling schemes, and improving accessibility to services is a crosscutting objective of most public agencies.

### **All Change**

It is not just about LAAs. Whilst Stern<sup>1</sup> and Eddington<sup>2</sup> and the debate commenced through the DfT's 'Towards a Sustainable Transport System' debate place transport investment again at the centre of discussions on the sustainable future of the country, the Treasury's response is not yet fully clear.

Delivery of the ambitious house building aspirations of the recently enacted Housing and Regeneration Act 2008<sup>4</sup> will require significant transport and infrastructure investment. The current market conditions will see increasing

pressure placed on public finances as private sector-led delivery stutters. Higher environmental building standards will put further pressure on the ability of developers to deliver quality and affordability. The jury is out on whether the Eco-Town concept will mature into reality; but if Government wants to secure their delivery in the current economic climate there is a danger that funding may be diverted from existing investment priorities and programmes.

The ramifications of the Nichols Review<sup>5</sup> are now becoming clearer in terms of the impact on committed schemes. The medium- and long-term response to projections of continually increasing oil prices will radically challenge the 'traditional' way of doing things in the transport sector. The new Growth areas should receive priority funding, but these resources will be spread more thinly as the Government increases the number of authorities eligible for such investment. Areas which are brave enough to trial congestion charging, will be rewarded via the Transport Innovation Fund (TIF), but takers for this option are, at this stage, relatively few.

At the national level it is still frustrating to see many Government departments promoting policies that increase the demand for travel.

The Sub-National Review of Economic Development talks of devolving funding down through the Regional Development Agencies more quickly and transparently to local authorities or agencies, which are best-placed to deliver.

Extensive discussions are now testing how sub-regional structures may or may not feature in these new arrangements. Alongside this, the completion of the first Multi-Area Agreements should confirm the potential benefits of collaborative joint working between authorities, whilst the Transport Bill<sup>6</sup> has generated a more structural debate on transport governance and delivery in most of the former metropolitan cities.

The first round of Regional Funding Allocations (RFA) challenged regional partnerships to undertake a real and meaningful prioritisation exercise, within the constraints of actual as opposed to inspirational budget. Whilst this was painful for some of those involved, the Treasury (and most regions) deemed it a success. The RFA2 process will repeat the exercise, through the scope and financial envelope of guidance issued in July 2008.

It is all a long way from the TPP and, despite talk of double devolution and local accountability, behind many of these initiatives local government will still be expected to deliver on Westminster policy imperatives and national performance targets. These joined-up aims are laudable if the Government allows politicians, local or national, true freedom of discretion on funding issues. However, there is a danger that less glamorous things like structural maintenance of bridges, or strategic road reconstruction will not appear near the top of manifesto pledges.

The TPP and LTP mechanisms were developed for a reason: to develop and maintain crucial infrastructure. Transport investment is important, expensive and complex to deliver. It is not always delivering to popular choice or

opinion, but when our transport services or networks fail, the public are quick to complain and rightly so.

## Conclusions

It is down to the transport profession to make a clear and cogent case for continued prioritisation for investment, to be open to working in new partnerships such as LAAs, Multi-Area Agreements (MAA) via the new Growth Points or Integrated Regional Strategies to secure wide-ranging understanding and support of our objectives.

The profession is well-positioned through experience in responding to the previous challenge set by the LTP Process and should learn lessons from this and move forward with optimism. If it doesn't, it will not be enough just to blame it on the Treasury.

