STUDY OF THE ENVIRONMENTAL IMPLICATIONS OF IRISH TRANSPORT GROWTH AND OF RELATED SUSTAINABLE POLICIES AND MEASURES

Volume 1

SUMMARY REPORT

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Study Background

This report presents the findings of a study of the environmental implications of the growth in transport and the scope for developing related sustainable policies and measures. The Study was commissioned in October 1997 under the Technical Assistance Programme within the Operational Programme for Transport. This report is supported by a separate Technical Report that contains details of the methods and calculations used to derive estimates of traffic volumes and external impacts.

The project work has been guided by a Project Committee with representation from the Department of Public Enterprise, the Department of the Environment and Local Government, the Department of the Marine, the External Evaluator for the Operational Programme for Transport and Coras Iompair Éireann.

The two principal objectives of the study were:

- to assess the overall environmental impact of existing transport volumes and patterns; and

- to project the environmental impact of continuing traffic growth and network development.

Two important subsidiary objectives were:

- to assess the current status of sustainable policies and measures, in particular taxes and subsidies; and

- to consider the scope for further such policies and measures, in particular pricing measures.

It is helpful to set the study within the context of recent transport and environmental policy within European Union. The most significant of these policy developments include:

- fair and efficient pricing in transport;
- limitation and reduction of CO_2; and
- transport integration and intermodality.

The European Commission's White Paper on transport infrastructure charging advocates that infrastructure charges should normally reflect marginal costs at the point of use and that the external costs of transport should be internalised through appropriate combinations of taxes and tolls. This is seen as the best way to ensure efficient transport and sustainable mobility over the longer term for the benefit of all regions and economies of the Union. Ultimately, the more efficient use of transport will lead to reduced transport costs for the whole of society and to reduced costs for some producers. It is recognised, however, that this type of policy will cause certain transport charges to rise.

Study Reports

The Final Report for the study has been produced in two volumes. This report (Volume 1) presents a summary of the study findings plus policy recommendations. The Volume 2 'Technical Report' presents further details of the technical methods, and results, associated with transport growth forecasting, environmental impacts and the valuation of transport externalities.

Study Approach

Overview

Given the aims outlined in Section 1, a study approach was developed with the goal of providing a quantitative basis for formulating sustainable transport policy measures in Ireland. Importantly the study has attempted to reflect the specific geographical, infrastructural and environmental conditions in Ireland; particularly to draw out contrasts between different modes of transport and the different scale of impact in urban and rural areas.

In overview the approach has been to:

- quantify the current volumes for all transport modes in Ireland together with their associated external impacts;

- investigate the current balance between transport revenues (principally from taxation) and the estimated external costs (associated with the environmental and accidents) as well as infrastructure costs;

- predict the future growth in the transport sector (up to the year 2010) in order to account for future trends in both transport volumes and external impacts; and

- in the light of the above, examine the scope for new policies and measures to ameliorate the adverse external impact arising from transport use.

Theoretical Case for Government Intervention

It is of value to set out the theoretical basis for Government interventions in the field of transport and environmental policy.

The need for intervention to control environmental costs arises because of the ‘externalities’ associated with pollution – the costs that the polluting individual imposes on the members of society. Without government intervention, a polluter may have no reason to take these external costs into account. Decisions regarding transport choices will be taken purely on the basis of the ‘private’ costs and benefits to the individual polluter.

Environmental policy needs to draw a balance between the costs of pollution and the costs of controlling pollution. Whilst there may be some forms of pollution that it would be desirable to eliminate entirely, this will generally be the exception rather than the rule. Ideally, pollution should be restricted up to the point where the benefits to society as a whole from further reductions in pollution are less than the costs of controlling pollution through the installation of control devices or the curtailment of polluting activities. In economic terms, therefore, pollution should be controlled up to the point where the marginal cost of further abatement measures just outweighs the gain from reduced emissions.

For a single polluting individual it is possible to define marginal abatement cost (MAC) and marginal damage cost (MDC) functions as shown in Figure 2.1. E* represents the efficient level of pollution control. At E*, the marginal abatement cost and marginal damage cost are equal, at level C*.

In theoretical terms, the appropriate level of abatement is achieved where the marginal social cost of reducing pollution by an additional unit is equal to the marginal social benefit of a one-unit reduction in pollution. Achieving this level, whether through tax policies or through other measures, requires information on the structure of both marginal abatement costs and marginal damage costs.

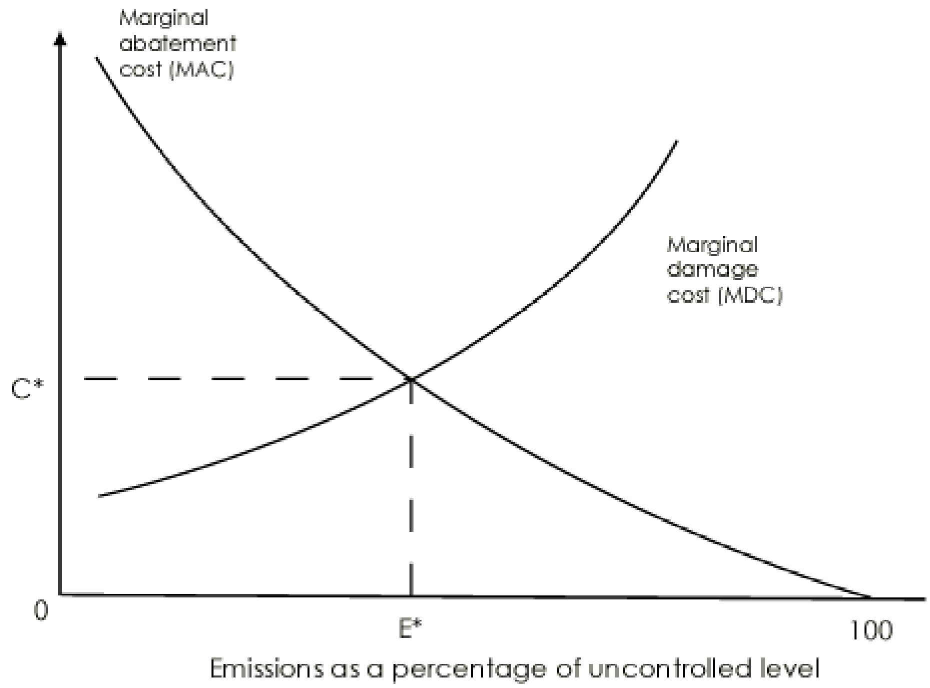

Figure 2.1 Efficient Pollution Abatement for a Single Polluting Individual

The transport sector provides considerable opportunities for enhancing the environmental orientation of the tax system. Road transport is already heavily taxed through levies on motor vehicles and on motor fuels, so that there is plenty of scope for introducing environmental incentives by restructuring these existing taxes rather than establishing wholly-new 'green' taxes or charges.

Formulating efficient environmental tax policies for road transport is, however, complex because of the range of social costs involved and because of the complex interactions between road transport, other modes of transport and issues of spatial development. In general, road transport taxes can reflect the various externalities only approximately, and optimal policy will therefore need to employ both tax and non-tax instruments in combination.

In principle, the taxation of transport might be used to address each of the principal forms of social cost involved in transport use:

- environmental costs including global and local air pollution, noise and aesthetic losses imposed on society;

- congestion costs and accident costs imposed on other road users; and

- the otherwise-uncharged costs of consumption of publicly-provided infrastructure.

