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TOWARDS FAIR AND EFFICIENT PRICING IN TRANSPORT

POLICY OPTIONS FOR INTERNALISING THE EXTERNAL COSTS OF TRANSPORT IN THE EUROPEAN UNION

Green Paper

(presented by the Commission)

COMMUNICATION BY MR. NEIL KINNOCK TO THE COMMISSION

Transport policy is at the cross-roads. Whilst the fundamental importance of adequate transport facilities to modern societies and economies is generally recognised, concern about increasing congestion, environmental consequences and accidents is mounting.

This insight has led to a review of transport policies in many Member States. Calls for debate at the European level are intensifying and the Cannes Summit has asked that measures should be taken to review policies to establish fairer competition between modes of transport.

As part of a comprehensive transport strategy, this Green Paper explores ways of making transport pricing systems fairer and more efficient by giving users and manufacturers incentives to adjust their transport behaviour. Various possible instruments are identified and discussed.

The Green Paper argues that fair and efficient pricing should constitute an essential component of a transport policy strategy and can contribute significantly to reducing some of the main transport problems (notably congestion, accidents and environmental problems). Its objective is to launch a broad discussion on this issue.

It is proposed that the Commission :-

- approves the attached Green Paper;
- agrees to its communication to the European Parliament, the Council of Ministers, the Economic and Social Committee and to the Committee of the Regions;
- agrees to its publication as a supplement to the EU bulletin.

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Executive Summary

1 *Transport policy is at the cross-roads. Whilst the fundamental importance of adequate transport facilities to modern societies and economies is generally recognised, concern about increasing congestion, environmental consequences and accidents is mounting. There is a growing realisation that, on current policies alone, transport trends are unsustainable. Without substantial change in transport patterns and investments, increasing delays and costs are guaranteed.*

2 *This insight has triggered a review of transport policies in many Member States. Calls for debate at the European level are intensifying and the Cannes Summit (June 1995) has asked that measures should be taken to establish fairer competition between modes of transport.*

3. *The outlines of a more comprehensive policy response to this unsustainable situation are gradually becoming clear. Responsible infrastructure investments aimed at removing bottlenecks and linking individual modes within an intermodal system are an important ingredient. The Transeuropean Transport Network is part of the Community's response to this challenge. In addition, efforts are needed to complete the internal market in those modes of transport that are generally environmentally friendly and where there is spare capacity. Here increased competition should lead to more competitiveness with respect to road transport. R&D activities are another ingredient to further the introduction of efficient and safe technologies.*

4. *This Green Paper looks at pricing. Transport policies have in the past focused largely on direct regulation. Whilst rules have brought significant improvements in some areas, they have not been able to unlock the full potential of response options that can be triggered through price signals. Price based policies give citizens and businesses incentives to find solutions to problems. The Union's objective of ensuring sustainable transport requires that prices reflect underlying scarcities which would otherwise not be sufficiently taken into account. Decisions made by individuals with respect to their choice of mode, their location and investments are to a large extent based on prices. So prices have to be right in order to get transport right.*

5. *The evidence presented in this Green Paper indicates that for many journeys there is a significant mismatch between prices paid by individual transport users and the costs they cause - both in structure and in level. Costs are seldom imputed at the point of use and the prices paid for a journey rarely reflect the true costs of that journey. Some costs - related to environmental problems, accidents and congestion are only covered partly or not at all. The degree to which infrastructure costs are covered varies significantly both within and across modes. Some transport users pay too much, others too little. This situation is both unfair and inefficient.*

6. *The size of these costs which are not directly borne by those who cause them is very large - even on conservative estimates. Congestion is estimated to cost the Union some 2% of GDP every year; accidents another 1.5% and; air pollution and noise at least 0.6%. All in all this amounts to some 250 BECU per year in the Union and over 90% of these costs are related to road transport. This paper therefore concentrates on road transport. The available evidence suggests that existing road taxation falls far short of covering all these costs.*

7. *This Green Paper explores ways of making transport pricing systems fairer and more efficient - by giving users and manufacturers incentives to adjust their transport behaviour. The aim is to reduce congestion, accidents and environmental problems. The purpose of this policy is not to increase the costs of transport. On the contrary, by reducing the negative side-effects of transport - and the sometimes hidden costs they represent - the real costs of transport (i.e. those currently paid by individual users plus those paid by others or society as a whole) are set to decrease.*

8. *A number of key characteristics of an efficient and fair pricing system emerge from this analysis. In principle, prices paid for individual journeys should be better aligned with the real costs of these journeys. As costs differ across time, space and modes, this implies a need for more* ***differentiation*** *Transparency is important and, ideally, accounts should be published identifying the relation between charges and costs. The principal aim of such a policy would not be to raise tax revenues, but to use price signals to curb congestion, accidents and pollution. If this policy were successful, revenues from charges would fall.*

9. *In the long run telematics - e.g. electronic road pricing - has the potential to provide a system which meets these requirements, whilst respecting the privacy of Europe's citizens. This would significantly reduce transport problems. There are great benefits to be derived from avoiding incompatible systems and European wide rules for interoperability are needed. However, the full introduction of these systems will probably take a decade and possibly longer.*

10. *Given the severity of the problems, action cannot be put off until then. Moreover, there are promising possibilities, either at national or Community level, to deal with a number of problems that can be introduced at short notice. These include:*

- *Adjusting existing Community legislation on road charges for Heavy Goods Vehicles, in order to make progress towards fair and efficient pricing;*

- *Electronic kilometre charges based on infrastructure damage and possibly other parameters (Heavy goods vehicles);*

- *Road tolls in congested and/or sensitive areas;*

- *Differentiated fuel taxes reflecting differences in fuel quality (e.g. environmental characteristics);*

- *Differentiated vehicles taxes in accordance with the vehicle's environmental and noise characteristics, possibly to be linked with electronic kilometre charges;*

- *Differentiated landing charges (air transport) and track charges (rail)*

- *The provision of information on the safety performance of vehicles and modes.*

11. *Adjusting the structure of existing tax systems by bringing charges closer to the point of use is likely to generate significant benefits. This paper suggests that getting the structure of tax and charging systems right should be the first priority. However, the uncertainties surrounding external cost estimates do not invalidate the need to raise charges where appropriate: the direction and order of magnitude of the required changes is often known. A policy of gradually phasing in instruments and charges, where needed, as more information becomes available is desirable.*

12. *Making progress towards fair and efficient pricing is likely to significantly strengthen European competitiveness. Reducing congestion, air pollution and accidents means that the associated costs, currently borne by the European economy as a whole, are reduced. For example, curbing congestion will reduce the time losses incurred by businesses and consumers. A reduction in accidents leads to lower health care costs which translate into lower social charges. Bringing down air pollution will also cut health bills and, in addition, increase agricultural productivity (e.g. through reduced ozone concentrations). Moreover, where higher transport charges might occur, revenues should be returned to the economy through reductions in other taxes and charges. In line with the analysis presented in the White Paper on Growth, Competitiveness and Employment, reductions in social security charges - in particular those on low skilled labour - would seem highly promising. Obviously, the incidence of policies will vary across households and industries and will have to be carefully evaluated.*

13. *The proposed pricing strategy necessitates a high degree of differentiation and should fully take account of local circumstances. This is important for reasons of efficiency and equity. In particular, rural areas, where transport problems are of a different nature would have to be treated differently, especially as available evidence suggests that prices in those areas are approximately right. The same is true for peripheral regions.*

14. *The need to make more progress on fair and efficient pricing is reinforced by the ongoing efforts to complete the internal market in transport and the move towards intermodal transport systems in Europe. Equitable conditions of competition are essential for reaping the full benefits from these policies.*

15. *Fair and efficient pricing holds out the prospect of better linking charges to infrastructure costs. Not only could this reduce repair and maintenance costs, appropriate infrastructure charging is also likely to be crucial for mobilising private capital for infrastructure construction. Efficient infrastructure pricing would thus facilitate the introduction of public private partnerships and relieve demands on tight public budgets.*

16. *Since some transport policies are formulated at the Community level (e.g. vehicle standards, minimum fuel excises etc.), whilst others are introduced by Member States, there is need for a broad agreement on the policy approach in order to ensure consistency. This is also necessary to safeguard the efficient functioning of the internal market and to take account of cross-border effects (e.g. ozone and acidification).*

17. *Given the vital importance of transport to our economies and societies, the Commission believes that a debate on transport pricing is essential. It is also urgently needed because the Commission will have in 1996 to table proposals relevant to transport pricing, notably on heavy goods vehicles taxes and on an environmental framework for transport. Whatever the form of decisions, the transport system will clearly need time to adjust: location decisions have long lasting implications, technologies to meet customer requirements have to be developed over time and vehicle stocks can only be replaced in a decade or so. It is precisely for this reason that, as businesses, people and governments are beginning to plan for the next century, a clear and urgent signal must be given that prices paid by individual transport users will have to more accurately reflect the full costs of transport, both in level and in structure. A wide and thorough discussion and consultation on how this principle can be implemented in practice is therefore urgently needed.*

1. INTRODUCTION

Need for policy action

Transport is an essential service in any society. Goods transportation ensures that products can be shipped from factories to markets and passenger transport, both private and public - allows Europe's citizens to visit each other, go to work or school, and participate in a myriad of economic and social activities. Increases in transport efficiency were an essential precondition to the industrial revolution and are still a driving force behind international trade and tourism. The benefits of transport are many and varied : an efficient transport system is a major contributor to economic growth, competitiveness and employment.

All this explains why the growing realisation that something is going wrong with our transport systems is so profoundly disquietening. Increasing transport delays have brought down travel speeds in a number of major European cities to levels which prevailed in the age of horse-drawn carts. Air pollution problems (e.g. ozone) in summer are requiring that, on more and more occasions, citizens across Europe have to refrain from outdoor activities. It is estimated that thousands of European citizens die each year from just one form of air pollution (particulate matter) - according to some studies air pollution from transport kills more than 6000 people in the UK alone. Road accidents kill some 50,000 annually in the Union and are the major cause of death for the under 40's.

Although some forms of pollution are expected to go down on the basis of current policies alone, congestion will increase to unparalleled levels if no further action is taken. Whereas technical progress has made transport much safer and the total of road accidents is slowly declining further, society is realising that the cost in terms of human suffering, misery and lost productivity is unacceptably high.

All over Europe debates are going on about what is increasingly becoming known as the "transport problem". And, whilst the nature of the problem differs across regions, the calls for policy action are intensifying everywhere. Member State governments have launched discussions and published consultation documents and a wide variety of institutions such as the European Parliament, the Economic and Social Committee and others have called for action[1]. Also, the Cannes Council concluded that other measures should be adopted to establish fairer competition between modes of transport.

The need to rebalance the policy strategy

Clearly, many measures have already been taken on a variety of levels and cities, regions Member States and the Union are each making important contributions.

For example, the Community has laid down progressively tighter standards for vehicle emissions, as a result of which tailpipe emissions of a new car are now 90% lower than in the early seventies. Also, in other areas - e.g. safety and noise - standards have forced improvements. However, many transport problems are related to decisions by individuals with regard to the choice of mode, route or timing. Congestion, for example, results from the fact that too many people decide to use private cars at the same time and in the same place.

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[1] See references

Most policies that have been devised so far do not influence these decisions directly and, therefore, overlook an important factor - human behaviour. Transport choices are influenced by transport prices and there is evidence that for many journeys there is a mismatch between transport prices paid by individual users and the underlying costs. The result is that decisions are distorted and too much of the wrong sort of transport occurs at the wrong place and the wrong points in time. This is clearly inefficient. The same is true of the fact that society pays large parts of costs caused by certain transport users. Here there is clearly also an equity problem.

The Commission believes that the potential of pricing instruments to help reduce the most important problems of transport - congestion, accidents, air pollution and noise - must be addressed. All these problems are characterised by significant differences between what various individuals pay in charges and the costs they impose on other transport users and society : some pay too much, others not enough. These situations are generally described as "externalities" as some costs are external to those who cause them - i.e. not part of prices paid by transport users. Bridging this gap is called the internalisation of external costs which means that someone making a journey should pay the real cost of that journey.

The importance of ensuring that prices reflect underlying costs has already been emphasised in the White Paper on the Future of the Common Transport Policy. It has grown with the completion of the internal transport market. Transport operators based in different Member States and using different modes of transport have been given the opportunity to offer their services across the Union in competition with one another. In order to avoid distortions, and to create equitable conditions of competition, it is essential that the principle that individual operators and users pay their way be more systematically applied. To do otherwise would be unfair, but also inefficient, because transport users would choose operators without taking full account of the resource costs their decisions imply. The Commission, if only as guardian of the Internal Market, has therefore the responsibility to address this issue and propose solutions.

Pricing should generally be seen as a complement, not a substitute for regulatory and other internal market policies. In some cases price based approaches might allow a certain reduction in red tape and could lead to a removal of some rules from the statute books, but in others, rules will continue to be necessary for the efficient functioning of the internal market, for guaranteeing essential health and safety requirements and protecting consumers[2]. Other policies relating to information, research and development and the promotion of public transport (as advocated in the Green Paper on the Citizens' Network) can also contribute to reducing transport problems. Therefore, the proposed approach consists of a rebalancing of, rather than a revolution in, transport policy making.

The need for making urgent progress on the required rebalancing can perhaps best be illustrated by the size of the costs that individual transport users impose on others or society as a whole: aggregate external costs of land transport have been estimated in various OECD studies at up to 5% of GDP. Although there is a large uncertainty surrounding cost estimates of individual externalities and costs vary significantly across and within modes, time and place of use, the order of magnitude of the total costs - which is broadly comparable to the total direct contribution of the inland transport modes to GDP - is so large that policy action is definitely warranted.

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[2] In conformity with Article 129A of the Treaty.

Table 1.1 Rough estimates of the external costs of transport (expressed as percentages of gross domestic product)

Air pollution[a]	0.4 %
Noise	0.2 %
Accidents	1.5 %
Congestion	2.0 %

[a] excluding global warming
Source: Various studies and OECD (1994)

Estimates suggest that over 90% of these costs are related to road transport. External costs of railways and inland waterways are estimated at only a fraction of the total, although there are complicated infrastructure cost recovery issues to be dealt with. To date, less information is available for maritime and air transport, where the required policies are also likely to differ from those in inland transport due to the highly intercontinental nature of trade in these services.

These findings explain why, whilst fully recognising that the principles developed in this paper should apply to all modes, it concentrates on road transport, without however, overlooking the other transport modes in relevant cases.

Objective and outline of this paper

The objective of this paper is to launch a discussion on how, as part of a multifaceted transport policy, pricing instruments can contribute to solving the most important transport problems with which the Union is currently faced. Different levels of policy making - local, national and Community - are involved in such a strategy and their respective competences will have to be defined.