## References

- <sup>1</sup> "Stern Review: The Economics of Climate Change", Sir Nicholas Stern, HM Treasury, 2006.
- <sup>2</sup> "Transport's Role in Sustaining UK's Productivity and Competitiveness", Sir Rod Eddington, HM Treasury, 2006
- <sup>3</sup> Local Transport Plans and Government Funding Announcements, 1998-2008
- <sup>4</sup> Housing and Regeneration Act, Communities and Local Government, 2008
- <sup>5</sup> "Review of Highways Agency's Major Roads Programme", Mike Nichols, report to the Secretary of State for Transport, March 2007
- <sup>6</sup> Local Transport Bill, Department for Transport, 2008

## Issues and Recommendations

- The more that transport can be placed in underpinning the Government's integrated and cross cutting agendas around sustainable and affordable economic growth, the better the case will be strengthened for securing and sustaining resources. This can particularly be successful when reduced environmental impacts are demonstrated.
- The current economic outlook with uncertain housing market conditions, lack of liquidity, fuel and commodity price inflation suggests that a prudent approach to budget and medium term financial planning is necessary.

## 6.2 Fiscal Instruments on Road Transport

### Introduction

The impact of fiscal instruments relating to road transport has become a significant topic of discussion over the last couple of years, particularly in the context of climate change and carbon obligations. In terms of sustainability, this has focussed to a large extent on the cost of motoring, which is a key political issue in the delivery of change. Consideration of the various fiscal measures currently deployed is therefore relevant in the future direction of sustainable transport. In this context, it is useful to understand the UK's four most important national taxation measures affecting road transport, which are:

- Fuel Duty on petrol and diesel;
- Discounted Fuel Duty rates for alternative road fuels, including natural gas, liquefied petroleum gas, electricity, and biofuels;
- Varying Vehicle Excise Duty by vehicle CO<sub>2</sub> emissions; and
- Varying Income Tax levied on company cars by vehicle CO<sub>2</sub> emissions.

### Taxes on Car Use-Fuel Duty

Between 1992 and 1999, both Conservative and Labour Governments in the UK operated the '*Fuel Duty Escalator*'. Linked to the abolition of Car Purchase Tax, Fuel Duty was increased above the rate of inflation, initially by 5% per annum and, from 1997, 6% per annum. This policy was justified as a major contribution towards the reduction of CO<sub>2</sub> emissions. Fuel demand elasticity studies (e.g. Glaister and Graham, 2000<sup>1</sup>; Goodwin, 2002<sup>2</sup>) suggests that the tax increases resulted in 10% less demand for fuel in 2000 than if the duty rates had only increased at the same rate as inflation.

Department for Transport (DfT), statistics show that road traffic grew by 18% in the six years 1987 to 1993 and by 13% in the six years between 1993 and 1999 when the Fuel Duty Escalator was operative (DfT, 2004)<sup>3</sup>. The UK Government (cited in Marsden, 2002)<sup>4</sup> calculated that the fuel duty escalator saved between 1 and 2.5 million tonnes of carbon emissions. This would have occurred as a result of a range of behavioural responses, including the suppression of some travel demand.

Most EU states have had a version of the 'escalator' if generally somewhat slower and less steep. By September 2007, the Netherlands had the most expensive petrol in the EU (102.5p per litre) with Germany next and the UK third at 94.4p/l. Belgium and Finland were close behind (93.2p and 92.7p). However, the rise in oil prices will now make it difficult to introduce even inflation-level increases in fuel duty.

Following blockages of oil refineries by lorry drivers and farmers in 2000, petrol and diesel duty was cut and the Fuel Duty Escalator policy abandoned. Only two inflation-level rises have been added since then and in the wake of oil price increases in 2008 the announced 2008 inflation-level increase in Fuel Duty has been deferred, if not abandoned. This has resulted in a steady drop in Government income from fuel duty over the past 8 years.

The use of road-fuel gases (liquefied petroleum gas and natural gas) is not as extensive in the UK as in some other European countries, notably the Netherlands and Italy. Discounts on Fuel Duty have increased in recent years and are now equivalent to 75% of the duty paid on petrol (Parkhurst, 2002)<sup>5</sup>. The cost of the fuel itself is higher, which means the cost to the consumer of gases is about half that of petrol. The fuels are now available in around 10% of filling stations, and use is increasing.