This study has therefore sought to assess the degree to which social costs of transport use are 'internalised' through transport charges (as measured by revenues arising from taxes and other charges).

To achieve this an infrastructure/environmental accounting method has been developed. For each mode of transport revenues have been compared with infrastructure and external costs using the principle that in a perfectly internalised market:

Revenues from Transport	=	Infrastructure Costs	+	External Costs	(environmental+accident/congestion)

The subsequent chapters in this report describe the way in which an infrastructure/environment account was developed to examine the absolute and relative performance of transport modes in Ireland.

Current Transport Volumes

Introduction

An essential first step in the study was to produce a quantification of the current volumes of transport use which, together with a set of parameters relating to the pollution characteristics of different transport modes, provides the basic mechanism for estimating the external transport costs. Clearly the design of an efficient system of charging/taxation requires the transport market to be broken down into segments (modes, vehicle types, fuel types etc.) that reflect differences in pollution characteristics. However, some constraints are imposed due to the lack of detailed segmentation and comprehensive cover of existing statistics. The market segmentation eventually adopted for the study is illustrated below.

Mode		**Fuel Type**
• road-based	• cars	• diesel • petrol
	• trucks	• diesel • petrol
	• buses	• diesel
	• motorcycles	• petrol
• non road-based	• rail	• diesel • electric
	• air	• aviation fuel
	• sea	• diesel

Due to the importance of the car mode in terms of overall volumes of passenger travel further disaggregations were undertaken to reflect the engine size and age characteristics of the vehicle fleet.

In addition it has been recognised that the external impacts of transport will differ according to geographic context; with higher density of 'recipients' in urban locations. Hence, wherever possible, separate estimates have been made for urban and rural transport use.

Transport Volumes - Overview

National statistics have been compiled for each mode of transport in order to produce estimates of the volume of transport use in the base year of 1996.

Domestic Passenger Transport

The dominance of the road mode, for domestic passenger transport is illustrated below.

Table 3.1 Domestic Passenger Travel by Mode (1996)

Mode	**million passenger kms**	**%**
Cars	40,046	82
Buses/Coaches	7,020	14
Rail	1,295	3
Motorcycle	280	1
Total	**48,641**	**100**

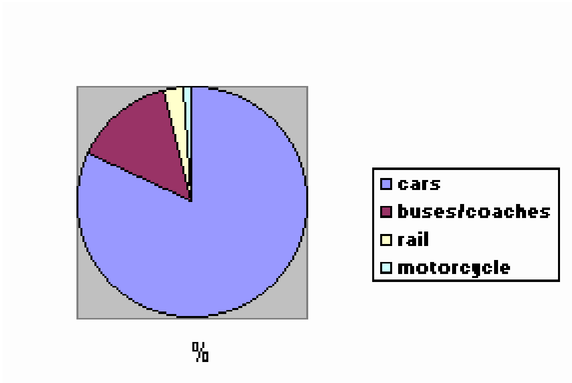

Figure 3.1 Domestic Passenger Travel by Mode (1996)

It can be seen that road transport accounts for 97% of domestic (excluding international) travel.

Road Transport Volumes

The volumes of transport by road can be described in more detail by comparing estimates of vehicle-kilometres by mode.

Table 3.2 Annual Vehicle - Kilometres by Mode (1996)

Mode	**Annual Vehicle-kms (millions)**	**%**
Passenger cars	27,355	79
Light goods vehicles	3,651	11
Heavy goods vehicles	2,831	8
Buses/Coaches	351	1
Motorcycles	262	1

Total	34,450	100

Small vehicles (passenger cars and light goods vehicles) account for 90% of total annual vehicle kilometres travelled. Heavy goods vehicles account for 8% of the annual vehicle-kilometres. This is shown below in Figure 3.2

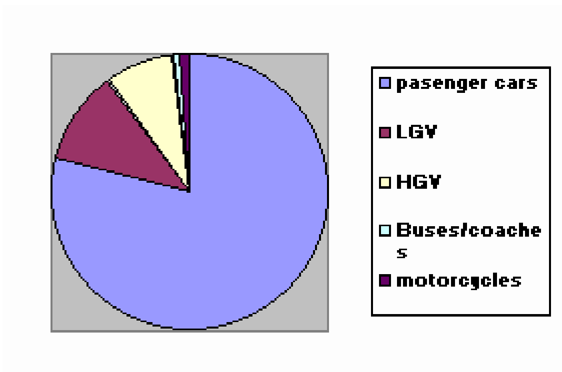

Figure 3.2 Annual Vehicle Travel by Mode (1996)

Road Travel by Geographic Area

It is of considerable interest to draw a distinction between travel in urban and rural areas since the external impacts of transport use in urban areas are exacerbated by high concentrations of those affected.

Table 3.3 Annual Vehicle – Kilometres by Sub-Area in 1996

Area	**Annual Vehicle-kms (millions)**	**%**
Rural - National Primary	7,924	23
- Other	20,670	60
Urban	5,856	17
Total	**34,450**	**100**

The data presented below shows that rural travel accounts for 83% of annual vehicle-kilometres.

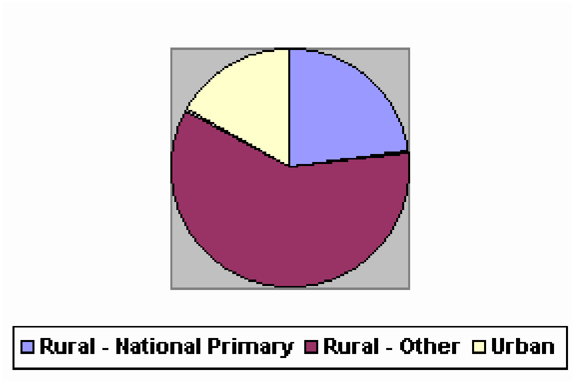

Figure 3.3 Annual Vehicle Travel by Sub-Area (1996)

Road Travel by Vehicle Fleet Characteristics

Different vehicle types give rise to differing levels of pollution, hence it is of value to examine the breakdown of annual vehicle-kilometres according vehicle fleet characteristics. Table 3.4 below indicates the breakdown.

Table 3.4 Distribution of Vehicle-Kilometres by Vehicle Fleet Characteristics (1996)

Category	Fuel Type	Engine Size	Total Veh-kms (millions)	%
Private Cars	Petrol	< = 1.4 litres	15,115	44
		>1.4 - 2.0 litres	7,145	21
		>2.0 litres	418	1
	Diesel	< = 1.4 litres	120	<1
		> 1.4 <= 2.0 litres	4,227	12
		> 2.0 litres	330	1

Goods Vehicles	Petrol	<1778kg ULW >1778kg ULW	172 30	<1 <1
	Diesel	<1778kg ULW >1778kg ULW	3,479 2,801	10 8
Buses	All	All	351	1
Motorcycles	All	All	262	1
Total	**All**	**All**	**34,450**	**100**

Note: ULW = unladen weight

The table above shows that petrol cars make up 66% of annual vehicle-kilometres. Diesel powered vehicles account for approximately 32% of total vehicle-kilometres.

Non Road Transport

Other than road vehicles, significant contributions to the external impacts of transport activities are made by rail, air and sea modes.