Chapters 2 and 3 analyse the general problem of externalities and which policy instruments are, in principle, available to address them. These two chapters clarify concepts and lay down general principles. In the next part of the paper - Chapters 4-7 - these principles are applied to the main externalities of transport: congestion, accidents, air pollution and noise. Each chapter contains a brief analysis of the problem, presents cost estimates and suggests policy options for solving the underlying problems. Chapter 8 subsequently summarises the discussion and analyses the role of possible Community measures. Chapter 9 addresses the next steps the Commission intends to take in line with the development of the Common Transport Policy. Finally, Chapter 10 presents the main conclusions of this document.

2. THE EXTERNALITIES OF TRANSPORT

2.1 <u>What are transport externalities?</u>

Transport externalities refer to a situation in which a transport user either does not pay for the full costs (e.g. including the environmental, congestion or accident costs) of his/her transport activity or does not receive the full benefits from it.

Any transport activity creates benefits (otherwise people would not engage in it!) as well as costs. However, not all of these costs and benefits accrue only to those who pay for this transport activity (i.e. the transport user). Some of the costs fall on other persons or on society as a whole. One can therefore distinguish between the so-called "internal" or private costs, those that are borne by the person engaged in the transport activity (e.g. time, vehicle and fuel costs) and the so-called "external costs", i.e. those that accrue to others. The sum of both types of costs is called "social costs". In general terms, externalities arise whenever the well-being of an individual is affected by the activities of others who ignore this "spill-over" when taking their decisions.

The criterion for separating the internal from the external costs of a journey is the person who pays. If a transport user has to pay for the use of a resource (e.g. the use of energy, infrastructure, etc.), the associated costs can be considered as internal costs. If, on the other hand, the transport user affects the well-being of others (e.g. by polluting the air) without paying for this then the ensuing costs are external to that person. As can be seen, there is a clear link with the "polluter-pays-principle", which requires the polluter to cover the costs of pollution. This principle is laid down in the Treaty (Article 130R2).

Table 2.1 presents a breakdown of total social costs of transport in external and internal costs for a number of cost items.

<u>Table 2.1</u> Classification of the Costs of Transport

Cost Categories	**Social Costs**	
	Internal/Private Costs	**External Costs**
Transport Expenditure	- fuel and vehicle costs; tickets/fares	- costs paid by others (e.g. free provision of parking spaces)
Infrastructure Costs	- user charges, vehicle taxes and fuel excises	- uncovered infrastructure costs
Accident Costs	- costs covered by insurance, own accident costs	- uncovered accident costs (e.g. pain and suffering imposed on others)
Environmental Costs	- own disbenefits	- uncovered environmental costs (e.g. noise disturbance to others)
Congestion Costs	- own-time costs	- delays/time costs imposed on others

2.2 *Why do transport externalities matter?*

The crucial importance of transport externalities arises from the fact that, in a market economy, (economic) decisions are heavily dependent on market prices. However, when market prices fail to reflect existing scarcities (clean air, absorptive capacity of the environment, infrastructure etc.), the individual decisions of consumers and producers no longer add up to an outcome that provides maximum benefits to society as a whole. Thus, pricing on the basis of full social costs is a key element of an efficient and sustainable transport system.

Externalities impair the efficient distribution of resources across sectors and activities. For example, if the use of a certain vehicle type entails significant air pollution and road damage costs which are not charged, then the demand for this vehicle type will be "too" high and the demand for cleaner and less damaging vehicles "too" low. This represents an inefficient use of resources. Externalities imply that individual transport decisions no longer lead to an outcome that is desirable from the point of view of society as a whole. Moreover, the external costs are paid by others: tax payers implicitly end up footing the bill of road maintenance and health care due to damage from air pollution, whilst damage to buildings and crops resulting from acidification and other forms of pollution is paid by house owners, businesses and farmers. This is unfair and inefficient.

To correct this, there is, therefore, a need for government measures.

2.3 *How can transport externalities be reduced?*

Government measures should aim at curbing these externalities, both for reasons of economic efficiency and equity. A price based approach ensures that prices paid by transport users better reflect total costs: this can be achieved by internalising the external costs - i.e. imputing them to users. The internalisation approach represents a different type of government policy than the traditional regulatory measures usually relied upon in the past.

Both policy approaches try to reduce the size of the (transport) externality (e.g. pollution, noise etc.). The internalisation approach does this by ensuring that each transport user pays the full social (i.e. private, environmental and other) costs associated to each individual trip and therefore has an incentive to reduce the underlying problem. Clearly, economic instruments are only effective if transport choices are sensitive to prices. Annex 1 shows that, certainly in the longer run (say 5 years), most transport behaviour is strongly affected by transport costs and prices. The regulatory approach tries to reach a reduction in the externality without relying on the price mechanism for changing transport behaviour. This approach consists, for example of laying down rules for products which reduce the environmental consequences of transport. Chapter 3 contains a more elaborate discussion on these two approaches.

The ideal case of an absence of externalities is by no means identical to the complete absence of environmental damage, accidents or congestion. There would be no transport activity if the level of noise, accidents or emissions had to be zero. Instead, the negative side-effects of transport activity should be at a level that is "optimal" from the point of view of society : the marginal costs[3] of further reducing these side-effects exactly equal the marginal benefits from doing so. Reducing the side-effects by more would entail higher costs than benefits.

In order to devise policies for internalising transport externalities, it is first necessary to measure them.

2.4 How can externalities be measured?

Externalities can be measured in monetary terms either by inferring their value from observed market transactions (e.g. expenditure on damage avoidance, health costs, property value loss etc.) or by asking people how much they would be willing to pay for the reduction of a specific negative transport externality by a certain amount.

Estimates concerning the present total external costs of transport, as a percent of GDP in different Member States, are useful to highlight the size of the problem, but they are only of limited value for implementing sound policies for dealing with individual cases. For this purpose, detailed estimates are required, distinguishing transport modes, times and places, as well as types of externality.

Different methods for measuring externalities can lead to significantly different results. But this does not invalidate such estimates. A large part of the differences can in fact be explained either by different assumptions (which can be harmonised) or by different degrees of comprehensiveness. In particular, market related valuation approaches tend to systematically underestimate the full amount of external costs by only including those that lead to easily identifiable changes in prices. Estimates based on willingness-to-pay or willingness-to-accept permit a more comprehensive measurement to be made (see Annex 2 for more details on this). Cost estimates reported in this paper for individual externalities generally refer to conservative assessments relying heavily on observed market transaction evaluation methods. For accident externalities, however, account is taken of peoples' willingness to pay for reduced mortality and morbidity risks as this is a crucial factor in evaluating accident costs (see chapter 5).

Research under the EU's Fourth Framework Programme is analysing different methods of measuring externalities as well as the effectiveness of selected pricing options (see Annex 10).

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[3] Marginal costs are the additional costs of providing one extra unit of a good or service. For example, the marginal costs of reducing air pollution equal the additional costs of reducing air pollution given certain prevailing air quality levels. The more stringent the air quality objectives are, the higher are the marginal costs for a given improvement, because it becomes increasingly harder (and, therefore, more expensive) to reduce emissions.

2.5 *What are the main transport externalities?*

The size of transport externalities varies significantly between transport modes, times and places. Thus, caution has to be applied when making general statements. Nevertheless, on the basis of the existing studies it appears that generally external congestion costs are the largest individual externality, followed by accident and environmental problems (air pollution and noise)

This Paper therefore concentrates on those externalities, without, however, overlooking **infrastructure costs** (closely related to congestion) which should, of course, also be covered by a comprehensive, accurate and fair pricing system.

It is sometimes argued that transport creates significant **positive externalities** because it stimulates productivity and economic growth. Increased productivity leads to economic benefits, which, however, are internal to the user and can thus not be treated as externalities. The bulk of the available scientific evidence suggests that, in modern industrialised economies, increases in transport efficiency are generally reflected in decreased transport costs: these effects are internal to the market mechanism and not external. Some studies claiming external benefits of transport seem to refer uniquely to private benefits.

Moreover, an important distinction has to be made between externalities resulting from the *provision* of infrastructure and the use of infrastructure : whereas, in planning infrastructure projects on the basis of cost benefit analyses, full account should be taken of possible benefits elsewhere in the network and of possible regional policy objectives, this does not mean that the benefits people derive from its *use* are external. This paper does not, therefore, analyse the case of positive externalities.

3. INSTRUMENTS TO CURB TRANSPORT EXTERNALITIES

In designing policy instruments to deal with different transport externalities - which will be discussed in the subsequent chapters - possible options have to be evaluated on the basis of clear criteria.

3.1 Criteria for selecting instruments

Among the most important criteria for selecting policy instruments to deal with transport externalities are effectiveness, cost-effectiveness, transparency, fairness (distributional equity), and the existence of possible (positive or negative) side-effects on other transport externalities or policies. In addition, the subsidiarity principle has to be applied in order to decide on the best role for the European Community. These are discussed in more depth in Annex 3.

It is clear that instruments should be *effective* in reaching their objective of reducing underlying transport problems. When policies impinge on a variety of problems, then these *side-effects* should be taken into account. Also, their costs should be compared. For example, if a differentiated circulation tax (based on emission per kilometre and mileage) can reduce vehicle emissions at nearly a twentieth of the cost of a fuel tax (see Chapter 6 and Annex 9), then the former instrument is much more *cost-effective* than the latter. *Fairness* is of major importance in assessing instruments: the incidence of measures and their associated costs and benefits on different income groups must be reviewed and corrective action taken where necessary. Finally, in devising policies it has to be decided which level of government does what. In accordance with the *subsidiarity* principle, competences should only be allocated to the Community if the objectives can be better achieved at the Union level.

3.2 Market based instruments and regulation

There are, as discussed in the previous chapter, two basic approaches to curbing transport externalities: market based instruments (e.g. pricing) and direct regulation (also sometimes described as "command and control").

In comparing the attractiveness of policies belonging to the two classes, ideally, a case by case approach is needed. Nevertheless, there are a number of general insights to be drawn. Provided that economic instruments can be closely linked to the problem at hand, they are likely to be much more cost-effective than direct regulation because they allow citizens and businesses to rely on a variety of response channels to reduce the externality[4]. The cost-effectiveness is likely to be particularly high when problems vary across space and in time: charges can reflect these differences, whereas rules - certainly Community legislation - tend to coincide with jurisdictional boundaries. Economic instruments dovetail nicely into the market system and, therefore, generally require less red tape than comparable regulation.

However, it has to be pointed out that market failures, high transaction and implementation costs and classification problems could significantly undermine the cost-effectiveness of economic instruments. If markets do not function efficiently then obviously price signals will not be transmitted efficiently and the effectiveness of economic instruments will be impaired.

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4 For example, an emissions fee could trigger the development of more environmentally friendly vehicles, could lead to shift in the composition of the car fleet, higher vehicle occupancy rates, an increased use of public transport etc. Chapter 6 contains a more elaborate discussion of this point.

High transaction costs - e.g. because advanced and expensive metering technology is needed - will obviously also reduce the cost-effectiveness. Classification problems could imply that it is difficult to link charges directly to problems. As discussed above, the less charges reflect costs at the level of individual transport users, the less attractive are economic instruments. Harmonised direct standards ensure a predictable regulatory environment for manufacturers to produce one version of a vehicle, thereby allowing economies of scale to be reaped. The approach taken by the Community has been to establish ambitious standards based on advanced technology. Regulations have also been easy to implement. The attractiveness of harmonised technical regulations will have to be compared with tax systems applied with sufficient uniformity and coherence at EU level.

In these cases direct regulation might have advantages because changes are mandated directly and the instrument, therefore, does not rely on the market mechanism. Direct regulation is also needed when the precise attainment of health and safety standards is crucial or when physical thresholds have to be guaranteed. For internal market reasons, it is in cases which concern the free circulation of goods often desirable to lay down minimum standards (e.g. maximum emission limit values) at the Community level.

This discussion shows that policies should consist of a mix of instruments belonging to both approaches and that solutions have to be developed on a case by case basis. Transport policies - both in the Union and in the Member States - have in the past relied heavily on regulation for achieving improvements in the safety and the environmental performance of transport while the use of economic instruments, although increasing, is still limited (see chapters 4-7).

There are various reasons for suggesting that it would be useful to review this approach. First, the general awareness of the problems has risen and calls for policy action are intensifying. On current policies alone, a number of problems are forecast to deteriorate significantly, while others will not improve satisfactorily. Regulation does not seem capable of tapping all mechanisms for solving the problems as some are closely related to human behaviour. Secondly, in some areas the costs of achieving further improvements have risen, and there is a general need for assessing the cost-effectiveness of policies. To the extent that economic instruments can be substituted for direct regulation, this would - as a side effect - also lead to a reduction of red-tape and bureaucratic rules. Thirdly, it seems that the technical possibilities to introduce efficient economic instruments have increased (e.g. telematics). Fourthly, the liberalisation of the internal market calls for removing distortions across modes and between operators of different nationalities. As the degree of cost-internalisation differs in different parts of the Union, more action is needed. Finally, as discussed above, the "transport dilemma" consists of a series of inter-related problems requiring an integrated response. A policy strategy that also relies on economic instruments is generally better able to provide such a response.

This paper, therefore, investigates the potential for making prices fairer and more efficient as part of a multifaceted transport policy.

4. INFRASTRUCTURE COSTS AND CONGESTION

4.1 *Why do infrastructure and congestion costs matter?*

Building and maintaining infrastructure entails costs. This raises the question of how these costs should be recuperated from the infrastructure users. Many of the charges that are currently used are not or, are only partly related to the actual costs of providing or using the infrastructure. Clearly, there is an important link between congestion and infrastructure costs, because congestion implies that infrastructure is used beyond the designed capacity (i.e. there is infrastructure scarcity). Congestion in infrastructure networks is increasing strongly in the Union. Congestion implies that transport decisions made by one user impinge on all other users of the network. For example, in some cases of congestion a car driver losing 10 minutes of her or his own time, imposes total time losses of 45 minutes on other road users. Since transport users only take their own losses into account they underestimate the full costs of their decisions. As a result, demand for transport in congested situations is too high. The introduction of a charge to bridge the gap between private and total costs could, therefore, generate significant benefits. By reducing the traffic volume, the imposition of a charge increases traffic speeds. This represents a net benefit for society.

4.2 Measuring and charging for infrastructure costs

4.2.1 What are infrastructure costs?

In evaluating infrastructure cost it is essential to make a distinction between:

(i) **capital costs** : Road, rail and inland waterway networks, as well as port and airport installations, represent important assets. The provision of these assets implies real costs.