Charges on using road space within the EU include bridge/tunnel tolls, road tolls and cordon/congestion charging in city centres. Bridge and tunnel tolls are commonplace and road tolls (usually only for motorways) exist in Austria, France, Germany, Greece, Italy, Portugal, Spain, and Norway. City centre congestion charging is one of the new car tax measures specifically designed to manage traffic, raise revenue (usually hypothecated), and address environmental aims. It has been introduced in several Norwegian cities (Leromonachou et al, 2006)<sup>6</sup> and recently in Durham and London in the UK and Stockholm in Sweden. A policy move towards the UK implementing national road user charging was announced in 2004 (DfT 2004<sup>7</sup>). The first stage was to be exploring charging system design through a series of area-based Transport Innovation Fund (TIF) schemes, but some of these have been abandoned and the general policy seems to have stalled. However, the most advanced scheme is in Greater Manchester, which has secured Programme Entry status for its Package of Investment and charging proposals with consultations this year, (2008).

## **Vehicle Excise Tax**

Fiscal measures can be placed at three crucial points in the life-cycle use of cars. These are:

- Tax on the initial purchase of a vehicle,
- Tax on the ownership of a car (annual registration tax and company car taxation), and
- Tax on the use of vehicles (fuel, road space and parking).

In addition to VAT, most EU states have a specific car purchase tax, with the UK and Germany being notable exceptions. The UK used to have a 10% car purchase tax, but in 1992 it was replaced by the UK policy for high fuel duty. Other EU states have retained vehicle purchase taxes, and many have reformed these to favour fuel-efficient or low-carbon vehicles.

In Finland there is a reduction for low emission vehicles and in the Netherlands car purchase tax is 45.2% with counterbalancing fixed allowances of €1540 for petrol and LPG cars, €580 for diesel cars and other allowances for cleaner vehicles. This fixed allowance cuts the charge significantly for smaller and more fuel-efficient cars and raises the price of larger and less fuel-efficient vehicles.

In the 2008 Budget, plans for the effective reintroduction of a UK purchase tax were announced. This is a modification of the UK's circulation tax ((Vehicle Excise Duty (VED) - see below)). From 2010 there will be a higher 'first year VED' rate for cars emitting more than 160g/km (with an additional charge over the normal VED rate of £495 for the highest band). This is detailed in the next section, but represents only a small additional charge for the highest-emitting vehicles, amounting to less than a half a percent of the purchase price (compared to the 10% purchase tax that existed in the early 1980s).

### **Annual Registration Tax**

All EU countries have a graded annual registration (or 'circulation') tax entitling owners to use the public highway. It is often varied by engine size or power of a car, but some nations have implemented an eco-reform to this tax. In Denmark the tax varies with fuel consumption, whereas Germany links tax liability directly to the Euro emission standards, with the least polluting car paying only 20% of the rate of the most polluting car. However, the overall tax is so low (about €50 per car) that its impact on car choice is negligible.

For cars registered from 2001, the UK has adopted a CO<sub>2</sub> emission-based system that has been incrementally developed to now involve in seven bands (A-G), with the charge ranging from zero for cars emitting up to 100 grams of CO<sub>2</sub> per kilometre, £35 for 101-120 g/km, up to £400 for 226g/km and above. The rates from April 2008 are shown in Table 1.

A similar system has also been introduced for road freight vehicles, with seven charge bands according to emissions and amount of road wear imposed.