Estimates have been made of the annual travel:

- rail in terms of passenger-kilometres;
- domestic and international air passenger volumes; and
- ship passengers at major Irish ports.

Rail Transport

Rail transport can be sub-divided into three categories; mainline services, Dublin suburban services and the Dublin Area Rapid Transit (DART). Table 3.5 shows the breakdown of services by category.

Table 3.5 Annual Passenger-Kilometres by Rail (1996)

Service	Passenger-kms (millions)	%
Mainline Dublin suburban DART	1,083 43 170	84 3 13
Total	**1,296**	**100**

Air Transport

The airports at Dublin, Shannon and Cork account for over 95% of Irish travel by air. The annual passenger numbers at each airport are given in Table 3.6 below.

Table 3.6 Annual Passenger Numbers by Air (1996)

Airport	Number (millions)	%
Dublin Shannon Cork	9.09 1.74 1.12	76 15 9
Total	**11.95**	**100**

Sea Transport

The four main Irish ports, Dublin Cork, Dun Laoghaire and Rosslare handled just over 4 million passenger movements in 1996. The details movements through each port are given in Table 3.7 below.

Table 3.7 Annual Passenger Numbers by Sea

Port	Number (millions)	%
Dublin	0.78	19
Cork	0.33	8
Dun Laoghaire	1.66	41
Rosslare	1.31	32
Total	**4.08**	**100**

The External Impacts of Transport – Base Year (1996)

Introduction

All of the transport activities described in Section 3 give rise to external impacts. The study has applied internationally recognised methodologies to estimate the level of transport-related external impacts for:

- atmospheric emissions;
- noise; and
- accidents.

Wherever possible separate assessments have been made for each market segment. However in the case of noise impacts, the limitations in data availability prevented a comprehensive analysis.

The assessment of the environmental impact of transport has focused on pollution to the air, in terms of the atmospheric emissions, and the noise effects from the use of transport. Other environmental impacts, such as liquid and solid waste emissions, were not covered by this assessment, due to the difficulties in undertaking such an assessment. It is assumed that such emissions are likely to make only a small contribution to the overall volume of liquid and solid waste emitted.

Atmospheric Emissions

The methodology for assessing atmospheric emissions from transport was based on the approach adopted by The European Environment Agency for the CORINAIR European atmospheric emissions inventory programme. Use of the CORINAIR methodology provides a means to organise data and produce estimates of emissions using a common framework. This allows comparability between the results across different countries or regions. CORINAIR provides separate methods for each mode of transport; therefore transport has been split into road, rail, shipping and aircraft modes.

Atmospheric emissions give rise to two types of impact; global (greenhouse gas) impacts and local air quality impacts. The various gaseous emissions associated with each type of impact are summarised below.

Global	Local Air Quality
Carbon Dioxide (CO_2)	Carbon Monoxide (CO)
Nitrous Oxide (N_2O)	Oxide of Nitrogen (NO_x)
Methane (CH_4)	

	Sulphur Dioxide (SO_2) Hydro Carbons (HC) Non Methane Volatile Organic Compounds (NM-VOC) Particulate Matter (PM) Methane – low level (CH_4)

The quantitative data relating to vehicle movements by mode and vehicle type have been input to the emissions calculation process to derive estimates of the volume of each of the above emission types. It is important to note that the methodology is sensitive to vehicle fleet characteristics such as fuel type, engine size and vehicle age.

Thus in the case of road transport the impact of the introduction of catalytic converters, on more recent petrol vehicles, can be estimated.

Atmospheric Emissions by Sector

Transport is only one of a number of sectors of the economy that contributes to atmospheric emissions in Ireland. The work compiled by McGettigan[1] is helpful in setting the transport sectors contribution in context of total atmospheric emissions. The figures below show the percentage contribution of each of the six major economic sectors to air emissions. It can be seen that transport activities make a very significant contribution to certain emissions. The largest contributions from the transport sector are:

<u>% of Total Emissions</u>

- Carbon Monoxide (CO) - 80%
- Oxides of Nitrogen (NO_x) - 46%
- Non Methane Volatile Organic Compounds (NM-VOC) - 34%
- Carbon Dioxide (CO_2) - 22%

With regard to total global warming potential the current contribution from the transport sector amounts to roughly 11%.

CO_2 Emissions

Emissions of CO_2 are of crucial importance since it is the main greenhouse gas emitted by the transport sector and forms by far the biggest element of growth in global warming potential.

Within the transport sectors 22% contribution to CO^2 emissions, , road transport accounts for 68% of the total. The second highest contribution is from air transport which accounts for 20% of CO_2 emissions. Table 4.1 provides further details of the contributions of different categories of road vehicle to annual CO_2 emissions from road transport.

Table 4.1 Annual CO2 Emission by Vehicle Type (1996)

Vehicle Type		**CO2 Emissions (million-tonnes)**	**%**
Cars	• petrol • diesel • diesel • diesel • petrol	3.31	50
		0.48	7
HGV		1.83	27
LGV		0.74	11
LGV + HGV		0.05	1
Bus		0.24	4
Motorcycle		0.03	<1
Total		**6.67**	**100**

The data show that cars currently account for 57% of CO_2 emissions from road transport. Although heavy goods vehicle movements represent just 8% of road vehicle kilometres their contribution to road-based CO_2 emissions amounts to 27%.

Source: 1. McGettigan M. (1997) UNECE ANNUAL EMISSION REPORT, Estimation from CORINAIR National Annual Data (According to SNAP 94), Environmental Protection Agency.

Local Air Quality

Emissions from road transport can produce important health impacts, particularly in built up areas where transport activities take place in close proximity to areas of relatively intense human occupation/activity.

Annual emissions of PM10/Dust from road transport in urban areas has been used as the key indicator of local air pollution. Table 4.2 compares emissions by vehicle type.

Table 4.2 provides a summary of PM10/Dust emissions in urban area for each main mode of transport.

Table 4.2 PM10/Dust Emissions in Urban Areas in 1996

Vehicle Type	**PM10/Dust Emissions (tonnes)**	**%**
Car	95	21
HGV	214	46
LGV	122	26
Bus	33	7
Total	**464**	**100**

The table demonstrates that HGV's and LGV's produce a disproportionately high level of PM10/Dust emissions in urban areas when viewed in the context of vehicle distances travelled. For example, goods vehicles account for just 16% of the overall vehicle-distance travelled in urban areas but are responsible for 72% of emissions. This is due to the higher levels of PM10 emissions from diesel engines.

Noise

Noise arising from transport can produce physiological, psychological and social impacts on human activity.

There is insufficient data available in Ireland to relate vehicle-distances, for each mode of transport, to noise damage. The collection of such data falls outside the scope of this study. However, work completed by Tinch[1] in 1997 provides a basis for the assessment of global noise damage costs from both road and rail transport. The results of this work are summarised in Table 4.3.

Table 4.3 Noise Damage from Road and Rail Transport in Ireland (1997)

Mode	Population exposed (millions) in each noise band (dB (A))						Value per dB	Cost of Noise Damage (MECU)
	50-55	55-60	60-65	65-70	70-75	75+		
Road	0.80	0.59	0.38	0.22	0.07	0.02	1.60	27
Rail	0.15	0.11	0.07	0.03	0.01	0.01	1.60	5

Source: 1. Tinch R. (1997) 'The Valuation of Environmental Externalities', Conference Paper, Determining the Monetary Values of Environmental Impacts, University of Westminster, October 1997.