Clearly, the capital invested in the provision of a transport infrastructure gives rise to a fixed cost that bears no relationship to the actual use of the infrastructure. The capital value of the transport infrastructure increases over time with additions made by new investments. It is important to distinguish annual investments (expenditure) from annual capital costs: these are very different concepts and there is no reason to make users pay annually for the investment costs that were incurred in a particular year (see Graph 4.1).

However, measuring the asset value of the network requires detailed information on parameters such as the replacement value of the infrastructure. Evaluations on road capital costs are presently only available for a number of countries, such as Germany, Austria, the UK and Finland. For other Member States, only annual outlays are calculated. More information needs to be collected, preferably on a harmonised basis, allowing cross-country comparisons to be made.

(ii) **operating and maintenance cost**. Examples of these types of costs are:

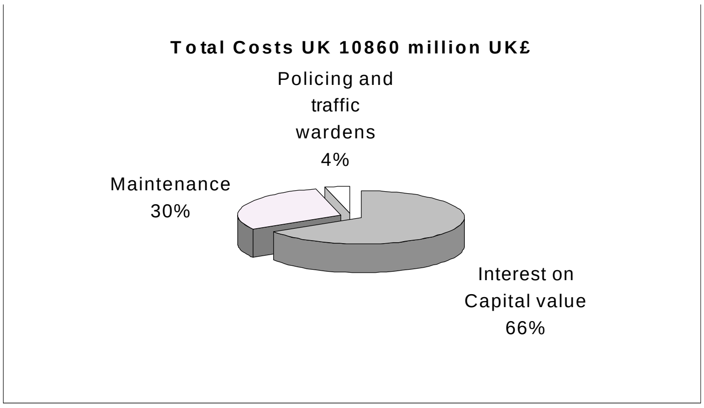
- the (annual) maintenance expenditure for roads;
- the expenditure for dredging a canal or a harbour.

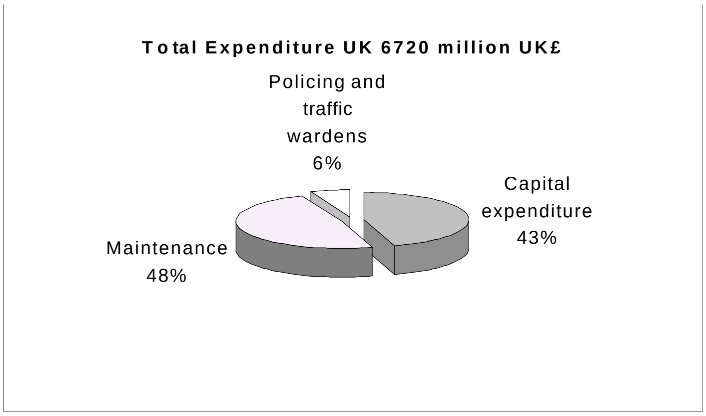
Some of the operating costs vary with transport volumes, but other factors, such as weather conditions also play a role. For example, the pavement of a road is damaged by the axle weight of the vehicles travelling on it but also by temperature variations, rain, snow and excessive heat.

Data on operating and maintenance costs are generally available, although no harmonised approach for measuring these costs exists at the level of the Union.

Graphs 4.1 show the allocation of annual road expenditure in the UK and an illustrative breakdown of road costs as calculated in a recent study.

Source: David Newbery (1995)





Graph 4.1

In addition, the construction of infrastructure often has major land-use implications. It can lead to a disturbance of eco-systems and might create so-called barrier effects. The associated costs are not well understood, but could be significant (UK Royal Commission on Environmental Pollution) and should, amongst others, be taken into account in the design stage.

4.2.2 How should we charge for infrastructure costs

Infrastructure cost charging should ideally meet three criteria:

- *The system should link charges as much as possible to actual costs (i.e. marginal cost pricing) at the level of the individual user:*

  Marginal cost pricing is important for the efficiency of the transport system since it gives individual users an incentive to reduce the underlying costs because cost savings are rewarded by lower charges. For example, traffic induced road wear and tear can be taxed relatively easily and efficiently by charging trucks on the basis of their axle weights (which determine the damaging power -see below) and their mileages. Such a system gives hauliers an incentive to use configurations with lower axle weights, to reduce empty runs or, in some cases to use combined transport.

- *In total, infrastructure charges should recover aggregate infrastructure costs:*

  If significant parts of total costs are not use dependent - as is the case with capital costs - then marginal cost pricing alone will not lead to full cost recovery. Cost recovery is, however, important for a number of reasons. First, private owners of infrastructure have to recover costs. Privately owned ports, airports and toll-roads have all developed pricing schemes that relate charges to other parameters (e.g. access, landing rights, slots etc.) to recover full costs. Secondly, in the absence of full cost recovery in the transport sector as a whole, the general budget would have to fund the sector by imposing taxes/charges elsewhere. It is generally felt that, although for reasons of economic efficiency marginal

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  A number of considerations have to be kept in mind when implementing the cost recovery criterion. First, it is quite common and perfectly legitimate to invest in infrastructure for non-transport related policy reasons, such as regional balance. It seems unreasonable to require transport users to cover the infrastructure cost imposed on these grounds. This highlights the need for a clear system of accounting. Secondly, past decisions on infrastructure projects that no longer meet present day transport demands have, in some cases, generated high costs which cannot be recovered by users. This kind of infrastructure has to be given special treatment.

  - *Transparency:*

    The system of charging for infrastructure costs should be clear to citizens and businesses.

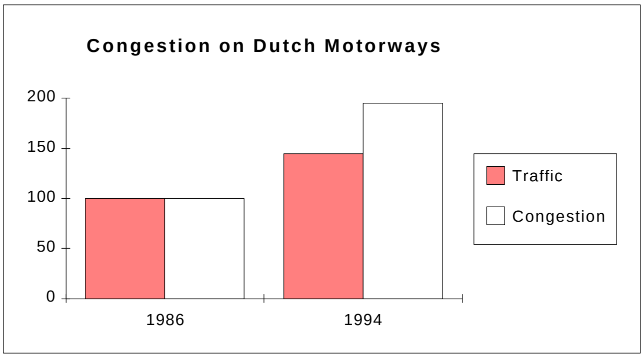
4.3 Congestion costs: nature, size and charging

Congestion is a waste of time. It arises when infrastructure networks carry more transport users than their design capacity. In such a situation every user incurs delays and imposes delays on others. These delays represent economic losses because people value time and, in addition, energy use increases with delays. Delays increase more than proportionally as more users enter the network until traffic comes to a standstill. This is why, in congested networks, a small reduction in traffic levels can significantly speed up flows.

Congestion deals with infrastructure scarcity through queuing (i.e. quantity rationing): everybody gets stuck in a traffic jam and incurs time losses whilst imposing further delays on others. When making transport choices, every individual transport user only takes his or her own time (and other) costs into account, ignoring those imposed on others. As everybody does the same, there is too much traffic and all infrastructure users waste time. Although, in the resulting situation *all infrastructure users put together* pay for the total time costs, there is still an externality and an ensuing wastage of scarce resources (time, energy). This results from the fact that there is a "market failure" because, as stated above, an *individual infrastructure user* does not compare the private benefits of his/her decision with the total costs this decision imposes on society as a whole (the so-called marginal social costs). A price based solution to infrastructure scarcity corrects this "market failure" by ensuring that prices paid by individuals reflect the full costs of transport choices to all other infrastructure users. The result is that trips which carry higher costs than benefits are avoided. The ensuing reduction in transport volumes leads to higher travel speeds and time savings, which represent a benefit to all.

An important point to note here is that the value of time differs considerably between different infrastructure users. The costs of being stuck in a traffic jam are much higher for a lorry carrying supplies for a production line or a businesswoman hurrying to catch a plane than for someone whose trip purpose does not depend so much on a specific arrival time. However, in the present situation without charging for congestion costs, there is no means of allocating the scarce infrastructure capacity to those who derive the largest benefits from using it. As a result, money is wasted and society as a whole does not reap the maximum benefit from its infrastructure networks.

Graph 4.2 shows that congestion on Dutch motorways has doubled in the past ten years. It gave rise to costs of 0.7 bn ECU in 1994 (0.25% of GDP). The US experience of the past ten years hints at developments in congestion that can be expected to occur in Europe as, in the next decades, EU car ownership levels are forecast to increase and approach levels currently prevailing in the US. In 1991, 47.2% of urban interstate mileage took place under congested conditions, up from 30.6% in 1983. Even on rural interstates congestion is currently problematic, affecting some 9% of total traffic, having tripled in just eight years (Gramlich 1994).



Graph 4.2 : Congestion 1986-1994, 1986=100

There is only a limited number of estimates available for congestion costs and most of these estimates refer to roads. A recent survey by the OECD (Quinet (1994)) puts road congestion costs in Western industrialised societies at some 2% of GDP. This figure suggests costs of the order of 120 Billion ECU for the EU as a whole. Estimates for other modes arrive at significantly lower numbers. For example, congestion costs in European aviation are put at some 2.4 Billion ECU in a recent study (ECAC (1995)), but this study seems to exclude time losses of passengers. One study for rail suggests that costs in France total some 0.15 billion ECU. If this were representative of Europe, total costs would be around 0.85 billion ECU. For inland waterways congestion costs are negligible as capacity is abundant. No figures are available for maritime transport.

The conclusion to be drawn from these studies is that congestion represents a major external cost, which is largely concentrated in road transport.

An important characteristic of congestion is that it varies strongly across space and in time. Clearly, this is a function of the spatial organisation of Western societies (80% of the population live in cities) and relatively fixed patterns of work and school over the day and week.

Table 4.1 presents results from a recent study for road congestion in the UK which strongly underlines this point. Road congestion is largely concentrated in urban areas. Costs during peak hour are significantly higher than during off-peak. Whilst traffic in rural areas accounts for more than 20% of total traffic, its share in total congestion costs is estimated at less than 1%.

Table 4.1 : Costs of Congestion in Great Britain, 1993

	SHARE IN TOTAL COST %	CONGESTION COSTS (pence per car km)	SHARE IN TRAFFIC %
Motorway	1	0.32	17
Urban central peak	13	44.74	1
Urban central off-peak	27	35.95	3
Non-central peak	17	19.51	4
Non-central off-peak	26	10.75	10
Small town peak	6	8.47	3
Small town off-peak	9	5.17	7
Other urban	0	0.08	14
Rural dual carriageway	0	0.06	12
Other trunk and principal	1	0.23	18
Other rural	0	0.06	12
Weighted average		4.18	

Source: Newbery (1995)

The conclusion to be drawn is clear: policies to curb congestion must be differentiated in time and space. Across the board increases in charges are unlikely to be effective as they do not allow for the required differentiation. Moreover, they would be unfair. Very strong increases in such charges would penalise rural areas and would still fall short of what is required in heavily congested conurbations.

An efficient and equitable solution would thus comprise introducing highly differentiated charges which vary over time and space. These charges should reflect the cost of congestion to all transport users and would give citizens an incentive to base their transport decisions on the full social costs of transport[5]. This would dissuade those trips of which the total costs are higher than the concomitant benefits and thereby raise welfare by lowering congestion.

Pricing is only one element of a comprehensive strategy to curb congestion. Other policies also have an important role to play. For example, the introduction of telematics based traffic guidance, management and information systems can significantly increase the "virtual" capacity of infrastructure networks. Similarly, the provision of efficient public transportation services, as advocated in the Green Paper on the Citizens' Network, will facilitate the transfer of travellers from private cars to bus and rail. Moreover, teleworking, teleconferencing, and teleshopping can all reduce the need for mobility. Clearly, the different components of a strategy have to dovetail in order to maximise its effects.

The full introduction of such a system would necessitate electronic road charging which has significant advantages in terms of flexibility and non-interference with traffic flows (as vehicles would not have to stop at toll stations). Recent systems can fully respect the privacy of motorists by relying on smart-card technologies. Significant progress has already been made in developing such telematic systems and a large variety of trials are carried out in the Union (see Annex 4). The fact that such systems are very close to the market is proven in the case of Singapore which has awarded a $140 million contract for the building of a system due to be phased in as of late 1997. Also, Austria has announced its intention to introduce electronic road pricing systems possibly before the turn of the century. In Germany and the Netherlands the introduction of road pricing is being considered for the period after 2001.

[5] It can easily be demonstrated that the charge should be set so as to equal marginal costs which reflect the increase in delay and other costs to all other road users and society of an additional unit of transport.

4.4 *Congestion charging, efficient infrastructure policies and recovering infrastructure costs*

It is sometimes argued that the best remedy against congestion is to simply provide more infrastructure. Notwithstanding the need for additional infrastructure in Europe for other reasons, this statement is generally untrue: as motorists are discouraged from using a congested road there is a "latent" demand which is triggered once extra capacity becomes available. In the long run congestion will persist. This has been demonstrated by numerous studies and real-life examples. Apart from introducing bans - which suffer from a wide variety of disadvantages - the only way to curb congestion in the long run is to set an explicit price for infrastructure capacity.

The introduction of congestion charging would also bolster the efficient provision of infrastructure. Efficient infrastructure provision basically entails making decisions on capacity by comparing the benefits from capacity extensions (e.g. time savings) with the costs (construction and maintenance): Optimal infrastructure provision requires infrastructure to be extended to the point where the costs of doing so are no longer outweighed by the benefits. However, in the absence of congestion charging transport speeds will - in the long run - always be too low because of the persistence of congestion and at the same time traffic volumes will be higher than what is desirable. Therefore, in the absence of congestion pricing, it will generally be attractive to build more infrastructure than that which is socially desirable. Congestion pricing could hence lead to important savings in resource costs of infrastructure[6].

It has been shown that if infrastructure is provided efficiently and capacity is priced through congestion charging, both the amount and the use of infrastructure would be such that it is impossible to accommodate more traffic and higher speeds on the network at costs that are lower than the associated benefits. The joint use of congestion charging and efficient investment rules is thus an essential precondition for arriving at a balanced transport system. Studies for the US have indicated that moving in this direction could lead to annual cost savings of 7.75 billion dollars - or nearly 18% of total 1982 highway expenditure.

Congestion charging would also raise significant revenues. These revenues could go a long way to recovering the capital costs of the network and might - if a number of conditions are met - ensure full recovery (Winston (1985)). Such an approach would have several advantages. First, the revenues from such charges would remain within the (road) transport sector and would, therefore, benefit those who pay them. Secondly, these revenues would allow other taxes which are currently used for the public financing of infrastructure but which are largely unrelated to the costs of infrastructure use to be cut. Thirdly, revenues could be used for financing other parts of a comprehensive strategy to deal with congestion (e.g. route guidance systems, public transport etc.). In the long run, congestion charging holds out the prospect of reforming transport taxation in a manner that would greatly increase the efficiency and equity of our transport system.

Clearly, this finding is also of major importance to the financial viability of public private investment partnerships (PPPs): the introduction of charging would provide a stable revenue source which could cover large parts of the costs. The Union's objective of furthering PPPs in infrastructure, is an additional reason for introducing road pricing.