**Table 1: Annual UK Vehicle Excise Duty (Circulation) Tax Rates (£),  
2008-09**

VED Band  
CO<sub>2</sub> emissions  
Diesel car  
Petrol car  
Green car\*\*\*

A  
Up to 100 g/km  
£0  
£0  
£0

B  
101-120 g/km  
£35  
£35  
£15

C  
121-150 g/km  
£120  
£120  
£100

D  
151-165 g/km  
£145  
£145  
£125

E  
166-185 g/km  
£170  
£170  
£150

F  
Over 185 g/km  
£210  
£210  
£195

G\*\*  
Over 225 g/km  
£400  
£400  
£385

*\*For cars registered before March 2001, the VED rates are charged according to engine size - £120 up to 1550cc and £185 for larger engine sizes.*

*\*\*For cars registered on or after 23rd March 2006.*



\*\*\**Alternatively fuelled cars*

From April 2009, VED will be totally restructured with 13 new bands (A to M) as shown in Table 2. VED will still be based on CO<sub>2</sub>, and band A will continue to apply to all cars with CO<sub>2</sub>-emissions of up to 100 gCO<sub>2</sub>/km, but most bands will be narrower and the highest band M will apply to cars with emissions of over 255 gCO<sub>2</sub>/km (currently the highest band applies to cars with over 225 gCO<sub>2</sub>/km). The 'Green Car' discount for alternatively fuelled cars will be reduced and phased out by 2011.

It is planned to build on this change in April 2010, with the introduction of a new first-year rate for all new cars during the first year of ownership. Cars emitting up to 130 gCO<sub>2</sub>/km or less will have a zero-rated first-year rate, cars with emissions between 131 and 160 gCO<sub>2</sub>/km will pay the normal first-year rate, but all new cars with emissions over 160 gCO<sub>2</sub>/km will pay a higher first-year rate, with a maximum additional VED supplement for the most polluting cars of £495 in 2010-11.

**Table 2: Proposed annual UK Vehicle Excise Duty (Circulation)  
Tax Rates 2009-10 and 2010-11 (£)**

VED Band  
CO<sub>2</sub> emissions  
Standard rate  
2009-10  
First-year rate  
2010-11  
Standard rate  
2010-11

A  
Up to 100 g/km  
£0  
£0  
£0

B  
101-110 g/km  
£20  
£0  
£20

C  
111-120 g/km  
£30  
£0  
£35

D  
121-130 g/km  
£90  
£0  
£95

E  
131-140 g/km  
£110  
£115  
£115

F  
141-150 g/km  
£120  
£125  
£125

G  
151-160 g/km  
£150  
£155  
£155

H  
161-170 g/km

£175

£250

£180

I

171-180 g/km

£205

£300

£210

J

181-200 g/km

£260

£425

£270

K

201-225 g/km

£300

£550

£310

L

226-255 g/km

£415

£750

£430

M

Over 255 g/km

£440

£950

£455

## Company Cars

Company car taxation is a sector-specific circulation tax. In the UK, around half of cars are purchased by commercial organisations for their employees for both business and private use. Until 2002, income tax was charged on 35% of the car's value per annum, with discounts for high business travel. For many years the Government was criticised for this taxation method, as the reductions for high business use encouraged employees to drive more in order to cut their personal tax bills.

A major reform in UK company car taxation took effect from 2002 when the tax charge was related to a car's CO<sub>2</sub> emissions. The charge rises from a

base level of 15% of a car's purchase price, for cars emitting 140 g /km CO<sub>2</sub>, in 1% steps for every additional 5g/km over 140g/km. The emission rates have gradually been lowered (the base level was originally 165g/km); this encourages the migration to lower emission cars.

The maximum charge is 35% of a car's price. Diesel cars not meeting Euro IV emissions standards incur an additional charge of 3%, up to the 35% ceiling. There are further reductions for company cars using cleaner fuels and technologies (e.g. a 3%-point reduction for hybrids). The charges are revised annually, generally increasing more for the higher emitting cars. Additionally, in 2002 discounts for high business mileage were abolished, together with most age-related discounts, which had provided an incentive to drive further and to use older, more polluting cars<sup>1</sup>.