The results should be interpreted with some caution since they are based on relatively crude assumptions regarding exposure to transport noise. They suggest that about a third of the population of Ireland is exposed to noise levels in excess of 60dB(A). This level of noise equates to a condition that would be experienced in a building close to a busy road with the window open.

The overall annual road noise damage cost in Ireland was estimated to be 27 million ECU (1996 prices). The equivalent rail noise damage cost was estimated to be 5 million ECU.

Transport Accidents

The human and economic costs of transport accidents are a major concern for modern society when confronted with rapidly increasing transport volumes.

An assessment has been made of both fatalities and serious injuries arising from transport using data from 1996. The data needs to be treated with some caution due to the statistical errors associated with a single year's data. Table 4.4 shows, perhaps not surprisingly, that road travel accounted for all but a few fatalities in 1996.

Table 4.4 Transport Fatalities in 1996

	Mode	**Fatalities**	**%**
Road	Cars	222	50
	Goods vehicles	28	6
	Buses	0	0
	Motorcycles	56	12
	Pedestrians	115	26
	Cycles	22	5
Rail		0	0
Air		4	1
Total		**447**	**100**

The data highlight two particular concerns:

- the high level of fatalities for vulnerable (pedestrians and cyclists) road users; and
- the exceptionally high level of fatalities for motorcyclists (20 times greater than car users) when expressed as a fatality rate per kilometre travelled.

The Current Balance of Transport Costs and Revenues

Introduction

As noted in Section 2 an accounting process has been established so that estimates can be made of the degree to which current transport revenues cover infrastructure and external costs. In undertaking this exercise it is important to draw a distinction between the principle of 'efficiency' and 'equity' in transport charging.

Efficient Charging

To take the road mode as an example infrastructure costs are of interest for two reasons. First, they are relevant to the task of designing an efficient system of road users charges. The rationale is that vehicles should be charged for the marginal social costs which they impose on the road system. These marginal social costs are exclusive of the costs which the road user incurs and pays for himself viz. his own vehicle operating costs and journey time costs. Instead they include the road maintenance, congestion, accident and environmental costs that the road user imposes on others. This may be termed the 'efficiency' argument for road user charges.

An efficient charging regime will:

- exclude sunk capital costs;
- exclude weather related and other non-use related maintenance costs; but
- include road congestion and accident costs.

Equitable Charging

It can be argued, on grounds of achieving an equitable system of charging across all modes, that users should pay for full costs rather than just marginal costs. This argument is often applied when comparing the road mode with charges for the use of public transport systems.

The efficiency and equity principles give rise to different approaches to the calculation of infrastructure costs. In the first approach, the *marginal* social costs arising from individual modes are calculated. These costs include costs imposed on other road users. In the second approach, the total and not just the marginal costs of the road system are estimated and allocated between the various modes. However, costs such as congestion costs which are borne by the road mode as a whole are excluded. Only those costs which are not borne by the road mode as a whole are reckoned.

For equitable charging, the appropriate costs will:

- include capital costs;
- include all maintenance costs whether use related or not; and
- exclude congestion costs and accident costs, except to the extent that they are borne by non road vehicle users.

The three main elements of the accounting exercise are **transport revenues**, **infrastructure costs** and **external costs**. The methods used to calculate these costs are summarised in the sections below.

Transport Revenues

Transport revenues are normally levied by national governments for the purpose of both general tax raising and as a policy instrument to encourage socially responsible travel behaviour. The amount of revenue raised varies considerably according to vehicle type, fuel, engine size and other factors, and hence a vital element of the infrastructure/ environment account is the quantification of tax revenue for each mode.

The revenues from road transport are those arising from fuel, road taxes and vehicle registration tax (VRT). These taxes are considered specific to road vehicles and not part of general taxes. Normally VAT is levied as a general tax at a standardised rate. However, in Ireland the incidence of VAT within the transport sector is non-neutral. Consequently deviations from a VAT ‘norm’ have been included as either positive or negative revenue impacts, depending on the scale and direction of variation.

Road taxes are annual taxes levied on vehicles and graduated by size of vehicle. In the case of cars, the tax is based on the volume capacity of the engine. The road tax on the typical 1300-1400cc car is £175 per annum (1998). The road tax on goods vehicles is graduated by unladen weight. LGVs of less than 3,000kg unladen weight pay £150 per annum (1998). The amount payable increases substantially with vehicle weight, so that a vehicle of 12,000kg pays £1,120 annually (1998).

VRT is levied on **cars** of less than 2,500cc at 23.2 percent of the open market selling price. Larger cars attract a rate of 29.5 percent. The rate for car-derived vans is 13.3 percent. Trucks, large vans, tractors and buses pay a flat rate of £40 only. In the 1999 Budget a new structure favoured smaller cars by raising the VRT rate on larger cars. The new structure introduced three tiers. A 22.5% rate now applies to cars up to and including 1,400 cc, a 25% rate applies to cars up to 2,000 cc, and a 30% rate applies on all cars over 2,000 cc. These changes were to bring in £43 in extra revenue and apply from 1 January 1999.

Fuel taxes are levied on a per litre basis and the rate differs between petrol and diesel. the 1996 rates of tax were:

- petrol: 29.00 pence per litre; and
- diesel: 24.38 pence per litre.

In order to give **public transport services** favourable fiscal treatment, diesel for trains and for licensed passenger transport is subject to low rates of excise, particularly so in the case of buses, which in fact pay the same low rate as that for trains, but then receive a further rebate. Public passenger transport, including transport by taxis, is VAT exempt and therefore no VAT is charged on the supply of the service. However, by consequence, these services cannot claim a refund of VAT on their fuel inputs, which stand at 21 percent, or 12.5 percent in the case of diesel for trains.

International sea transport services are exempt from excise tax on fuels. They are also exempt of VAT deductibility on inputs, in accordance with section 12 of the VAT Act. There is a £5 Foreign Travel Duty charged on each ticket for outward journeys originating in Ireland. From January 1999 the eight port companies will be subject to corporation tax. This is being phased in over a period, with full taxation from 2001. A similar regime is being applied to privately owned ports. The companies being brought into the net currently handle over 90% of commercial port traffic.

Protection of state-owned airlines throughout the world has meant that **air transport** is subject to few taxes. Furthermore, international and bilateral agreements governing the industry forbid taxes on international air travel. EU rules also forbid countries from introducing unilateral taxes, such as VAT, on domestic air travel, though there may be more discretion for member states with the sixth VAT Directive. The main fuel used for air travel is kerosene. Commercial airlines on international routes do not pay tax on their aviation fuels. Furthermore international air transport is subsidised, like sea transport, by the concession of duty-free shopping both in airports and in flight. A study by KPMG estimates that abolition of duty free could raise air fares by £10 per journey, which is an indication of the subsidy enjoyed at present.

Infrastructure Costs

Costs associated with the running of a transport system can be broken down into two broad categories:

- infrastructure costs; and
- operating costs.

Infrastructure costs incorporate:

- investment in new infrastructure such as road or rail track;
- maintenance of infrastructure; and
- renewal of existing infrastructure.

For the purpose of this study operating costs are considered to be those associated with operating vehicles on the transport system such as fuel costs etc.