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6 Moreover, it can be demonstrated that an efficient congestion charge is a helpful guide for making infrastructure decisions. Newbery (1988) shows that if the congestion charge is higher than the costs of building more infrastructure, it is generally attractive to expand the capacity of the network.

4.5 *How are we charging for infrastructure and congestion costs now?*

4.5.1 *Charging systems*

No Member State charges explicitly for congestion, although some toll systems have different rates for peak periods. Policies to curb congestion are mainly of a regulatory nature and local authorities apply a host of measures such as parking restrictions, public transport subsidies, land use decisions etc to fight congestion. Whilst some of these measures are relatively successful, the steady increase in congestion across the Union shows that more progress on pricing is needed.

Member States use different systems for allocating and recovering road infrastructure costs, which all rely on **annual vehicle taxes** and **fuel excise duties**. In six Member States (France, Italy, Austria, Spain, Greece and Portugal), **road tolls** are also used. Moreover, **road user charges** - based on the time during which the infrastructure network is used - were introduced for trucks in 1995 in Germany, Denmark and the BENELUX countries. Sweden, prior to joining the EU, also applied a distance related tax on diesel fuelled vehicles which depended on weight and the number of axles, the so-called **kilometre tax**.

Annual vehicle taxes in Member States are often based on overall weight and, sometimes, axle weight of the truck. However, the relation between total taxes paid and damage caused is generally quite poor. This is because there is no link with mileage in the annual vehicle tax systems. Moreover, the relation between fuel consumption (taxed through fuel excises) and road damage is also imprecise, especially for larger trucks. Annex 5 presents evidence on the road damage costs of different types of heavy goods vehicles. The conclusion from this evidence is clearly that these costs vary significantly in function of vehicle characteristics. Moreover, when it is realised that the costs of similar infrastructure are also likely to vary significantly across the Union in function of local characteristics (e.g. geography) it is clear that an efficient charging system for road damage costs will have to be highly differentiated.

Minimum levels of annual circulation taxes and maximum levels for road user charges are laid down, for commercial vehicles, in Community law. Minimum rates of fuel excise duties are also laid down. However, the actual rates applied still differ significantly. Table 4.2 presents information on this matter.

The present system is a mix of taxes based on the nationality principle (e.g. annual vehicle taxes) which holds that taxes are paid in the country of origin and the territoriality principle which implies that charges are paid where the costs are caused (e.g. tolls, road user charges and, to a lesser extent fuel excise duties). Clearly, the need to link charges as closely as possible to costs would imply that the principle of territoriality is followed[7].

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[7] This was also favoured by the European Parliament (OJ N° C158, 1989; OJ N° C150, 1992; OJ N° C21, 1993) in its opinion to the so called Eurovignette Directive (93/89/EC).

Table 4.2 : Road taxes applied in the European Union - ECU

Member State	Belgium	Denmark	Germany	Greece	Spain	France	Ireland	Italy
Annual Vehicle Tax[1]	940[3]	1245	2676	307[4]	464[4]	787	1965	711
Fuel Excise Duty[2]	298.3	289.6	324.9	243.4	257.6	328.2	301.8	375.8

Member State	Lux	NL	Austria	Portugal	Finland	Sweden	UK	EU legislation (min)
Annual Vehicle Tax[1]	779	1038	2825	349[4]	3333	2591	4100	700
Fuel Excise Duty[2]	260.1	316.5	297.0	315.0	284.5	316.2	399.3	245

Source : Commission services

1 HGV 38 tonne (1994)

2 Diesel per 1000 L (1995)

3 HGV 40 tonne (1994)

4 Greece, Spain and Portugal are allowed lower rates until 1.1.97

The significant differences reported in Table 4.2 also point to a potential distortion of competition between hauliers of different nationalities as hauliers operating the same vehicles and carrying identical consignments are charged differently on the basis of their nationality. This, in turn, constitutes an obstacle to the efficient functioning of the internal market. More harmonisation of minimum levels is needed to create a level playing field for hauliers of different nationalities.

The systems used to recover infrastructure costs in rail and inland waterways also differ strongly between Member States. This is to a large extent a consequence of the highly regulated market organisations that (used to) characterise these modes. In some countries track charges are used in rail whereas in other Member States flat charges are imposed or access is free. Similarly a great degree of variation exists in inland waterways.

4.5.2 Infrastructure cost recovery: road, rail and inland waterways

The question arises whether the individual modes cover their infrastructure costs and whether there are significant differences across modes. The evidence in Annex 5 suggests that, on balance, taxes paid by road users are significantly larger than current infrastructure expenditure. Road *expenditure* averages some 1.0% of GDP in the Union, total tax revenues from road users (tolls and vehicle and fuel taxes) equal 2.0% of GDP. The difference can be roughly estimated at some 65 BECU and should be compared with the external costs of road transport (see Chapter 8). Available studies suggest that road users also cover infrastructure *costs*. Nevertheless, significant distortions seems to occur within the road sector. Studies where cost is allocated to different road users show that the overall levels of HGV taxation in some Member States do not cover the infrastructure costs of these vehicles. In these cases passenger cars seem to compensate for these costs of trucks.

Both rail and inland waterways appear to have much lower cost recovery rates than road haulage. For example, a recent study concluded that the average infrastructure cost recovery rate of European railways is 56% (IWW/INFRAS 1995). It has, however, to be pointed out that in both cases significant problems of measurement play a role and that, on balance, the problem seems to be as much one of accountancy and transparency as of uncovered costs. The cost recovery figures for inland waterways, for example, do not seem to take account of the fact that waterways provide water supplies for both domestic and industrial customers, maintain ground water levels and are relevant to a multitude of objectives and activities such as flood protection, tourism, fishing, irrigation etc. Studies by the Service de la navigation de la Seine, which attempt to take these factors into account, suggest that only 18% of total infrastructure costs of the river Seine should be allocated to waterway transport.

Similarly, for rail the cost recovery figures can be questioned because it is unclear to what extent the figures have been corrected for public service obligations that have been, and are, imposed on railways. It would appear that much of the "uncovered" infrastructure costs would continued to be paid by Member States in order to maintain certain public services. It seems that there is a major mismatch between the present infrastructure networks and the commercial demands of modern railway operations. The Community's railway policy implies a gradual liberalisation of the sector which should make operators increasingly sensitive to market forces: as operators adjust the structure of their services their demand for infrastructure use will also change. Provided that Member States restore railway finances, where these have been eroded by past public service requirements - as required by Directive 91/440 - and pay market based prices for future public services, the railways should be expected to be in a much better position to pay for infrastructure costs.

4.6 Charging for road infrastructure and congestion costs: policy conclusions

The long run

Efficient charging implies that charges should be linked as closely as possible to costs. As infrastructure and congestion costs vary significantly across vehicle characteristics, in time and in space, efficient charging systems will have to differentiate accurately in a large number of respects. Such a high degree of differentiation would require the introduction of telematics based pricing systems, notably in road transport. It is clear that, in view of the significant and rising congestion costs and the inefficiencies of current infrastructure cost recovery systems, the Union should give high priority to the development of this approach.

The objective should clearly not be to equalise charges across Europe (since infrastructure costs for the same type of road vary according to local/national circumstances), but to make infrastructure charging more transparent and fairer by basing it on the same principles and methods. This is all the more important in the case of commercial heavy goods vehicles, where a fair, non-discriminatory charging system is essential for the elimination of distortions of competition among Union hauliers. Equitable cost recovery systems are of major importance as full liberalisation of the road haulage market is achieved.

The infrastructure charging policy should in principle aim at full cost recovery, covering both capital costs (and not current expenditures) and operating costs. Common principles for computing the value of the capital base and the rate of return to be used might be needed.

Also, the allocation of costs to different road users should be reviewed. Congestion pricing and road damage recovery on the basis of marginal cost pricing should ideally recover most of the costs in the future, but charges based on average costs will probably have to complement revenues from these sources, certainly in the early phases of this policy. The system to be introduced will have to be examined and evaluated from the point of view of, fairness towards international users, towards other modes of transport and, within the road sector, between rural and urban users or different classes of vehicles. The introduction of such an approach would, in the long run, reduce the need for using existing charging systems for infrastructure cost recovery. A system which closely links costs to charges would be very transparent and would, in addition, allow to assess whether taxes are raised for pure revenue reasons. The Commission considers that in principle *charges* on transport should only be related to the recovery of infrastructure and external costs and would therefore welcome the publication of detailed accounts on transport fiscality. The introduction of *taxes* over and above this recovery level could lead to distortions in transport as in any other sector of the economy, and should therefore be carried out only for general revenue raising purposes. Decisions on this matter would, therefore, ideally have to take account of the relative costs of different options and the impact on the Single Market.

Significant measurement and allocation problems play a role in inland waterways and rail. As both sectors are currently undergoing a process of structural change due to liberalisation, it would not seem logical to target these sectors for ensuring full cost recovery in the short run. The Commission intends, however, to launch studies into cost imputation methods for rail and inland waterways and will draw up proposals for guidelines on this basis at a later stage (see Annex 11).

The short and the medium run

It is clear that the telematics technology will not be available for wide-scale implementation in the short to medium run except for dense urban areas where significant possibilities exist and a number of European cities are already introducing such systems. On the secondary and peripheral network the introduction will, most probably, not be feasible for another decade. Therefore, the question has to be asked whether transitional measures should be taken in the short to medium run.

Here it seems that, in addition to making proposals on interoperability of road pricing apparatus and preparing discussion documents on the principles of the system to be introduced, there are three actions that could be taken with relative urgency:

- the Commission could draw up proposals to better align the current levels of charges for road haulage in the Member States with infrastructure costs. This would require a revision of the various rates that are currently in force at the Community level;

- it should be seen to what extent the structure of the current system can be improved so as to better enable it to accommodate the high degree of differentiation in costs;

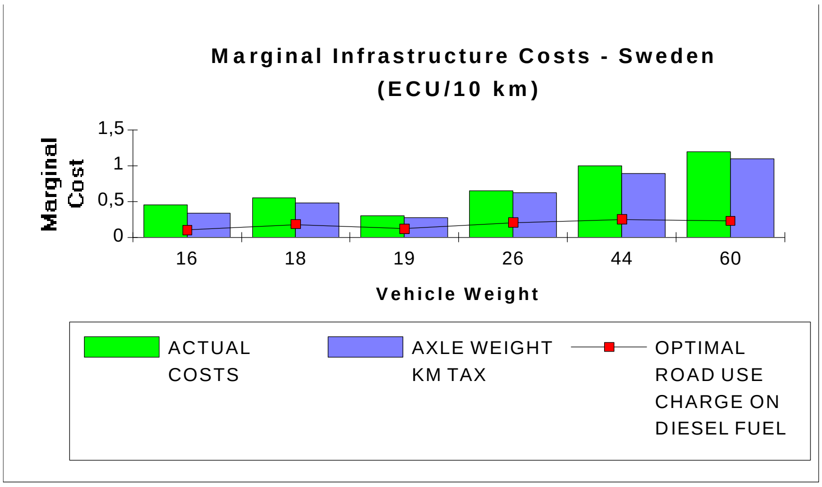
- the Commission will take account of the question of internalising the external costs of passenger cars in its current review of vehicle taxation and associated policies in Member States.

With respect to these points a first step could be to revise the rates (for annual taxes and user permits for Heavy Goods Vehicles) laid down in the so-called Eurovignette directive (93/89/EC) and to see to what extent more differentiation could be introduced so as to better align charges with costs. Significant possibilities would seem to exist with respect to better accommodating geographical differences in infrastructure costs and further differentiating charges according to vehicle characteristics. These issues will also be considered in the Commission's overall review of car taxation which is underway and will also be taken into account, as appropriate, in the next review of the minimum rates of excise duty which is scheduled for 1996.

It would also be worthwhile investigating whether, as a first step towards an efficient system of charging, a so-called electronic kilometre charge - based on axle-weights and other characteristics - could be introduced for heavy goods vehicles. This system is mileage based and can differentiate very finely across different vehicle types.

A more primitive version of this system was used in Sweden prior to its accession to the Union and relies on proven technology. Essentially, an electronic odometer would keep track of the mileage driven and charges would be imposed on the basis of a registration card stamped in the vehicle's meter[8]. The major advantage of this system is that charges could be brought close to road damage and other costs. Graph 4.3 illustrates that this system allows charges to be closely linked to actual road damage costs and has significant advantages over using diesel excises which are not strongly related to costs. The current version is not able to differentiate across time and space. It would, therefore, be useful to investigate whether improvements in this respect can be introduced which would further enhance its attractiveness (the possibility to link this instrument with the electronic tachograph should also be analysed). Also, revenue redistribution issues between Member States would have to be addressed for international road haulage. Lessons could possibly be learned from the operation of the Eurovignette system and the Commission intends to launch a study into the possibilities and advantages of moving towards an electronic kilometre charge for Heavy Goods Vehicles.

Graph 4.3 : A kilometre tax is a more efficient instrument than a fuel tax to charge for road damage costs[(a)].



(a) Road damage costs depend on axle weights. The road costs in this graph refer to standard configurations for vehicles.

Source : Lindberg (1994)

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8 Two types of odometers have been developed in Sweden. The wire driven odometer cost about 800 ECU and an electronic hub odometer was produced - but never implemented - for around 300 ECU. The administrative cost of the charge was around 1% of the revenues generated, which is very low compared to other charges and taxes (see Hoornaert (1992)).

5. TRANSPORT ACCIDENTS

5.1 Introduction

Transport accidents are a human tragedy, whether they occur in road, rail, inland waterways, aviation or, maritime transport. In the Community every year about 50,000 individuals are killed in transport accidents, almost all in road traffic accidents. The consequences for the EU of the total road accidents have been consistently undervalued to date primarily because of the inadequacy of recorded accident, in particular non fatal injury accident, data. If the statistical data from Member States are adjusted to those of the most thorough Member State's records the number of persons suffering from severe and slight injuries is above three million. In rail transport approximately 600 fatalities occur every year and in commercial aviation in 1994 eighteen fatalities occurred.

Table 5.1 : Transport Fatalities, Casualities and Accident Risk in the European Union by mode

	Fatalities	Casualties	Fatalities per billion passenger kilometres		
			EU average	MS with lowest risk	MS with highest risk
Road (1993)	47,800	3,300,000[a]	13	6	118
Rail (average 88-92)	600[b]	1300	2	1	10
Aviation[c] (1994)	18	6	0.5	-	-
Inland waterway & maritime	na	na	0.5[d]	-	-

Source : Commission Services

a) adjusted for under reporting
b) no railway personnel, 50% of accidents at level crossings are included
c) only commercial aviation
d) based on UK statistics

There is an alarming difference in recorded injuries and in the definition of serious injury across the Community (Annex 6). So important is this difference that it renders four fold variations in recorded injury accidents (based on the ratio between what Member States report and an assumption of the number of injury accidents based on the number of recorded fatalities). There must be an acceptable convergence in accident statistics gathering if trends can meaningfully be compared. The gross under reporting of injury accidents radically affects the overall accidents costs and, thereby, possibly attitudes to road and vehicle safety policy.