An initial assessment of the impact of this tax change, (Inland Revenue, 2004)<sup>8</sup> showed that, in the first year of the new system, average CO<sub>2</sub> emissions of new company cars decreased from 196 g/km in 1999 to 182 g/km in 2002. The number of business miles was reduced by over 300 million miles per year and the overall effect was to reduce the emissions of carbon from the company car fleet by around 0.5% of *all* CO<sub>2</sub> emissions from road transport in UK.

This policy has proved influential due to the large changes in tax liability produced. A car costing £20,000 used mainly for business purposes under the old system would have cost an employee paying the standard rate of tax £690 a year. If the car is a fuel efficient one then the new tax bill will be similar. If it is an inefficient one, the bill is more than doubled to £1,600 per annum. This is in contrast to the relatively small tax gains of the VED reform. The latter saves users only about £100 per annum, which for most purchasers of new cars is arguably too little to influence car choice, although there may be a greater influence<sup>footnote 1</sup> on the used car market.

## Tax Reform and Tax Regime Change

Over the last ten years there have been significant reforms to the UK's car taxation regime. This has met with varying degrees of success and very variable degrees of political support or opposition.

By 2000, the policy to redirect tax from the purchase of cars to the use of cars through the Fuel Duty Escalator was starting to achieve results. In this context the reform to VED could have provided a useful supporting measure.

However, with the Fuel Duty Escalator put into reverse in 2000, the VED reform alone stood no chance of having any impact. The more recent increases appear likely to have some impact, particularly in conjunction with the substantial rises in fuel prices now taking place. For high CO<sub>2</sub>-emitting cars, VED is now a significant cost. A key lesson is that, because company

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<sup>1</sup> Notably, 'classic cars' are excluded from these (and also certain other tax) provisions, and a minority effect has been to encourage the ownership of such cars as company vehicles. They are by definition old, and generally produce high levels of emissions.

car tax was a major cost to users, its reform has been effective in influencing vehicle choice.

Overall, the Government has increasingly retreated from tax measures on car use, even to the extent of distancing itself from London's congestion charge and now retreating from their original national road user charging proposals. Regulations and ownership measures to improve fuel economy and encourage cleaner fuels have been maintained but, with the notable exception of the company car tax reform, have proved ineffective in the absence of strong complementary car use measures.

The transport policy White Paper, published in July 2004 (DfT)<sup>9</sup>, made official the retreat from car use tax measures. Despite a certain amount of rhetoric, the 2004 White Paper contains little on managing transport demand. It focuses on the competent management of the Government's transport investments and cutting costs (of the railways in particular). This produces a dilemma. The intellectual and research case for transport demand management is well proven. Even if energy and environmental considerations were discounted, trying to tackle congestion without strong demand management measures would be futile.

Politically this truth is unpalatable, so the White Paper ends up arguing for demand management measures, but relegates them to politically less sensitive (and less effective) areas. Therefore motorway capacity enlargement is being implemented, but the complementary measures (tolling or other measures such as high occupancy lanes to 'lock in' the benefits of new capacity) seem to have been abandoned.

There remains an unresolved policy dilemma. On the one side is the retreat from pricing measures on road transport, while on the other there is an acceptance that transport demand management is inevitable and that simply reforming existing tax measures is not enough.

## **Targeting Measures**

In summary, the UK has limited tax measures on purchase and a useful circulation tax on company cars but VED reform on its own has been an insufficient policy measure. Overall, in the UK, the major tax impact is on fuel, which has been avoided as a policy mechanism for seven years, but has recently come to fore as a result of high oil prices.

The situation over the concept of national road user pricing is looking confused. However, as conceived, it is proposed as purely a congestion/traffic management measure and is entirely separated from environmental policy objectives. Indeed, the 2004 Transport White Paper conceded that the policy for national road user pricing was not to address CO<sub>2</sub> emissions and that there was uncertainty about whether road pricing would increase or decrease emissions.