The costs of infrastructure investment, maintenance and renewal have been calculated for the base year of 1996 for road, rail, air and shipping. Where appropriate, these costs have been apportioned to the various market segments to show which elements of the transport market are the most demanding in terms of infrastructure provision.

External Costs

The quantified external impacts summarised in Section 4, have been converted to monetary values through the adoption of appropriate externality valuations. A comprehensive and authoritative review of environmental impact valuation has recently been published by the European Conference of Ministers of Transport (ECMT). In deriving values for environmental externalities the ECMT draw on a range of studies which have employed a variety of valuation techniques (including hedonic pricing, stated preference and dose-response). Because of the wide range of valuations associated with CO_2 emissions, the accounting exercise in this study has adopted a low to high range of environmental values for this pollutant.

Comparison of Revenues and Costs

Revenue: Cost Calculations

Having compiled revenues, infrastructure costs and external costs it is possible to calculate a ratio of revenue to cost for each main mode of transport. A ratio of >1.0 indicates that current revenues exceed infrastructure + external costs. A ratio of <1.0 indicates that current revenues fail to cover infrastructure + external costs. Due to the wide range of uncertainty associated with the valuation of external costs a low to high range of values has been presented. It is also important to note the external cost values exclude congestion-related costs. Congestion costs will have the effect of increasing road transport costs, particularly in urban areas. For example data from the Dublin Transport Initiative traffic model indicates that current road-related delay costs amount to approximately £500m per annum.

Road Transport: Revenues and Cost

Table 5.1 presents the results of the revenue to cost comparison using the marginal cost (pricing efficiency) values, that is, through the application of the 'polluter pays' principle of relating marginal costs of transport use to marginal revenues.

Table 5.1 Ratio of Transport Revenue to Marginal Costs – Roads

Mode	Revenues (MECU)	Infrastructure (marginal), Accident, Environmental and Noise Costs		Revenue: Cost Ratio	
		Low	High	Low	High
Passenger cars	1843.4	755.1	1003.4	2.4	1.8
LGV	194.6	73.1	113.5	2.7	1.7
HGV	236.3	312.0	413.6	0.8	0.6
Buses	21.2	24.4	37.7	0.9	0.6

Motorcycles	14.7	82.7	90.7	0.2	0.2
All	2308.3	1505.5	1903.7	1.5	1.2

The results are presented graphically in Figure 5.1 and include a breakdown between infrastructure accident and environmental costs.

The results indicate that:

- revenues from cars and light goods vehicles exceed marginal costs by a wide margin;
- HGV's fail to cover marginal costs due to the relatively high (in proportion to distance travelled) infrastructure costs and environmental costs;
- due to the relatively high environmental costs associated with the existing stock of diesel powered vehicles, revenues from buses fail to cover costs; and
- motorcycles incur exceptionally high accident costs relative to distance travelled and consequently revenues fail to cover costs by a wide margin.

Fully Allocated Revenues and Costs

In the case of non road transport (rail, air, shipping), in which full rather than marginal infrastructure costs are normally charged, it is of more relevance to examine the balance between fully allocated costs and revenues. In order to fully embrace the issues of 'fairness' in allocating resources between modes, Table 5.2 presents a comparison of both marginal and fully allocated costs to revenue ratios for all main modes of transport and for both high and low emission predictions.

Table 5.2 Summary Infrastructure/Environment Account

Low Estimate

Ratios of User Revenue to Total Costs								
Mode	Infra. Costs		Infra. + Env. Costs		Infra. + Env. + Acc. Costs		Infra.+Env.+Acc. Noise Co	
	Full	Marginal	Full	Marginal	Full	Marginal	Full	Marginal
LGV	3.66	34.14	2.24	4.95	1.83	3.30	1.61	2.66

HGV	0.91	1.58	0.60	0.83	0.57	0.79	0.56	0.76
Car	5.56	160.36	2.34	3.94	1.75	2.48	1.74	2.44
Bus	1.58	7.38	0.62	0.89	0.62	0.89	0.49	0.87
Motorcycles	5.87	321.69	0.96	1.15	0.17	0.18	0.17	0.18
Road	3.45	13.62	1.74	2.78	1.16	1.57	1.16	1.53
Rail	1.04	n/a	0.97	n/a	0.97	n/a	0.93	n/a
Shipping	-1.23	n/a	-0.81	n/a	-0.81	n/a	-0.81	n/a
Air	-31.35	n/a	-2.14	n/a	-2.00	n/a	-2.00	n/a

High Estimate

Ratios of User Revenue to Total Costs								
Mode	Infra. Costs		Infra. + Env. Costs		Infra. + Env. + Acc. Costs		Infra.+Env.+Acc. Noise Co	
	Full	Marginal	Full	Marginal	Full	Marginal	Full	Marginal

LGV	3.66	34.14	1.66	2.49	1.41	1.96	1.28	1.72
HGV	0.91	1.58	0.50	0.61	0.49	0.59	0.48	0.57
Car	5.56	160.36	1.97	2.65	1.51	1.86	1.50	1.84
Bus	1.58	7.38	0.49	0.57	0.49	0.57	0.48	0.56
Motorcycles	5.87	321.69	0.90	0.95	0.16	0.16	0.16	0.16
Road	3.45	13.62	1.46	1.90	1.02	1.20	1.01	1.20
Rail	1.04	n/a	0.93	n/a	0.93	n/a	0.90	n/a
Shipping	-1.23	n/a	-0.48	n/a	-0.48	n/a	-0.48	n/a
Air	-31.35	n/a	-1.01	n/a	-0.97	n/a	-0.97	n/a

The results are illustrated graphically in Figure 5.2.

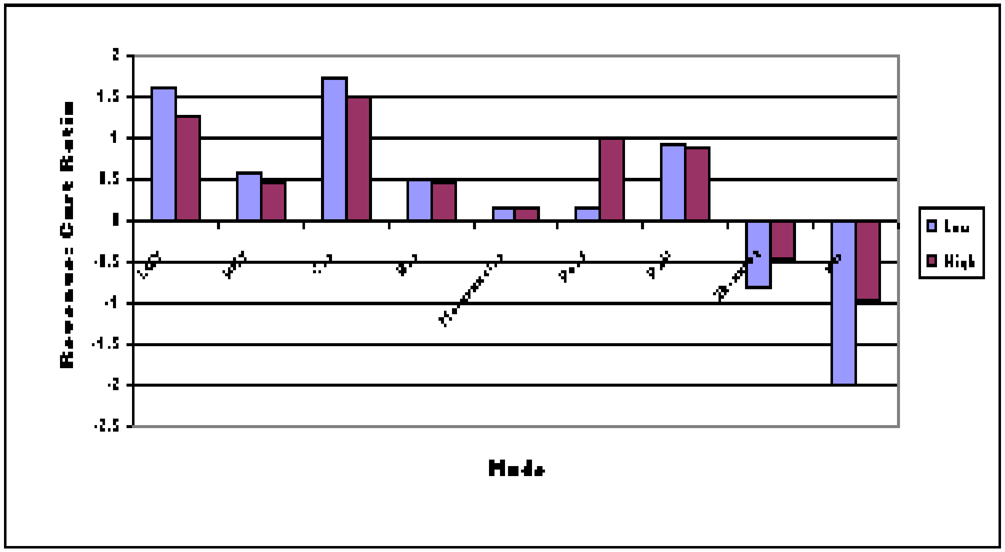

Figure 5.2 High/Low Estimates of Revenue: Cost Ratios (fully allocated costs)