5.2 Regulatory policies have brought down accidents considerably

Large regulatory efforts have been made, and should continue to be made, to reduce the risk of accidents in transport irrespectively of mode. However, due to the relative magnitude of the accidents in road transport compared to other modes the main concern is the problem of road accidents. Member States are, on the whole, making good progress in improving road safety, and especially in reducing deaths and serious injuries substantially despite the continuing rapid growth in traffic. These improvements are for the most part the result of many different measures, most of which make a fairly modest contribution to the overall achievement, but which collectively provide a very worthwhile improvement.

Among the measures taken, which have contributed to the positive trend of declining road accidents, are the enforcement of speed limits, drink/driving legislation, traffic and road engineering and vehicle safety performance standards. It is important that further measures are developed and applied if the current downward trends are not to reverse under the influence of traffic growth in the future. New design methods can increase the protection of passengers and, through adequate design of the exterior of cars, reduce injuries to pedestrians. Moreovor, further improvements may be expected through the introduction of active safety technologies, which should help prevent collisions from occurring in the first place.

5.3 The cost of road accidents to the Union

Road accidents are the primary cause of death among the under 40s and, for this reason responsible for the greatest loss in terms of years of life. A road accident fatality on average represents 40 lost years whereas death from cancer represents 10.5 lost years and death from cardio-vascular disease 9.7 years.

The concept of cost in relation to accidents is complicated; both with regard to the underlying economic theory, practical estimates and the ethical questions it raises. However, it is estimated that a year's road accidents costs the Union approximately 15 Billion ECU in medical, administrative and damage reparation expenditures alone. The future lost (net) production is estimated to be a further 30 Billion ECU[9]. In addition, road users are estimated to have a willingness to pay of over 100 billion ECU in order to prevent all accidents in the Union from occurring.

Not all of these costs, however, are external. It is estimated that of a total cost of 2.5% of GDP, external costs amount to some 1.5% (see Annex 7). The method of evaluating the cost of accidents, in particular the use of the "willingness to pay" approach as the costing mechanism for human value, can render an order of magnitude difference in accident costings. Although there is a general tendency to rely more on this approach, Member States still use strongly varying methods. As discussed in Chapter 2, the willingness to pay approach is generally to be preferred to other methods as it provides a more comprehensive measurement of all the costs. The gradual move towards a more comprehensive costing of accidents, demonstrates how large the bill of accidents is and justifies a strengthening of policy action.

The Commission is convinced that the true costing of road accidents will prompt:

i) the authorities to allocate resources to minimise road safety risk taking such as providing extra enforcement of safety laws, enhanced infrastructure, better maintained roads;

ii) the auto industry to market even safer cars both for those inside and outside the car. A car crash safety rating would be to the industry's, insurance companies and individual's best interest;

iii) increased chance of a common position by Member Sates to legislation aimed at improving safety, it being judged as cost effective on a similar basis.

iv) safer driving.

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9 Measured as lost future income less private consumption.

5.4 *Possible economic instruments to bring costs closer to users*

Taking account of differences in risks between different users, vehicle types and roads with different traffic safety performance will help to ensure that charges are brought closer to costs at the level of the individual who makes the transport decisions.

More careful driving can be secured by, for example, a differentiation of the insurance premium with a greater bonus for safe driving. Vehicles with higher total safety, to the passengers as well as the unprotected users outside the vehicle, should be rewarded with lower rates. Driving on roads with higher safety standard, such as highways with segregated lanes, should in principle ensure a lower rate then on the rest of the road network.

Among the potential economic instruments mentioned in the discussion are adjustments to existing fuel excise duties, purchase taxes and annual circulation taxes. However, the use of these economic instruments to exert a positive influence on road safety have important shortcomings; the fuel tax, although more or less distance related, can not take into account the difference in risk between users and vehicles or networks; the purchase tax and the circulation tax can, albeit with difficulty, be differentiated according to the vehicle's and, possibly, the owner's risk characteristic but will not be distance related or related to the network. The inverse is true of road tolls.

This discussion shows that efficient instruments to internalise the external costs of road accidents should aim at reducing risk taking in the broadest sense of the word and should, therefore, be introduced at the level of the individual motorist. This suggests that one should seriously review the possibility of using existing insurance systems and ensure that the premiums, both in level and in structure, reflect risk to society as a whole. The use of insurance premiums has the additional advantage of relying on an existing instrument.

5.5 *Road Accident Insurances in the Union*

Pricing and compensation practices vary widely from one country to another and often depend on the basis of cover. Civil liability cover exists in all countries, at least for damages in the case of personal injury: the insurance company takes the place of the policyholder who is responsible for an accident in order to compensate non-responsible third parties.

Most European insurance companies have adopted either bonus systems or bonus/malus systems. These systems either grant a reduction in premium to drivers who have caused no accidents or provide both for reductions in premium for an absence of accidents and penalisation of drivers who cause accidents.

The principle of how liability is funded, and how the driving public as opposed to society in general bears the cost, differs between the Member States. Indeed, consideration has been given to the introduction of a "pain and suffering" scale to be adopted throughout Europe and that all countries produce guidelines for judges to follow when assessing levels of personal injury awards. Differences exist with respect to the type of victim receiving compensation and the limits of cover :

i) The type of victims receiving compensation varies : in some countries only victims who are not at fault receive compensation by cover which calls into question the driver's liability. In other countries third party cover may extend under certain conditions to victims, even when drivers are not at fault. However, in no country are the drivers of vehicles who are entirely responsible for accidents ever compensated by civil liability cover;

ii) The limits of cover vary considerably: in some countries they do not extend to full compensation of loss suffered by victims and allow little or nothing for non-material injury (e.g. mental distress in the event of a fatality, temporary loss of use of vehicle, etc.). Limits of cover and compensation for injury or loss still vary significantly across the Union. Within the European Union, these limits are the subject of a Directive[10] which will progressively align all EC States to certain minima.

In the Union, social protection systems in different Member States treat accident costs in different ways:

i) There are some countries, such as Sweden, whose social security scheme covers all road accidents in the framework of health insurance, no claim being possible against the insurance company. Medical, pharmaceutical and hospitalisation costs are all met by State institutions;

ii) In countries such as Belgium, France or Germany, social bodies may claim against the insurance company of the driver who caused the accident. The insurance companies civil liability costs become much higher as a result of this. Economic harm is no longer financially assessed by the State body but is fixed by normal judicial practice.

This discussion shows that premiums paid by individual motorists do not accurately reflect the full underlying cost. First, a large part of the cost is paid by society as a whole (e.g. via general taxation or social security charges) implying that, in total, road users do not pay for all accident costs. Secondly, risk based or "true pricing" pricing governs one part of the premium and inter-generational cross-subsidisation (from older and female drivers to young male motorists) another part. Consequently, the current rate is not based upon a true evaluation of an individual's risk and charges, therefore, do not correspond to the likely (statistical) risk at the level of individual road users (mismatch). If one accepts the principle that the "polluter pays" in proportion to the pollution he/she generates, the driver too should pay something in proportion to the full risk he creates.

5.6 Towards fair and efficient pricing for accidents

The current policy towards insurance in the Union is based on the necessary improvement of the Single Market. If it was decided that more progress should be made on cost internalisation through the insurance system, then this policy would need expansion.

The basic principle of such an approach would be to ensure that the insurance liability covers the whole accident cost and that the premium is differentiated as much as possible:

i) This approach would imply withdrawing the "road accident subsidy" that is currently paid by governments and societies and leaving the true and total costs to be borne by the driving public;

ii) The cost of insurance should ideally vary with risk. Assessment of a driver's attitude towards risk taking could include historical evidence such as:-

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10 Articles of Directive 84/5

- Rewarding responsible behaviour through driving offence registrations or, proof that driving behaviour is better than average, ie. by assessing acquired ability to drive in a safer manner, eg. advanced testing is to be encouraged;

- A scale of charges by offence, perhaps automatically linked to the driving licence point system, could be an equitable way of targeting the higher risk taker rather than only relying on a blanket charge for high risk groups such as young male drivers.

This approach would give consumers an incentive to buy safer cars, drive more safely, drive less, use safer roads, switch to other modes, where appropriate, or car pool. It would, therefore, leave it to individual users to decide how to reduce accident risk in a way that they deem fit.

There are, however, a number of possible problems that would have to be solved before such a system could be introduced. For example, in this system the young inexperienced driver, particularly male driver, would, at present risk rates, incur the bulk of the higher costs, whilst the experienced older driver would receive a rebate (the differential risk for young drivers is currently between 2 and 4 times that of a comparable adult reference group). Such a structure could cause an increase in the number of young people driving uninsured and exacerbate under-claiming/non reporting of accidents. Enforcement and training will be the key to ensuring that an insurance based internalisation works effectively.

Whatever approach is chosen, it is clear that it must respect the efficient functioning of the internal market in insurance services.

5.7 <u>Policy conclusions</u>

- The Commission will promote harmonisation of the recording and assessment of traffic accident statistics at the most thorough level throughout the Union.

- The Commission should encourage the willingness-to-pay principle as costing mechanism for traffic injury accidents.

- Insurance premiums are the most direct and focused method for targeting the driver in proportion to the risks involved. The Commission will analyse the potential of this instrument and whether Community action is needed.

- There is significant scope for harmonising the practices and criterion for settlement. The Commission will convene a working party to consider the possibility of establishing a pain and suffering scale when assessing levels of personal injury awards and the provision of compensation for bodily injury.

- Publicising the relative safety performance of cars through either analysis of their occurrence and performance in road accidents or through crash simulation studies has proved to be successful in influencing buying decisions and so reducing the user's risk. Relative safety evaluation of passenger cars should be encouraged at EU level. By giving sufficient incentives to reduce risk, cost targeting should give added incentive for buying safer cars.

6. AIR POLLUTION FROM TRANSPORT

6.1 Emissions from transport: levels and trends

In most Member States of the European Union the major share of carbon monoxide (CO) and oxides of nitrogen (NOx) emissions come from transport (around 69% and 63%, respectively). This sector also contributes a substantial share (around 30%) of non-methane volatile organic compounds[11] and a minor share (1%) of sulphur dioxide (SO_2) emissions. Secondary pollutants are formed as a result of complex chemical reactions that the primary pollutants undergo in the atmosphere. The main secondary pollutants attributable to transport activity are nitrogen dioxide (NO_2) and ground-level ozone. Oxides of sulphur and nitrogen also contribute to acidification. Other air pollutants of concern come from fuel substances such as lead and benzene in gasoline, are directly emitted from diesel vehicles such as particulate matter, or are linked to fuel consumption such as emissions of carbon dioxide.

It has to be pointed out that there is a significant variation in the share of transport in total emissions across the Union. For example, in Greece only 26.9% of total NOx emissions are from transport, whereas this share is 52.9% in Portugal and 68.7% in France. The lion's share of these emissions is from road transport. Although emissions depend heavily on technology and vary according to a number of parameters, road transport emissions per passenger or tonne-kilometre of freight are often a multiple of emissions from other modes, even for modern cars and trucks (Table 6.1). By vehicle type, cars are responsible for the large majority of emissions of CO and VOCs, while heavy goods vehicles are responsible for a substantial share of NO_x emissions and the majority share of SO_2 emissions.

Table 6.1 : Specific Emissions by mode

	CAR			AIRCRAFT			TRAIN			WATERWAYS		
	A	B	C	A	B	C	A	B	C[2]	A	B	C
Passenger transport (grammes per passenger km)												
CO_2	180		126.4	160		210.0	78		48.7			
CO	11	3.1	1.038	0.28	0.13	1.266	0.13		0.008			
NO_x	2.1	1.4	1.367	0.71	0.88	0.588	0.46		0.120			
C_xH_y	2.3	0.75	0.168	0.31	0.043	0.198	0.30		0.003			
SO_2			0.084			0.078			0.209			
Aer[1]			0.046			0.028			0.074			
Freight transport (grammes per tonne km)												
CO_2	207			1160			41					
CO	2.40		2.10	1.40			0.05		0.6			0.20
NO_x	3.60		1.85	5.30			0.20		0.40			0.58
C_xH_y	1.10		0.92	0.80			0.08		0.02			0.08
SO_2												
Aer[1]			0.04						0.08			0.04

Source : OECD (1994) and AECMA (1994) A = Germany; B = Switzerland; C = Belgium

[1] Aerosols

[2] Corresponding figures for high speed trains are 28.9, 0.005, 0.071, 0.002, 0.124 and 0.044 respectively

Transport-related air pollution has traditionally been addressed in Europe with regulations on fuel quality, emission standards and vehicle inspection and maintenance programmes (see 6.3).

[11] The main ingredient of VOC is hydrocarbons (HC). The lightest hydrocarbon, methane (CH_4), is often excluded from regulation and for that reason data is sometimes compiled as non-methane VOC, NMVOC.

Overall, these regulations have succeeded in reducing emissions per vehicle-kilometre by some 90% compared to 1970. As a result, transport-related emissions of carbon monoxide, volatile organic compounds and oxides of nitrogen show a downward trend, while lead emissions from gasoline are gradually being phased out. For example, NOx and VOC emissions are expected to go down by 38 and 54 over the period 1990-2010. But total emissions of other air pollutants continue rising due to the growth in motorization and transport demand. This is the case of particulates and carbon dioxide.

6.2 The costs of air pollution

Transport-related air pollution can have local, regional, or global impact. Local air pollution has impacts on health (e.g., respiratory diseases) and causes material damage to buildings and vegetation. Local air pollution is caused by primary pollutants, SO_2, lead and particulates. Regional impacts derive from acidification and ground level ozone. Global impacts are related to the progressive accumulation of greenhouse gases and their role in the gradual warming of the earth's atmosphere. Transport sources are major contributors to the so-called "greenhouse effect" principally through emissions of CO_2 and CFCs[12], but also through emissions of other air pollutants. Besides their impacts on local air pollution, VOCs and NO_x emissions contribute to ozone formation and indirectly to global warming. NO_x and VOC emissions are both a local problem and, through chemical reactions, an important contributor to regional air pollution. Lead and particulates are very local problems.