The Paper also noted that the most cost-effective way of reducing CO<sub>2</sub> emissions from transport would be measures affecting the cost of fuel, the price of energy efficient vehicles and the efficiency of road haulage. This raises the issue that were a national road user charge to replace in full or part Fuel Duty and VED it would skew the situation further to taxes on the use phase. If the aim of transport policy is only to manage the volume of traffic, then this emphasis is justifiable.

However, current taxation instruments are also intended to affect the type of vehicle purchased - both cars and freight vehicles. Taxation is part of the UK's policy to have a market transformation to cleaner and more fuel-efficient cars, vans and goods vehicles. Unfortunately, efforts to promote cleaner and more fuel-efficient vehicles have been ineffective to date.

For both cars and road freight, the price premium for cleaner technologies is prohibitive in the bulk of situations (Potter and Parkhurst, 2005)<sup>10</sup> and now even the technically modest CARS 21 target has failed to be met.

Fuel duty has to date only delivered an indirect influence upon car purchase. In practice, people and businesses making car purchases put fuel economy well down their list of priorities. Whilst the recent increases in fuel costs has had a short-term effect on this decision-making process, (and a significant impact on the second-hand car market), this short-term adjustment could soon be absorbed into household budgets.

In real terms, the cost of motoring has fallen significantly over the last 20 years. So although costs, (buying a car, running a car and the cost of fuel) have risen, after inflation has been taken into account it is still 28% cheaper to buy and run a car, excluding fuel costs, in 2008 than 1988.<sup>11</sup> In effect, the increase in the total cost of motoring since 1988 is well behind the overall increase in the cost of living.

Although the increasing cost of fuel tends to increase the perception that the costs of motoring have increased significantly, the reality is somewhat different. Should fuel costs stabilise, it is likely that the short-term behaviour change will lose momentum. It is considered that a direct tax measure on purchase or on circulation would have a much stronger and longer lasting influence.

If fuel taxes are replaced by a road user charge then even this indirect influence on vehicle purchase is broken. At the moment the national road-pricing proposal is to vary the charge only by congestion. We therefore have a serious problem of the unravelling of existing measures to promote cleaner cars. This could be compensated for in one of two ways:

- To weight the road user charge by CO<sub>2</sub> emissions (say into the existing VED bands).
- To accept that national road pricing is only to manage traffic volume and to introduce a separate strong purchase measure.

If this is to be fiscal, the prime candidate is a new car purchase tax highly graded by emissions, fuel economy or vehicle power. Alternatively VAT could

be grouped into three bands (e.g. 5%, 17.5% and 25%). Regulation, such as a quota on sales of vehicles by fuel efficiency bands, is possible but could be very difficult in practice.

Whether or not there is a shift to national road pricing, there is a need for taxation measures that will stimulate the purchase of cleaner vehicle and fuel technologies. As currently envisaged, moving to a national road pricing would worsen an existing weakness in the UK's policy to cut the car's environmental impacts.

## **Other Transport Taxation Change**

In addition to the more obvious types of transport taxation, other types of fiscal measures will need to come within the policy frame, particularly to address the inevitability of serious transport demand management.

More effective demand management measures such as workplace parking levies or road user charging (be it city, on motorways or wider area-based schemes) could stimulate people and businesses to relocate to low charge areas. A policy response could be in terms of the planning system, for example through more stringent land-use controls. However, these have not in the past proved to be very effective in controlling traffic-generating decentralisation and sprawl, especially when the issue of land value is taken into account.

Furthermore, planning controls affect only changes in land use. People change their pattern of activities in response to changes in transport costs with relative ease and speed. Metropolitan decentralisation and the dispersal of land uses is often linked to increasing car and energy use, but most of the increase in car dependency occurs through people changing their behaviour *within* the existing land-use pattern. A radical pricing change, such as Road User Charging, would have an immediate impact on activity patterns and only a gradual effect on land-use development.