The results indicate that:

- even when fully allocated costs are applied overall revenues from road modes more than cover infrastructure plus environmental costs;
- revenues from rail transport are shown as covering infrastructure costs. This outcome is largely due to the way in which Government grants (approx. £150m in 1996) for rail infrastructure have been allocated (as both a revenue and an infrastructure cost). If these grants were excluded from revenues the relevant ratios would be significantly less then 1.0. This would more closely reflect the way in which rail costs appear to rail customers whose ticket prices do not include infrastructure costs;
- the absolute external costs of rail travel (in the range 10-20 mECU per annum) are relatively small when compared with the external costs of road transport (in the range 1330-1630 mECU per annum);
- both air and shipping produce negative revenue values due to the high value of public funding relative to revenues raised from taxation;

- the external costs of air transport fall in the range 60-140 mECU and can be attributed to the relatively high volume of CO_2 emissions from jet engines;
- the external cost of shipping are made up entirely from environmental costs which can be attributed largely to CO_2 emissions from diesel engines; and
- as a consequence of negative revenues and significant environmental costs both air and shipping activities fail to cover costs by a wide margin.

Future Growth in Transport Volumes

Introduction

In assessing the scope for new or revised policy interventions in the transport sector it is important to gain an appreciation of the future growth in volumes for each main mode of transport. The underlying growth in transport volumes is strongly related to economic growth trends. The study has taken advantage of the work completed as part of the Mid-Term Evaluation of the Operational Programme for Transport to produce forecasts of transport growth up to the year 2010. In addition, because the external impacts of transport are influenced by technology and lifestyle choices, it is necessary to consider a number of other future trends. Thus, additional levels of sensitivity have been incorporated in the forecasting process to account for:

- changes in the age and size distribution of the car fleet;
- the incorporation of car ownership saturation effects;
- changes in the use of different vehicle fuel types;
- historical trends in passenger rail transport;
- recent historical growth of international air traffic and aircraft loadings; and
- changes in the characteristics (capacity) of the shipping fleet.

Growth in Road Transport Volumes

Table 6.1 provides a summary of the predicted growth in vehicle-kilometres by road over the period 1996-2010.

Table 6.1 Predicted Growth in Vehicle-Kilometres, 1996-2010

Mode	Type	Veh-kms (millions)		Growth (1996-2010)	
		1996	2010	p.a.	Total
Passenger Cars	< 1400 CC	15,235	29,246	4.8%	92%
	1400-2000 CC	11,372	23,997	5.5%	111%
	>2000 CC	748	2,383	8.6%	219%
Sub Total – Cars		**27,355**	**55,626**	**5.2%**	**103%**

Goods Vehicles	LGV	3,651	3,949	0.6%	8%
	HGV	2,831	5,592	5.0%	98%
Sub Total – Goods Vehicles		**6,482**	**9,541**	**2.8%**	**47%**
Buses	All	351	368	0.3%	5%
Motorcycles	All	262	262	0.0%	0%
Total		**34,450**	**65,797**	**4.7%**	**91%**

The forecasts 'build in' the results of sub-models that were designed to predict future changes in the age and size distribution of the private vehicle fleet. These sub-models incorporate assumptions regarding:

- the growth of the adult population;
- consumer expenditure trends;
- car price;
- interest rates; and
- vehicle imports.

Overall road traffic is expected to grow by 91% over the 14 year period 1996 to 2010. The growth in larger cars and heavy goods vehicles is expected to be significantly greater than the average growth.

Tables 6.2 to 6.4 summarise the study predictions of growth in transport by rail, air and sea. In all three cases passenger growth forecasts have been converted into predictions of growth in vehicle movements.

Table 6.2 Non-Road Transport Predicted Growth in Train-Kilometres, 1996-2010

Service	**Train-kms (millions)**		**Growth (1996-2010)**	
	1996	**2000**	**p.a.**	**Total**

Mainline	9.13	13.64	2.9%	49%
DART	1.92	3.05	3.4%	59%
Total	**11.05**	**16.69**	**3.0%**	**51%**

Table 6.3 Predicted Growth in Aircraft Movements

Aircraft	**Movements (LTO's) (thou)**		**Growth**	
	1996	**2000**	**p.a.**	**Total**
Dublin	140.0	192.5	2.3%	37%
Shannon	47.2	93.1	5.0%	97%
Cork	40.9	92.4	6.0%	126%
Total	**228.1**	**378.0**	**3.7%**	**66%**

Table 6.4 Predicted Growth in Demand for Sea Transport

Type	**Growth**	
	p.a.	**Total**
Passenger	4.3%	81%
Cargo	4.6%	88%

Transport Growth – Commentary

The tables presented above highlight a number of important trends that will have an influence on the scale of future external impacts from the transport sector. In particular it is worth noting:

- continued dominance of private travel by road with the number of private cars predicted to grow from 1,065,000 in 1996 to 1,849,000 in 2010 – an increase of 74%;
- the strong growth in new car sales over the forecasting period and, as a result, the change in the age distribution of the car fleet (the average age of the fleet will decline from 6.60 years in 1996 to 6.15 years in 2010);
- the increase in personal incomes will also mean that the proportion of new cars which are large will increase; as a result the proportion of small cars in the fleet will decline marginally from 60 percent in 1996 to 57 percent in 2010. As shifts in new car purchases take time to impact on the total car fleet the proportion of small cars in the fleet will continue to decline;
- the share of diesel cars in the fleet may be expected to increase slightly from 14.5 percent in 1996 to 15.6 percent in 2010;
- car vehicle kilometres are expected to increase from 27.4 billion in 1996 to 55.6 billion in 2010, an increase of 103 percent;
- demand for both Mainline and DART rail travel is expected to increase by at least 50% over the forecast period;
- the recent rapid growth in international air travel is forecast to continue and overall LTO's (aircraft movements) are forecast to increase by 150,000 between 1996 and 2010; and
- although the movement of cargo and passengers by ship is forecast to increase in line with economic growth, changes in ship capacities and loadings will accommodate the bulk of the forecast growth within the current level of shipping movements.

Future Changes in External Impacts

Introduction

It is important to make a forward projection of the external impacts of transport activities in order to examine the likely sensitivity of impact to the growth in transport volumes, changes in the vehicle fleet characteristics and vehicle technology and the impact of stricter emissions standards.

As noted in Section 4, forecasts have been produced for the year 2010 using a combination of:

- national economic growth forecasts (consistent with the Mid-Term Review of the Operational Programme);
- growth estimates from transport operators;
- models of vehicle fleet age and size characteristics (for cars); and
- model new sales and survival rates (for cars).

The forecasts reflect a 'no policy change' scenario, that is, they reflect the current policy for the taxation and regulation of transport in Ireland.

The growth forecasts have been converted into estimates of external impacts using a set of parameters consistent with those used to estimate base year (1996) impacts. The future year parameters do, however, take account of the predicted impact of:

- improved vehicle fuel efficiency;
- the increase in the proportion of newer road vehicle fitted with catalytic converters;
- stricter emissions control standards; and
- changes in EU vehicle fuel standards.

Changes in External Impacts

Changes to external impacts have been estimated for emissions, noise and accidents.

Emissions

Table 7.1 provides a summary of the predicted changes in air emissions, for each individual mode of transport, over the period 1996 to 2010.