The air pollution externality from transport originates from the environmental impacts caused by the emissions of air pollutants. If these emissions were harmless to public health, buildings or vegetation, there would not be an externality. However, people's continued exposure to high-level concentrations of local air pollutants, for example, can result in severe health damage, including respiratory diseases, cancer and premature deaths. A recent OECD survey puts the external costs of (local and regional) *air pollution* from transport at roughly 0.4% of GNP. This estimate excludes cost estimates for greenhouse gases from transport. Clearly, the figure of 0.4 % of GNP is an average figure which varies across countries and cities depending on the age and composition of the vehicle fleet, climatic conditions, population exposure, etc. Moreover, preliminary results of ongoing research point to the possibility that the above-mentioned average cost figure underestimates the costs of air pollution by several orders of magnitude, by not fully taking account of public health effects. In particular, emerging evidence suggests that the health effects of particulate matter have been significantly underestimated until now.

6.3 The current policy approach: scope and limits of regulation

The costs per gramme of emissions do not normally depend on the mode from which it was emitted. In this case, charges to bring these costs closer to users should, therefore, not discriminate across modes. However, given the dominant share of road transport in total, policies should be developed with a certain urgency for this mode. Other modes should, however, not be overlooked, especially when they make an important contribution to total emissions. For example, emissions of NO_x and SO_2 from maritime transport in the North East Atlantic are of the same magnitude as total emissions in France. The levels for the English Channel and the Southern North sea are approximately comparable to the national emissions levels for Denmark. It was found, for example, in an environmental assessment of the Öresund bridge that, although road traffic will increase, emissions of NO_x and SO_2 will be reduced by 5 to 15% due to a reduction in ferry traffic (which uses high sulphur diesel oil and has no catalytic converters) after the opening of the bridge.

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12 CFC = Chlorofluorocarbons, emitted from the airconditioning of vehicles

6.3.1 ***The current policy approach***

The control of transport-related air pollution in the EU has largely followed a regulatory approach aimed at bringing down emissions through product standards and rules to reach air quality standards[13]. Limit values for tailpipe emissions from gasoline and diesel cars, as well as heavy and light duty vehicles, were introduced in the early 1970's. According to the current fiscal incentives framework existing in "emissions" directives, Member States may grant fiscal incentives for vehicles complying with the limit values set by the directive before these become mandatory, in order to encourage their earlier application. The fiscal incentives framework aims, on the one hand, at accelerating the early application of strict limit values and, on the other hand, at avoiding any risk of disrupting the proper functioning of the Internal Market.

In addition, fuel standards limit the sulphur content of diesel, the maximum amount of lead in petrol as well as the benzene content. Vehicle inspection and maintenance programmes have been introduced at the EU level to ensure compliance with existing emission standards. A differential between leaded and unleaded gasoline excise rates has been introduced in the Community's mineral oil excise system. The share of unleaded petrol has risen from less than 1% in 1986 to some 53% in 1993.

Finally, the Commission has recently set up a series of R&D Task Forces to better focus the Community's R&D programmes by gearing them to users needs and, thereby, also reinforcing industrial competitiveness. The "Car of tomorrow" Task Force is of particular importance in this respect as it will focus on ultra low or even zero-emission vehicles.

6.3.2 ***Limits of the current policy approach: Differentiated causes and effects of air pollution across Europe***

The nature and causes of air pollution differ, sometimes considerably, across the regions and cities of Europe. This variation is very important in the case of regional air pollution (e.g. acid rain) and local air pollution in urban areas. Regional air pollution differs considerably across Europe and the damage costs of acidification are much higher in northern and Central Europe than in southern Europe.

Regarding local air pollution, the differences are also widespread. The Hague, for example, suffers more from summer ozone than from high NO_2 concentration while the opposite is true in Milan. Lead in gasoline, has practically disappeared due to the high turnover rate of the vehicle fleet and the early use of relatively strongly differentiated taxes in Denmark, Austria, Finland, and Sweden while it is still highly consumed in Portugal and Spain (70%- 80%leaded petrol). The average age of the vehicle fleet also differs considerably across Europe along with the composition of the urban vehicle fleet in terms of private/public transport vehicles as well as in terms of gasoline and diesel vehicles.

This high degree of variation suggests that the implementation of European wide measures alone is not very cost-effective, because these can not take account of differences in the Union. For example, recent analysis by the Commission services indicates that the reductions in urban NOx emissions from transport that are necessary to reach ambient air quality targets in 2010 in cities like London, Lyon and The Hague will fall short of reaching the same targets in cities with very severe transport-related air pollution, like Athens, Madrid or Milan.

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[13] Air pollution from gasoline cars;70/220/EEC OJ L76, 6.4.1970, major amend. 91/441/EEC OJ L 242 30.8.91 and last amend. 94/12/EC OJ L 100 19.4.94; limits of pollutants from diesel engines; OJ L 190 20.8.72 last amend. OJ L 238 15.8.89 resp. 88/77/EEC OJ L 36, 9.2.1988 last amend. 91/542/EEC OJ L 295, 25.10.91 .

Moreover, a European-wide use of best available technology to address the problems of cities like Athens, Madrid and Milan will fall short of solving their urban NOx problem, whilst it would impose additional compliance costs in cities like London, Lyon and The Hague. However, for internal market reasons, it is obvious that product standards for vehicles should be set at the European level. Clearly, in determining these standards, account should be taken of the costs of reaching air quality objectives to all citizens in the Community and the potential contribution from all instruments should be analysed.

Given the strong variation of problems across the Union, it seems clear that economic instruments have a key role to play in a broad strategy that provides the necessary flexibility to accommodate the significant differentiation found in the Union.

6.4 Reducing emissions from transport: leverage points

The amounts and proportions of air pollutants emitted from an engine depend on a large number of factors, including the design and size of the engine, the characteristics of the fuel, and the conditions in which the vehicle is used: how the vehicle is driven, its age, and its state of maintenance. A diesel engine, for example, produces much less CO and VOC than a gasoline engine, but it produces more emissions of PM[14] and NO_x. A well maintained and tuned-up engine emits less pollution per unit of travel than a poorly maintained vehicle. New vehicle technology has a very strong potential to bring down emissions. But, of course, emissions depend on real driving conditions. Therefore, in-use compliance testing is important as it guarantees the continued effectiveness of exhaust emission systems. Annex 8 lists the relevant "points of leverage" for reducing emissions from vehicles.

An efficient policy approach would rely heavily on low cost options and aim at equalising the incremental costs of each individual leverage point, thereby arriving at an optimal mix. In this situation changes in the intensity at which individual instruments are used are no longer attractive. Charges that are directly based on emissions would, hence, in principle be a particularly attractive policy instrument, since they would give citizens and businesses an incentive to select the least cost mix of response options.

Ongoing studies suggest that the costs of technical improvements to both vehicles and fuels are relatively low compared to the total cost of pollution to society. Further R&D work in this area, for example in the context of the Task Forces "Car of tomorrow" and "Intermodality", is thus particularly promising.

6.5 Economic instruments as a complement to the existing regulatory approach

Although direct emission charging is currently not possible because of very high transaction costs, Member States have in the past years experimented with a variety of economic instruments to complement the existing regulatory approach.

Sweden, for example, has long recognized the advantages of using market-based incentives as an environmental policy tool (see box 6.1). Other examples are vehicle or sales taxes based on engine powers (found in a variety of countries) or on emission standards (Finland, Sweden). In the past, several Member States (Austria, Finland, Greece, Netherlands and Germany) introduced temporary tax reductions to promote the introduction of cars with catalytic converters in the vehicle fleet.

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[14] Particulate matter

Further progress towards bringing air pollution costs closer to users

Many alternatives have been proposed during the last years to internalise the environmental costs of transport; from the implementation of advanced emission fees based on actual emissions to adjustments of the level of the existing fuel, vehicle or purchase taxes to take into account an approximation of the emissions. Tradeable permits have been discussed as a means to set the levels, even road pricing and scrapping fees have been examined as possible measures. Clearly, the closer the charge is to actual emissions, the more efficient it will be in "tapping" all the different sources of emission reduction. However, implementation decisions will have to be based on a trade-off between an instrument's link to emissions and its implementation costs. In addition to emission fees, which, however, require advanced metering technology, the following instruments could be considered:-

i) Different approximations of the actual emissions based on distance driven and emission per kilometre for each vehicle type can be developed. In practice this could consist of modifying existing annual vehicle taxes to include environmental charges. In the somewhat longer run, it could be seen to what extent a kilometre based element in these charges could be introduced, either through annual checks (e.g. at the inspection and maintenance control) or through an electronic device. Such systems would in addition give vehicle owners incentives to reduce fees by maintaining the car properly, or by driving less. Obviously, implementation and enforcement issues would have to be analysed carefully.

ii) The option of increasing fuel taxes is often promoted as an effective solution, because of the direct relationship between fuel consumed and distance travelled, as well as its low administrative costs. However, the relation between fuel consumption and emissions is generally weak (with the exception of CO_2), as a result of which increased fuel prices do not trigger a number of the highly effective response options (in particular emission controls) listed in Annex 8. Moreover, increases in fuel efficiency generally imply a cost. They are, therefore, likely to be neither an effective nor a cost-effective way of reducing emissions (other than CO_2) from transport. This is confirmed by the simulations presented in Annex 9 which show that the cost-effectiveness of emission based circulation taxes is much higher, especially if they are kilometre based.

    However, differential fuel taxes can be used to promote the consumption of cleaner fuels. The difference should be based on an approximation of the actual emissions and the same value per unit emission should be used for all fuels. Examples are the differential taxation of leaded and unleaded gasoline, fuel price surcharges based on the sulphur/heavy oil content of diesel, or lower taxes on clean fuels such as, for example, compressed natural gas.

iii) The tax differential in favour of diesel fuel which is found in most Member States should also be re-considered in light of its potential environmental impact. For example, this tax differential in favour of diesel in Europe has contributed to the growth of a significant market for diesel-powered passenger cars. The advantages of diesel engines regarding CO and HC emissions is substantially offset by the diffusion of three-way catalytic converters. Moreover, poorly adjusted diesel engines are an important source of black smoke and fine particulates. In addition, CO_2 emissions from motor vehicles are directly proportional to the amount of fuel consumed and its carbon content. While diesel engines are more fuel efficient than gasoline engines, diesel has a higher carbon content per litre than gasoline. The conclusion is that tax differentials in favour of diesel cannot be justified on environmental grounds. Clearly, other factors that could possibly justify this differential, have also to be taken into account in the final assessment.

iv) Older vehicles are responsible for a disproportionate share of air pollutant emissions. Vehicle scrappage programs intend to eliminate the most polluting units of the vehicle fleet by means of inducing their destruction and/or replacement with less polluting units. A carefully designed early retirement programme, targeted at cities or regional areas that are out of compliance with air quality standards, could potentially achieve environmental benefits at costs equal to or lower than those of other emission-reduction options. These programs can also achieve gasoline savings as a byproduct. Such an early retirement programme involves equity issues and should, therefore, be based on non-mandatory participation brought about by incentives and economic instruments. Experience in some Member States shows that incentives directed towards new and cleaner cars through differentiated purchase/registration taxes can also be an efficient means to reach environmental goals. The incentive is more perceptible for the user and could therefore have a relatively large impact.

v) Similarly, it could be seen to what extent charges in other modes can be made to reflect environmental costs. Track charges in rail and landing charges in aviation could be differentiated on this basis. The variation in environmental costs across the Union should ideally be reflected. An additional point that should be reviewed in this context is the tax exemption for aviation fuels which could lead to a distortion in transport choices.

6.6 Policy conclusions

The internalisation of air pollution costs presents a major opportunity for bolstering the Community's air quality policy. A rebalancing of the mix between regulatory instruments, which will continue to be necessary for the efficient functioning of the internal market and the protection of public health, and economic instruments, which are required to ensure cost-effectiveness and for dealing with the wide variation of air quality problems across the Union, could increase the environmental effectiveness of the policy, whilst reducing its costs.

Emission fees are, in principle, the most attractive instruments to internalise the costs of air pollution in the transport sector. Direct emission metering and charging in accordance with regional differences in environmental costs is currently not feasible because implementation is prohibitively expensive. However, this is not a reason to refrain from action as there are a number of attractive instruments allowing a sufficiently high degree of differentiation to be achieved, which can be introduced at short notice.

Instruments which should be examined more closely include;

- adjustment of the relation between taxation on gasoline and diesel fuel to better represent each fuel type's environmental performance;
- differentiated fuel taxes reflecting differences in fuel qualities;
- differentiated vehicle taxes in accordance with the environmental performance of the vehicle;
- differentiated track charges (rail) and landing charges (aviation);
- a kilometre tax based on a vehicle's environmental characteristics;
- differentiated user charges and road tolls according to the environmental performance of vehicles, possibly to be defined by a common environmental classification.

Some of these measures would require changes in existing Community legislation (e.g. a kilometre tax for Heavy Goods Vehicles) whilst others could be introduced by Member States without any Community action. However, a broad consensus at Community level on the pricing instruments to be implemented by Member States is desirable, in order to ensure that these dovetail into an overall policy strategy and are duly taken into account in the definition of regulatory measures (e.g. vehicle standards) which, for Internal Market reasons, are decided at the Community level.

BOX 6.1 : The Swedish experience with market-based incentives to curb air pollution from transport

Differential fuel taxes

In order to facilitate the introduction of so-called reformulated gasoline, which contains less carcinogenic substances, sulphur etc, and makes the catalytic converter function more efficiently, an additional tax differentiation was introduced in 1994. The difference in taxation between the two grades of unleaded gasoline is only 0.06 SEK (0.006 ECU) per litre, but this difference has been large enough for the reformulated fuel to entirely replace the standard quality (Annex 1).

Tax on diesel fuel for vehicles has been differentiated, based on environmental characteristics such as content of sulphur and carcinogenic compounds, since 1991. The cleanest fuel, class I, has a tax advantage of 0.47 SEK (0.05 ECU) per litre compared to standard fuel, and contains only 0.001% sulphur compared to the standard of 0.2%. Virtually 100% of the diesel sold for vehicle use now consists of class I (Annex 1).

Differential vehicle taxes

In order to stimulate the sales of vehicles with lower emissions, tax differentials exist for cars and light and heavy trucks. The vehicles are classified in three environmental classes, with class III representing the basic requirements, identical to current EU norms. Class II represents a stricter norm, usually equivalent to the future EU norm, while Class I represents even stricter standards. Originally the sales tax was differentiated, but now the differentiation is put on the annual vehicle tax for the first five years of the life time of the vehicle. The classification system is often used in the marketing of vehicles, and has probably affected the type of vehicles sold in the Swedish market. Class I cars have a small percentage of the market, Class II have 33% and the rest are Class III cars.

Environmental tax on domestic flights

In 1989 a tax on emissions of HC and NO_x from domestic flights was introduced. The tax is 12 SEK (1.4 ECU) per kilogram of HC and NOx emissions. It is difficult to precisely gauge the effects of the tax but it arguably induced an early change of combustion chambers in a large number of high emitting engines. This reduced the cost for the domestic aviation company from 60 MSEK at the introduction of the tax to 45 MSEK after the more environmental friendly engines where installed.