There could be rapid shifts in activity patterns away from high-charge areas to low-charge areas, shifting congestion, generating new areas of congestion and increasing travelling distances. This would exacerbate the existing trend for traffic growth to be highest in low-congestion (rural, small town) areas. In the longer term this would be joined by increased decentralisation of land uses, so acting against the policies for sustainable communities and liveable cities.

This highlights the need for more locally targeted fiscal measures to counterbalance such negative effects. This is a much-neglected area, with all attention being at the national level. Measures could include Workplace Parking Levies, Business Improvement Districts or changing the basis of calculating Council Tax and the Business Rate. They could be weighted to fiscally favour accessible locations and so counterbalance effects of the higher road user charge in such places.

This could take the form of a variation on the Dutch ABC accessibility zoning. However, rather than being used for development control, the accessibility zones would represent council and business tax bands. In addition, parking spaces (now often identified separately for business rate assessment purposes) could be subject to a premium rate above a locally set ratio. Workplace Parking Levy (WPL) is a charge made for each parking space provided by an employer. Employers are required to apply for an annual licence for the maximum number of spaces, and then receive an annual bill to cover the levy for the number of agreed spaces. This income stream can provide a cost-efficient funding source for high-quality public transport alternatives if ring fenced appropriately. It is also envisaged that it will encourage employers to actively manage their car parking requirements and reduce the level of car commuting, which is a key method of managing congestion at peak periods. Such a scheme is currently being promoted in Nottingham and referred to in the chapter on parking control measures.

The other half of the tax 'sticks' are tax 'carrots' - tax exemptions and reforms favouring accessible locations that reduce travel demands and more environmentally-friendly travel modes. Some measures have already attracted very limited tax concessions. These include Travel Plans, but the main effect of recent tax concessions has been to reduce tax disincentives rather than provide positive incentives.

Furthermore, there is no real tax incentive for employers to provide a Travel Plan benefit (with the possible exception of the current cycle purchase scheme). The corporate tax regime is the weak link in the chain and all the personal tax regime concessions will count for little if the corporate tax regime does not positively encourage employers to offer Travel Plan benefits to staff. This could be addressed by capital and revenue allowances for specified Travel Plan expenditure (Travel Plan Tax Credits) and credits for developers including Travel Plan infrastructure.

## **Conclusions**

Although the increasing cost of fuel tends to increase the perception that the costs of motoring have increased significantly, the reality is somewhat different. Should fuel costs stabilise, it is likely that any short-term behaviour change will lose momentum. It is considered that a direct tax measure on purchase or on circulation would have a much stronger and longer-lasting influence.

In assessing the application of motoring taxation, the evidence indicates that in real terms the cost of motoring has fallen significantly over the last 20 years. It is well behind the overall increase in the cost of living over the same period and it could be argued that there is an obvious opportunity to mitigate the environmental impact of motoring through fiscal instruments.

However, based on recent experience, there is also a clear responsibility for transport professional advisers and decision makers, to use all the available evidence, to effect better understanding, need and acceptance of such action.



This is particularly important at a time when society is beginning to assess the global impact of 'climate change', with growing road usage, congestion and casualties from road collisions already being seen as unsustainable.

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## Issues and Recommendations

- In future, fiscal instruments will need to cover a range of national, local and sector-specific measures to promote fuel economy and innovative clean fuels. These measures are currently progressing but in order to achieve maximum benefits, their progress should be accelerated. Such action is currently gathering pace but progress needs to be stronger.

- Additional measures, which will complement integrated transport policies, should consider the introduction of locally targeted fiscal measures including Workplace Parking Levies, Business Improvement Districts or changing the basis of calculating Council Tax and the Business Rate. These could be weighted to fiscally favour accessible locations and so counterbalance potential effects of road user charge in such places.
- It may also be beneficial to promote and achieve sustainable travel benefits through the introduction of tax exemptions and reforms, favouring accessible locations that reduce travel demands and using more environmentally friendly travel modes. Some measures have already attracted very limited tax concessions using Travel Plans, but much more could be achieved in adopting this approach.