Table 7.1 Summary of the Projected 2010 Emissions and the Relative Change from 1996 Levels

2010 Emissions (tonnes)										
Pollutant	Road		Rail		Shipping		Aircraft		TOTAL	
	total	change from baseline	total	change from baseline	total	change from baseline	total	change from baseline	total	chang ba
CO_2	12,177,778	83%	162,659	50%	1,553,300	44%	3,217,454	66%	17,111,191	
CO	62,854	-66%	502	50%	3,626	44%	12,001	66%	78,982	
NO_x	35,273	-42%	1,858	50%	38,955	44%	8,586	66%	84,672	
N_2O	2,299	283%	59	49%	98	44%	108	66%	2,564	
SO_2	3	-100%	253	53%	9,369	-19%	1,020	66%	10,625	
						44%				

HC			0.6	53%	1,176				1,117	
NM-VOC	10,764	-80%	211	49%			4,961	66%	15,935	
CH_4	3,578	117%	8	46%	4		494	66%	4,079	
NH_3	3,766	432%	0.3	41%					3,767	
PM	1,215	-55%	214	49%					1,429	

Emissions from rail, shipping and air travel are forecast to increase broadly in line with the growth in transport volumes. Changes in road transport volumes and fleet characteristics produce by far the most significant changes in the volume of emissions. The sections below provide a brief summary of the predicted change in the level of each pollutant.

CO_2

Carbon Dioxide (CO_2) emissions are forecast to increase by 83%. This is slightly less than the forecast increase in distance travelled, reflecting the assumed increase in fuel efficiency of the vehicle fleet. This shows that CO_2 emissions increase in direct proportion to the change in fuel consumption. This pattern is notable in that there are almost identical changes in CO_2 and fuel consumption across all the different vehicle categories.

CO, NO_x and NM-VOCs

The 2010 projections show a marked decrease in emissions of Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), and Non-Methane Volatile Organic Compounds (NM-VOCs) in relation to the baseline. Even though fuel consumption is projected to rise by over 80% from the baseline level, emissions of CO are projected to fall by 66%, NO_x by 42%, and NM-VOCs by 80%. These falls are due to the increased take up of catalytic converters in the vehicle fleet and the introduction of stricter emission limits on other engines such as motorbikes.

N_2O and NH_3

The largest rise in emissions is for Ammonia (NH_3) and Nitrous Oxide (N_2O), which are respectively forecast to increase by over 430% and 280% from the baseline level. This increase in emissions is a negative side effect of the introduction of catalytic equipped vehicles, which produce higher levels of N_2O and NH_3 than vehicles without catalytic converters. These effects occur within the passenger cars categories and are influenced by the continuing uptake of new, or newer vehicles.

PM

Emissions of Particulate Matter (PM) are forecast to fall by 55%. The reasons for this are similar to those attributable to the decline in CO, NO_x and VOCs, namely the introduction of cleaner vehicles due to stricter emission standards.

SO_2

The pollutant that shows the largest fall in emissions is Sulphur Dioxide (SO_2), the emissions of which decline by around 100%. The large fall in emissions is evenly spread across the range of vehicle categories. These falls are attributed to the introduction of low sulphur fuels as proposed under the EU Auto/Oil programme.

CH_4

Methane emissions (CH_4) increase broadly in line with the increase in travel demand. The 117% growth in emissions is closely related to the 110% projected increase in distance travelled. The model used to estimate emissions uses simple grams/per km methane emission factors for all modes, which appear not to be affected by changes in technology and emissions standards.

Noise

Damage from road noise is likely to increase in the future broadly in line with the predicted growth in vehicle-kilometre. The introduction of quieter vehicles and the improved noise mitigation features associated with new road construction will, however, help to reduce the rate of growth of noise damage costs.

Accidents

As noted in Section 5 road transport accounts for all but a few transport-related fatalities in Ireland. In the future personal injury accident numbers will be influenced by the growth in traffic volumes, the construction of new roads with higher design and safety standards, the introduction of newer and generally safer vehicles, regulatory policies such as reduced speed limits and changes in driver behaviour.

Drawing on recent evidence from the UK it seems reasonable to assume that the observed increases in road accidents over the period will cease and possibly be reversed as accident reduction targets are met.

Conclusions and Recommendations

Conclusions

In assessing the scope for future policy change it is necessary to draw together the results contained in earlier sections. The scope for policy change is influenced by:

- the current context of transport revenues in terms of covering infrastructure and external costs;
- the future growth in transport volumes within each transport mode;
- the future changes in external impacts in relation to factors such as engine size, catalytic converters, fuel standards, etc; and
- other criteria that influence the selection of appropriate policy instruments, such as; effectiveness, equity, side effects, transparency, cost effectiveness and other factors such as legal and political constraints.

Transport Revenues and Costs

Section 5 of this report provided a summary of the degree to which revenues from transport taxes and other charges cover infrastructure and external costs.

Key conclusions were that:

- revenues from road transport as a whole cover total infrastructure and external costs but for certain vehicle types, specifically heavy goods vehicles, buses and motorcycles, cost exceed revenue by a significant margin;
- heavy goods vehicles incur both relatively high infrastructure costs, due to axle loadings and environmental costs, due largely to CO_2 emissions from diesel engines;
- motorcyclists incur relatively high accident costs per kilometre travelled and it is notable that insurance revenues fail to compensate these costs by a wide margin;
- revenues from rail transport cover infrastructure costs, and external costs are relatively insignificant when compared with road travel; and
- revenues from both air transport and shipping fail to cover infrastructure costs and both modes contribute significantly to global warming potential through CO_2 emissions.

It is important to extend the mode by mode revenue: cost comparisons to consider the overall magnitude of impact by mode. Road transport accounts for:

- 97% of domestic passenger travel;

- over 80% of transport-related environmental costs; and
- 99% of transport-related accident costs.

Private cars account for:

- 82% of domestic passenger travel; and
- over 65% of road transport-related environmental costs.

The statistics suggest that, even though private cars may be seen to ‘pay their way’, with revenues exceeding cost by a considerable margin, significant benefit could be achieved by targeting environmental costs using ‘the polluter pays’ principle. This is particularly the case in urban areas. Car travel in urban areas accounts for just 17% of total car mileage in Ireland, but in urban areas cars account for 26% of total car-related environmental costs. Furthermore, the quantified external cost exclude the significant additional costs associated with congestion and the fact that urban areas contain much higher concentrations of potential impacts. Together these factors suggest that taxes on car use need to be targeted more closely to reflect external costs at the point of use.

In assessing the scope for new policy intervention due regard must be given to both transport growth effects and other factors that influence the volume of external impacts. In the future the passenger travel market will continue to be dominated by private car travel, with car ownership predicted to grow by 74% between 1996 and 2010 and car-kilometres predicted increase by over 100%. However, the average age of the car fleet will gradually decline and this newer fleet will help to reduce the rate of increase in environmental impact through greater fuel efficiency and the increased use of vehicles with catalytic converters.

Urban areas stand to suffer disproportionately from the impact of the growth in private vehicle travel demand, due to the high intensity of vehicle use and the concentration of the potential recipients of external impacts. However, urban areas also offer the greatest opportunities for controlling the adverse impacts of transport growth; due to the potential to both provide viable public transport alternatives and to implement management measures that help prevent the indiscriminate use of private vehicles.