Car scrapping charge

In 1975 a charge of 250 SEK was introduced on the sales of new cars: The objective was the prevention of waste from abandoned cars. Revenues were used to pay a premium of 300 SEK to those who received a scrap certificate from an authorized scrap firm. When the system was introduced, the ratio of scrapped cars to new cars increased. In 1988 the charge was increased to 300 SEK and the premium to 500 SEK; in 1992 a further increase of the charge to 850 SEK took place together with the introduction of a differentiated scrapping premium, which was higher for cars which had passed a safety control within the last 14 months.

Clearly, the development of market based incentives has to respect the Treaty and should not obviate the efficient functioning of the Internal Market. Given their effectiveness, the development of a Community framework might be needed.

7. NOISE

7.1 Introduction

Many Europeans consider noise caused by traffic, industrial and recreational activities as their main local environmental problem especially in urban and mountain areas. The increasing number of complaints from the public about noise, especially since the mid 1980s (up 66% for example in England and Wales (CEST 1993)), is evidence of growing public concern. Traffic noise disturbs more people than any other noise source and the continuing growth in traffic volume in all modes, and its increased spread over space and time, is offsetting the impact of the policy measures implemented to date to address the problem.

Studies carried out recently have estimated that over 20% (close on 80 million people) of the Union's population are exposed to day-time transport noise above acceptable levels (above 65 dB(A)). An additional 170 million citizens are exposed to noise levels which cause serious annoyance (as defined by WHO - between 55-65 dB(A)). Road transport noise is the dominant source - 19% of the Union's population is exposed to unacceptable levels of road traffic noise. As for rail only 1.7% of the population and air transport a further 1% of the population are exposed to these high levels. Data for expressed annoyance are insufficient. National surveys do not always use the same wordings of questions to enable assessment of the way in which noise is perceived (disturbed, annoyed or affected). Comparable data is only available for four countries - D, F, GB, NL. This shows that road traffic appears to annoy between 20 and 25% of the population and railway noise between 2 and 4% (INRETS 1994).

Data over the past 15 years do not show any significant improvement in exposure to traffic noise. Although exposure levels remained fairly stable at the beginning of the 1980s and action on "black spots" over 70dB(A) has been successful, increases in the 55-65 dB(A) range occurred by the end of the decade in many Western European countries, apparently as a result of fast growing road traffic (INRETS 1994). The data show that the numbers of those acutely exposed are decreasing but the overall problem is getting worse. In many urban areas, traffic noise peaks are not increasing but the period of high noise exposure is becoming longer.

7.2 Existing legislation has only been a mixed success

European Community legislation governing the emissions of noise from vehicles has been in existence for over twenty five years for passenger cars and heavy vehicles and, for fifteen years for two-wheeled vehicles. Since the implementation of the first directives, the current regulations have achieved a reduction in specific noise levels of 60% for motorcycles, 85% for passenger cars and over 90% for heavy lorries. This legislation is amongst the most stringent in the world. However, the reduction in actual road traffic noise levels has been much less: only 1-2 dB(A). The reasons for this low level of effectiveness have been identified as: the increase in road traffic, a worsening of traffic fluidity and, in general, traffic conditions and a lower threshold to achievable noise reductions caused by the interaction of tyre and road noise (Sandberg 1993). Other disadvantages of relying solely on regulations are the fact that the test procedure (ISO R 362) does not realistically reflect driving conditions and that, without a regular inspection procedure to ensure maintenance of the acoustical design features, the noise levels may increase over time. For example tampering with the exhaust silencers on motorcycles can increase noise levels by 10 dB(A). European Union goals, as set out in the Fifth Environmental Action Programme, up to the year 2000 are that exposure of the population to night-time levels in excess of 65 dB(A) should be phased out and to ensure that, at no point in time, a level of 85 dB(A) should be exceeded. The aim is to further ensure that the proportion of the population exposed to levels between 55 and 65 dB(A) and to levels below 55 dB(A) should not increase.

The future impact of legislation limiting vehicle noise emissions on overall noise levels is likely to remain limited and effective noise abatement action will require increased recourse to other instruments such as land-use planning and economic instruments in combination with stricter standards. In order to put greater emphasis on the polluter-pays principle, economic instruments in particular should have a greater role.

7.3 *The costs of the transport noise problem*

An overview of studies produced in 1993 (Quinet 1993) found that the estimated costs of noise pollution vary between 0.1% and 2% of GDP. Generally studies based on the avoidance cost approach give low values for noise costs - below 0.1% of GDP, while studies using the willingness to pay approach give higher values; partly because they are carried out in countries with a high per capita income. Most in line with the principle in this paper is the willingness-to-pay method (see Annex 2).

7.4 *Economic instruments*

The use of economic instruments for noise abatement from transport, especially from road transport, is not widespread in Europe although the OECD in its report "Fighting noise in the 1990s" (OECD 1991) concluded that economic incentives for noise reduction have shown their effectiveness in relation to road vehicles in the few cases where they have been used. Noise charges - except in the field of aircraft noise - have been used even less than incentives and, where used, have generally been set too low to encourage noise reduction. Their main function has been to raise funds for noise control measures such as the insulation of buildings.

The impact of landing charges[15] for aircraft to reduce noise remains unclear. The OECD's 1990 evaluation argued that the efficiency had been low and did not influence the airlines choice of aircraft, whereas a report on the situation in Germany (Walter et al 1993) pointed to considerable success.

The possibilities for taxing noisy vehicles include: a tax on new vehicles dependent on their noise category (which may depend on noise emission and type of use/average annual mileage) or an annual tax dependent on noise category. Such a tax may be used in conjunction with in-service checks that a vehicle is still within its designated noise category (this would also open the possibility of operators being able to reduce their annual tax by fitting noise suppression equipment). A third possibility is a charge on noisy vehicles when they are used in an environmentally sensitive area.

Noise taxes paid by manufacturers have the advantage of encouraging them to produce quieter vehicles. However, if users pay, they have an incentive to reduce noise by maintaining the vehicle, fitting better noise suppression equipment, and using the vehicle less (assuming that the taxes are made dependent on in-service noise and distance travelled). For example, Austria is planning to introduce a road user charge that differentiates according to the noise (and also emissions) of vehicles in 1996.

A consequence of road pricing should be optimal use of the road network and this may lead to both increases (e.g. if speeds increase) and decreases in noise nuisance. However inclusion of a noise cost element in the charge should be an incentive to reduce noise on these routes.

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15 Summary of different economic instruments drawn from an INRETS (1994) study done for the Commission.

Incentives in the form of grants to purchase low noise goods vehicles have been in operation in Germany and the Netherlands. For a period of approximately ten years in the Netherlands, operators of heavy goods vehicles were offered a two tier subsidy if they purchased and used vehicles fitted with "hush kits". Subsidy levels were 7.5% and 5% for noise reductions of 6dB(A) and 3dB(A) respectively. The costs of the quietening measures were borne by the operators. The programme, now abolished, resulted in specified lower noise levels and more than 60% of the lorries now in use in the Netherlands have noise levels 5dB(A) below current minimum standards. Similar schemes exist in Germany. Although of limited scope, this type of initiative is likely to become more widespread in the future and could be extended to include incentives for tyres and road surfaces producing lower noise: the tyre-road noise problem will have to become an important part of abatement policy in the future.

Instead of subsidising a reduction in pollution, compensation could be given to those it affects. Compensation for house price depreciation caused by noise or other environmental impacts is a well established policy. An important aspect of compensation is that, in some circumstances, the polluter, or the authority making decisions about pollution, may have to pay the compensation themselves. This is particularly so in the planning of new railways, airports and roads where projected compensation payments may be an incentive to the promoting authority to reduce or mitigate environmental impacts.

7.5 <u>Policy conclusions</u>

Economic incentives in the form of charges or subsidies have been used for both aircraft and road vehicles. Evidence suggests that some reductions in noise levels have been achieved.

The further, or future, development of incentive schemes for road vehicles based on annual taxes or road pricing can be a way forward to the extent that it is effective. For railways, track charges could be modulated according to train characteristics and regional and local conditions.

The Commission services are currently considering the environmental issue within the wider context of airport charges. A Consultation Paper has been presented outlining a common framework for airport charges within the European Union. The paper rests on the three key principles of cost-relatedness, non-discrimination and transparency. In order to ensure the internalisation of external costs, such as noise and congestion, the possibility of differentiating the charges has been included in the paper and this matter will also be considered in the context of the overall review of vehicle taxation being undertaken by the Commission.

The Commission has also decided to prepare a Communication on noise policy for adoption in 1996, which will aim to draw up an action plan on noise abatement. The communication will contain : a brief review of the noise situation in the Community; an analyses of Community and national abatement measures taken to date and; noise quality criteria already applied. This will be followed by discussions on ways of ensuring that the public is informed of the noise situation, of appropriate harmonised noise exposure indices and the costs and benefits of different actions to reduce noise levels. It will also include a discussion on tasks for the different actors (Community, national and local).

8. TRANSPORT EXTERNALITIES: COSTS AND POLICY OPTIONS

This chapter summarises the available evidence on external costs and draws some preliminary conclusions with respect to their size, distribution across modes and other characteristics (8.1). It subsequently proposes general principles for complementing the existing policy approach with instruments aimed at internalising external costs (8.2). Finally, a short overview is provided of concrete steps that can be taken in the short/medium run to make the transition towards a system of fair and efficient transport pricing.

8.1 Summary of the available evidence on external costs

Although cost estimates vary according to local circumstances and evaluation methods used, it nevertheless seems useful to gain an impression of the overall size of external costs and their breakdown across modes. Table 8.1 presents the results of a review of the existing literature carried out for the Commission. Annex 10 contains an overview of a recent study which also covers air transport and shipping. The results of these studies illustrate that:

- External costs of transport are large, even if congestion costs are not taken into account.
- The most important problems exist in Road and Air-transport, although also in Rail and Shipping externalities occur. The share of road transport in total costs is over 90% and costs per passenger and vehicle kilometre are an order of magnitude more important than in rail and shipping.
- Ignoring congestion, accidents and air pollution are the single most important externalities.
- External costs from road transport are significantly larger than the excess of transport taxes over infrastructure costs (estimated at some 65 BECU; see Chapter 4).

Given the dominant share of road transport in total passenger and goods transport, it is useful to further differentiate the results for road transport. Table 8.2 provides some further information on the breakdown across different types of road users and locations of the external costs for road transport in France. The qualitative pattern is very similar to that found in Table 8.1 and in other reports.

Table 8.1:External cost of transport (ECU/1000 per passenger km & per tonne km) - excluding congestion

	Road		Rail		
	Pass.	**Freight**	**Pass.**	**Freight**	
Accidents	18	13	3	2	
Noise	2.5	3.2	2.5	1.8	
Air pollution & climate	15	17	2.5	1.5	
Total	35.5	33.2	8.0	5.3	
	Total External Costs (BECU p/a)				**Total**
	118.4	32.1	1.9	1.6	154
%	77%	21%	1%	1%	100%

Source : Commission Services (1994)

Table 8.2 : Road Taxation and External Costs, France 1991 (bn FF)

	Two Wheelers	Cars		Light Vans		Trucks	Buses	Total
		P[1]	D[2]	P[1]	D[2]			
Urban Traffic								
- Tax revenue	1.5	37.5	5.1	4.6	5.5	2.1	0.7	57
- Road expenditure	1.3	20.3	5.8	3.6	8.0	4.7	0.5	44.2
- Balance of tax revenue and road expenditure	0.2	17.2	-0.7	1.0	-2.5	-2.6	0.2	12.8
- Noise	0.7	5.4	1.5	0.8	1.5	0.4	0.1	10.4
- Pollution	2	7.7	2	0.3	2.3	1.4	0.6	17.3
- Greenhouse effect	0.1	2.9	0.7	0.4	1.2	0.4	0.1	5.7
- Accidents	4.7	11.8	3.4	0.2	0.5	0.3	0.1	21.0
- Congestion[a]	0	9.5	2.8	1.9	4.1	0.7	0	19
- Total external costs	7.5	37.2	10.1	4.6	9.6	3.3	0.9	73.5
- Balance: public expenditure/revenue minus external costs	-7.3	-20.0	-11.4	-3.6	-12.1	-5.9	-0.7	-60.7
Balance/km (cnts)	-73	-23	-46	-30	-47	-292	-108	-
Rural Traffic								
- Tax revenue	1.6	54	11.8	3.6	3.8	22.5	2.9	100.2
- Road expenditure	0.9	23	10	2.3	3.5	19.8	1.7	61.2
- Balance of tax revenue and road expenditure	0.7	31	1.8	1.3	0.3	2.7	1.2	39
- Noise	0	1.0	0.4	0.1	0.1	0.4	0	2.0
- Pollution	0.3	1.4	0.3	0.1	0.1	3.1	0.3	5.6
- Greenhouse effect	0.1	3.2	1.4	0.3	0.6	2.5	0.2	8.3
- Accidents	2.4	12.2	5.3	0.4	0.6	2.7	0.2	23.8
- Congestion[a]	-	-	-	-	-	-	-	-
- Total external costs	2.8	17.8	7.4	0.9	1.4	8.7	0.7	39.7
- Balance: public expenditure/revenue minus external costs	-2.1	13.2	-5.6	0.4	-1.1	-6.0	+0.4	-0.7
Balance/km (cnts)	-30	+9	-9	+3	-6	-25	+18	-
Balance/km (centimes) All Traffic	-55	-3	-19	-13	-29	-46	-9	-

Source : ECMT/OECD (1995)

(a) excluding congestion imposed on other motorists
1 Petrol
2 Diesel

Further conclusions that can be drawn on the basis of this and similar information are:

- In passenger transport cars and motorcycles have the highest external costs (buses have high external costs per vehicle kilometre, but low costs per passenger kilometre - provided they have reasonable occupancy rates).

- Urban traffic has very high external costs, whereas costs in rural traffic are relatively low. If the balance between infrastructure costs and taxes is taken into account for rural traffic, then transport prices would seem approximately in line with full costs. Motorcycles and trucks are exceptions to this rule.

- In a number of Member States, diesel fuelled cars and light vans pay significantly less tax than gasoline powered vehicles as a result of which the balance between taxes and social costs is worse than in the case of gasoline cars.

- The difference in external costs between urban and rural areas underlines the importance of differentiation. This is also borne out by the strong differences in environmental and noise characteristics across different classes of vehicles (see Chapters 6 and 7).