Recommendations

Road Transport – General

As noted above although road transport as a whole covers marginal infrastructure, environmental and accident costs there is a strong case for restructuring taxes to produce charges that are related as closely as possible to the costs incurred at the point of use.

Policy Recommendation 1. Differentiate registration tax and circulation tax more closely according to environmental damage and raise excise duty on diesel.

Because of the relatively high volume of car-based travel in rural areas and the difficulty in servicing mobility needs by other modes, priority should be given to measures/incentives that improve car fuel efficiency. This dictates against general fuel tax increases and towards measures that encourage the production and purchase of more fuel efficient vehicles.

Policy Recommendation 2. Replace the rebate on diesel by explicit subsidies based on passenger kilometres and impose VAT at a low rate.

It has been shown that emissions from diesel-powered buses make a significant contribution to environmental cost. In this context the fiscal treatment of scheduled public road transport is somewhat perverse. Owing to its being exempt of VAT, new technology in the form of new buses, for example, is subject to full, non-deductible VAT at 21 percent. Meanwhile there is a large rebate on diesel. Rebates and subsidies tend to encourage extra use. It is not fuel use that should be encouraged and furthermore diesel may not be the fuel one wants to encourage.

Urban Transport

In urban areas the combination of the high intensity of transport use and high density of population and activity lead to a concentration of external transport impacts and recipients. Thus, policies directed at external impacts of traffic in urban areas must form a central part of any programme of measures because:

- these policies will produce environmental, energy and congestion benefits;
- they address local as well as global emissions impacts; and
- the urban context leads to high levels of exposure to external impacts.

Policy Recommendation 3. Parking at place of work should be charged to the commuter on a daily basis through the rating system.

Parking spaces have a value and free provision does amount to a transfer from the employer to the employee. This benefit could be taxed by the subjection of car spaces to benefit-in-kind tax treatment, but this could end up being a perverse incentive to use the space. Being a tax paid upfront, once a year, there would be no daily incentive to use public transport.

A daily charge for spaces could be implemented relatively easily and it is suggested that the local business Rates be the means used. That part of the business premises that is the parking area should be separately assessed for Rates. The level of Rates charged on the parking area should reflect the cost of parking infrastructure generally and, pending road use charging, should cover the external costs imposed by peak time driving. In order to encourage businesses to introduce daily charging for use of parking spaces businesses could be granted, say, a few years' derogation from the rise in Rates on their parking area.

With this daily charge in place, drivers would not pay on the days when they did not bring in their cars. Flexibility and individual choice are preserved. If people reduced their car commuting by two days per week only, there would be a 40 per cent reduction in private car commuting to work.

Such a valuation of commercial and industrial premises as proposed here is not precluded in the consolidated rateable valuation code. In order to restrict their Rates bills, owners of business properties will be interested to keep down the number of car parking spaces on their premises. If they decide to reduce the number of parking spaces, they can seek to have their premises revalued on request, for a fee which currently amounts to £100.

By law at present only one Rate in the Pound is payable whereas the proposal outlined above would require a higher Rate, or a surcharge, to be payable for the parking area of business premises. While a change in the law might be required to allow this, there are no insuperable problems to be expected.

Policy Recommendation 4. The feasibility of road use charging should be investigated as a medium to long term measure for efficiently applying 'the polluter pays' principles

Charging at the point of use potentially offers the greatest scope for internalising the external costs of transport by virtue of the fact that prices can be targeted towards the users that create the highest external impact. It is worth highlighting that road pricing can operate both as a restraint measure and, through the 'earmarking' of revenues, as a means of developing a funding stream to support other transport management measures.

Heavy Goods Vehicles

The infrastructure/environment account results indicate that heavy goods vehicles are not paying their way. There is therefore a case for raising the taxes levied on them.

Policy Recommendation 5. Heavy goods vehicles (HGVs) are not paying their way. HGV taxes should be restructured to more closely reflect external costs.

Even without consideration of congestion costs, heavy goods vehicles (HGVs) are not paying their way. The most significant cost, which HGV's impose, is damage to the road system. Contrary to popular opinion, it is not simply a matter that the heavier the vehicle the greater the damage – the weight on the axle is a more important determinant. This means that a five-axle vehicle may cause less damage than a four-axle vehicle of lower overall weight.

Motorcycles

Policy Recommendation 6. Reform the structure of road tax and VRT for motor cycles to discourage the use of motorcycles, particularly larger engine sizes. Introduce other incentives to encourage safe driving.

Motorcycles fail by a wide margin to pay their way. The major cost they impose relates to accidents. Again a raising of taxes to reflect these costs would be appropriate. The problem is that of finding a tax measure which encourages the safer use of motorcycles.

Passenger Rail

Policy Recommendation 7. The rebate on diesel should be abolished and replaced, if appropriate, by a direct subvention to Iarnrod Eireann for the provision of special services.

Railways benefit from a rebate on diesel. This does not encourage either the purchase of fuel efficient rolling stock or good housekeeping.

Air Transport

Policy Recommendations 8. Support moves at international level to make international air travel subject to VAT and to emissions charges.

Although aviation contributes but a small share of pollution at present, global emissions are expected to treble over the period 1990 to 2015. Emissions from air transport include ozone depleting substances, greenhouse gases and acidifying emissions and local air pollutants. Odours and noise are also caused by air transport. Some emissions relate to the quantity of fuel used, some to landings and take-offs, and some to engine characteristics.

There is discussion at international level and studies have been undertaken on the subject of making air transport, and other international transport modes, eligible for VAT. Air transport is effectively zero rated for VAT, being able to reclaim VAT on inputs, which gives it an advantage for which there is little justification.

Planning Policies

Policy Recommendation 9. Current urban planning policies should be reviewed with the aim of complementing the fiscal measures outlined above.

Changes to the fiscal system should not be viewed as 'stand alone' instruments for dealing with the environmental implications of Irish transport growth. Supporting planning policies will be required to both supplement fiscal measures and to help control the 'knock-on' effects of measures such as business parking charges and road pricing.

The Dublin Transport Initiative contains a comprehensive set of infrastructure and non-infrastructure measures designed to promote sustainable transport objectives. The combination

of new fiscal measures and policies to encourage the development of sustainable transport modes provides the opportunity to implement a balanced strategy of 'carrot' and 'stick' measures.

In this respect the issue of public acceptability is critical. New fiscal measures may only be seen as acceptable if suitable high quality alternatives to private vehicle use are provided.

In the longer term, development control policies could also play an important role in reducing the need to travel. Measures worthy of further consideration include:

- changes to allowable urban densities;
- encouragement of mixed use development and use of brownfield sites; and
- giving more favourable treatment to development in high capacity public transport corridors.

Regulatory Policies

Policy Recommendation 10. Review and further develop traffic management measures for urban area.

Regulation and associated enforcement procedures can be very effective in controlling the volume of certain external impacts. These measures can be particularly effective in reducing transport externalities in urban areas. Specific measures that are in common use in the European Union and of potential benefit in Ireland include:

- setting and enforcement of lower speed limits – particularly in the most sensitive urban areas;
- implementation of accident remedial schemes to improve road safety;
- the extension of parking controls to complement fiscal measures in urban areas;
- traffic management measures to reduce congestion; and
- provision of improved traffic information to allow drivers to avoid heavily congested routes.