As discussed in Chapter 4, there are important infrastructure cost recovery issues to be addressed in all modes. The balance of evidence available suggests that, whilst in some Member States private motorists seem to be subsidising road costs caused by heavy goods vehicles, road as a whole more than pays for its infrastructure costs (also see Annex 5). In rail and inland waterways cost recovery ratios are much lower, but this seems to be partly related to measurement issues, the joint use of infrastructure for a variety of objectives (inland waterways) and public service obligations (rail).

Although the precise estimates of external costs are uncertain this should not be taken as a reason for inaction: the direction and the order of magnitude of the required changes is often known. A policy of gradually phasing in instruments and raising the internalisation charges over time as more information becomes available is to be preferred to inaction. Such an approach should be combined with efforts to improve and harmonise estimates of external costs, across modes, vehicle technologies, countries, regions and in time.

8.2 Cost internalisation as an essential component of a transport strategy

In the past, Community and Member State transport policies have relied heavily on mandating technical change and imposing standards to reduce externalities. Whilst some important successes have been achieved in this way, a number of problems have deteriorated. Moreover, even in cases where progress was made through this approach, transport users have never been directly charged for remaining costs. They have, therefore, not had an incentive to further reduce these externalities by looking for additional ways to further bring down external costs. This situation also implies a distortion of competition between modes and operators as the degree to which external costs are paid for differs across the Union.

The current policy approach relies largely on regulation and operates essentially on a problem-by-problem basis. It, therefore, has considerable difficulty with taking interactions between externalities into account and in reconciling trade-offs. Finding an appropriate balance between different problems would be greatly facilitated if a cost could be attached to the different externalities and it could be left to individual transport users to decide on the best ways of simultaneously dealing with a variety of problems. Therefore, progress on cost-internalisation could allow the construction of a more consistent policy framework for dealing with a large number of inter-related transport problems. It would also imply a rebalancing of the current policy mix and constitute an important complement to existing regulatory policies, the development of an inter-modal infrastructure network, Research and Development Programmes and policies to complete the internal market in rail and inland waterways. Without full recovery of social costs in every mode the intermodal policy strategy of the Community could well fail as the conditions of competition would not be equitable across the Union.

Clearly, the precise balance between regulation and economic instruments has to be reviewed carefully on a case-by-case basis within the context of an overall policy strategy. This requires further analysis and a careful preparation of policies over time. A number of principles which could underpin a pricing policy are set out in Box 8.1. These principles aim at enhancing both the efficiency and the fairness of pricing in transport.

Various studies suggest that moving towards efficient and equitable pricing on the basis of the above principles is likely to generate significant benefits, because the approach would be highly effective in reducing the underlying external costs. Box 8.2 reports on a study that was carried out for the city of Brussels (1 million inhabitants) which suggests that such a pricing approach would improve welfare by some 150 MECU annually.

Box 8.1 : Fair and efficient pricing : The principles

The aim of an internalisation strategy is to increase both the fairness and the efficiency, in the broadest sense, of the European transport system. The objective of the policy is to ensure that prices reflect costs so that businesses and citizens base their decisions on the right price signals. For some users this will mean higher prices, for others lower. If the policy is successful and transport users adapt their behaviour and technology, then the revenues from the system could diminish as the externalities decrease in the future.

The principles of such a strategy can be summarised as follows :

- Charges should be linked as closely as possible to the underlyng costs. This will enhance both the equity and the cost-effectiveness of the system. The more charges are linked to costs, the larger the reduction in externalities and the improvement in welfare will be;

- Charges should, hence, be highly differentiated and behavioural adjustment to reduce externalities has to be rewarded in the form of lower charges. Of course, the degree of differentiation should take account of transaction costs and the need to safeguard transparency;

- The price structure should be clear to the transport user. The publication of detailed accounts of the social costs and charges of the transport system is to be encouraged;

- Charging should be non-discriminatory across modes and nationals of different Member States and revenues should flow to authorities in countries where the costs are factually caused (principle of territoriality);

- In all modes, transport prices of individual journeys should be better aligned with the total costs of these journeys to society (i.e. including accident, environment, noise, infrastructure and congestion costs);

- The full infrastructure costs of all infrastructure networks should be recovered from transport users in the long run, unless infrastructure has been constructed for other policy reasons. This implies that an additional charge might have to be paid if charges based on the marginal infrastructure and congestion cost do not cover total infrastructure cost;

- Imposing additional charges for simple revenue raising purposes (i.e. over and above what is needed for cost internalisation) is likely to lead to distortions, both in the economy as a whole and in the transport system. These costs should be compared with alternative ways of raising revenues.

Box 8.2 : Fair and efficient transport pricing in Brussels

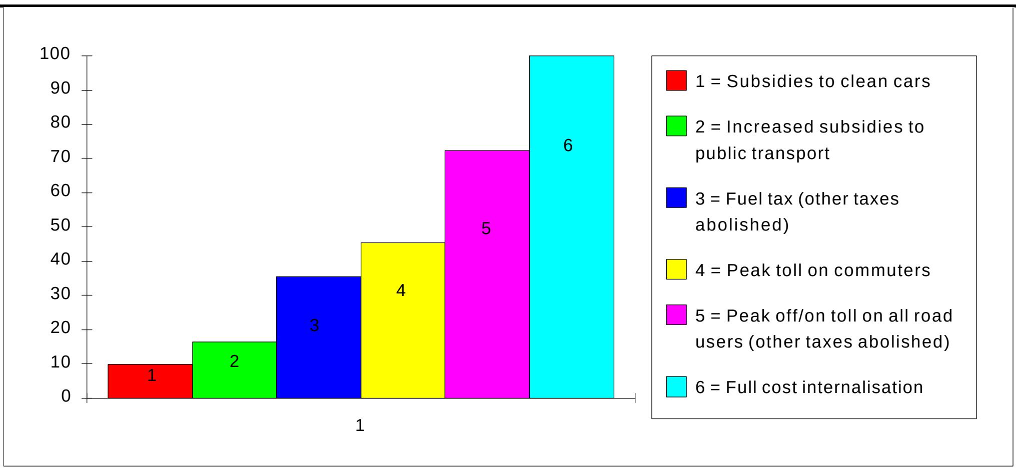
The benefits of fair and efficient transport pricing can be illustrated by a study funded by the Community's Fourth Framework R&D Programme which has analysed the consequences of internalising the external costs of transport for a number of European cities. This box reports on the results for the city of Brussels.

Average peak travel speeds in Brussels are forecast to go down from 38 km/hour in 1991 to 23 km/hour in 2005 if no further policy action is taken. Although improved vehicle technology will bring down pollution, emissions would still entail significant costs. The same is true of accidents.

The introduction of an efficient pricing strategy that brings costs closer to users would have a significant impact on the underlying transport problems. This policy would lead to a large reduction in peak car traffic (-21.8%) and a sizeable increase in peak use of public transportation (19.5%). Air pollution problems would be cut by some 50%. Annual benefits would be in the order of 150 MECU.

The policy would comprise electronic road pricing and emission fees. These instruments might not be fully available in 2005. However, Graph B.8.1 shows that relying on more conventional instruments could also lead to sizeable benefits.

Graph B.8.1 : Alternative instruments for internalising the external costs in Brussels - Benefits as a percentage of full cost internalisation case



Of course, the results from this study are rough approximations on the basis of available knowledge regarding costs and behavioural responses to prices. They should not be interpreted too literally. But the message arising from this and similar studies is clear: progress towards fair and efficient pricing can generate significant benefits.

Table B.8.1 : External costs in Brussels, 2005 (million ECU per day)

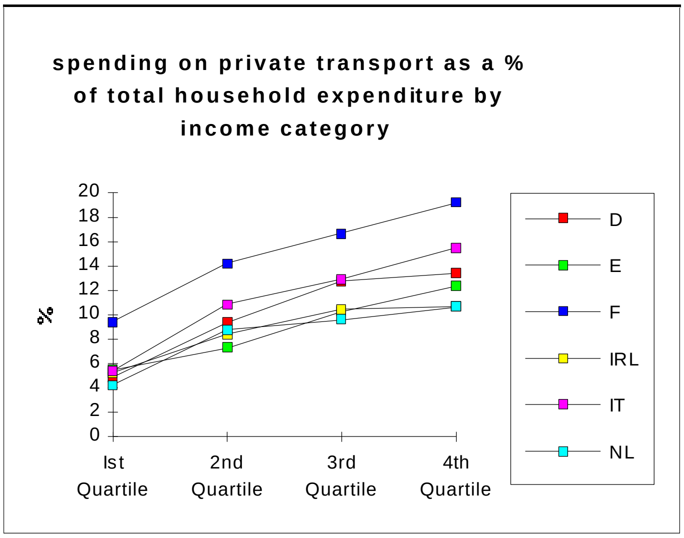
	No Additional Policies	Fair and Efficient Pricing
Noise	0.131	0.126
Accidents	0.964	0.789
Pollution	0.196	0.094
Travel Speeds (km/h)	23	38

Source : Ochelen and Proost (1995)

Equity considerations

It is sometimes argued that cost internalisation in transport will have negative equity implications: the poor will be hit hardest.

Whilst it cannot be ruled out that some people on lower revenue will pay relatively high charges, it can easily be shown that, in general, this is untrue. Graph 8.1 shows that in the Union spending on private transport (i.e. car ownership and use) rises strongly with income: in some countries the richest 25% spend twice as high a share of their income on this service as the poorest 25%. To the extent that cost internalisation will raise the prices of car use - which will not always be the case - the rich will, on balance, be harder hit than the poor. This notwithstanding, an increase can cause relatively more hardship for people on low incomes. This general finding does, therefore, not imply that cost internalisation will never have adverse impacts on low income households and studies have identified possible cases (in particular, it should be avoided that cases of "mobility exclusion" arise). Clearly, the design of any cost-internalisation strategy will have to take full account of its impact on different groups of consumers and the possible need for additional policies, possibly to be financed out of revenues raised, has to be carefully investigated (see Annex 3).

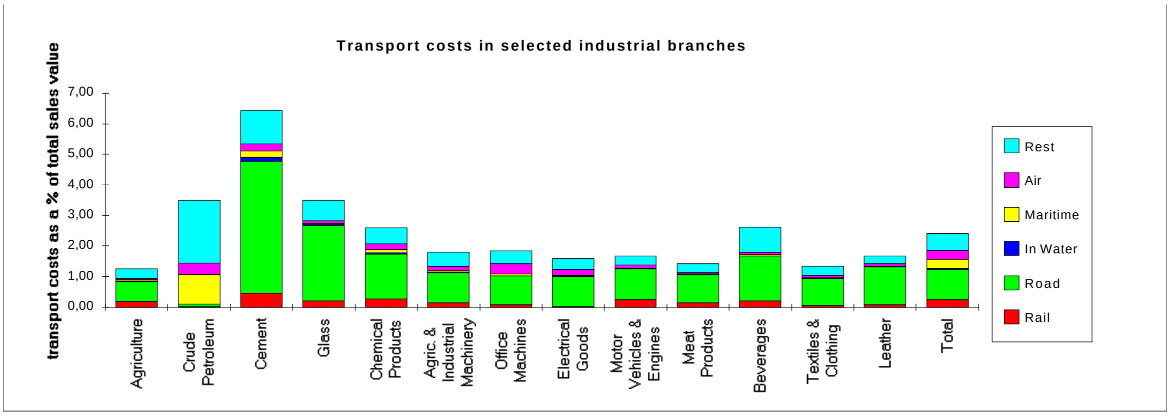


Graph 8.1

Competitiveness and Employment

On average, transport costs only account for 2.8% of final product prices in the Union of which a third (1%) relates to road transport. For most industrial branches, transport costs represent 1-4% of the sales values (see Graph 8.2). In general transport costs decrease as the value of products increase : there is a strong inverse relation between transport costs as a % of total sales value and the value per Kg of individual products. Highest costs are found when products with low value-added are traded over long distances (e.g. intercontinental trade). For example, transport costs as a percentage of total sales value can be as high as 18% for cast iron in intercontinental trade. In such cases, maritime transport costs and port charges are relatively important. However, even in intercontinental transport costs can be quite low: for example, the transport costs of a T-shirt sold in Germany made from Pakistani cotton, spun in Tunisia and sewn in Morocco amount to only 2.7% of the sales price. Moreover, in intra-European trade, transport costs are generally quite low, even for agricultural products which have a relatively low value per Kg of product (around 5% of the total value).

Transport costs are only a part of the total logistical costs, which also comprise inventory management and other stock related costs. In fact, industries are increasingly using new production methods such as just-in-time to reduce inventory costs. These methods are heavily based on reliable transport operations and have made European industry vulnerable to transport inefficiencies and congestion. The benefits and costs of efficient transport pricing will, however, differ across industry and, therefore, the impacts on individual branches should be studied when devising policies in this area. The Commission will launch a study into this matter (see Annex 11).



Graph 8.2

Source : Eurostat Input/Output Tables

On the whole, progress towards fair and efficient pricing is likely to significantly strengthen the competitiveness of European industry. Reducing congestion, air pollution and accidents implies that the associated costs which are currently borne by the European economy as a whole are reduced. For example, curbing congestion will reduce the time losses incurred by businesses and consumers. Knocking off only a fraction of the current congestion costs - estimated at 120 BECU - would already imply significant benefits. Efficient production planning and inventory management is crucial for modern economies and requires reliable deliveries. A reduction in accidents leads to lower health care costs which translate into lower social charges. Bringing down air pollution will also reduce health bills and, in addition, increase agricultural productivity (e.g. reduced acidification and ozone concentrations).

Efficient and fair pricing implies that revenues from charges will fall in line with the reductions in underlying transport problems. The previous chapters have highlighted a variety of efficient instruments that can be introduced through adjusting the structure of taxation systems without increasing the overall level. Higher taxation levels are, in any event, not an objective of the proposed approach. Moreover, where higher charges might occur, revenues could be returned to the economy through reductions in other taxes and charges. In line with the analysis presented in the White Paper on Growth, Competitiveness and Employment, reductions in social security charges - in particular those on low skilled labour - would seem highly promising and could lead to significant benefits in terms of increased employment.

8.3 Phasing in of policy instruments: priorities

Whilst all modes should be charged equally in relation to the external costs they generate, the cost estimates presented in this paper suggest that, without overlooking other modes, road transport should be prioritised in the development of policies. These policies should, as much as possible, take account of the variation in externalities across vehicle type, time and space.

In devising an internalisation strategy a distinction has to be made between what is desirable in the long run and achievable in the more immediate future. However, the selection of instruments to be introduced in the early phases of this approach should clearly take account of the desired long term development. Table 8.3 presents possible instruments for internalising a variety of external costs, in road and in other modes. The long term policy instruments represent potentially attractive options because they can be highly differentiated. They are, however, currently not operational and their implementation costs would have to be verified before any decision is made.

The principle of linking charges closely to costs and underlying transport choices would ideally require the introduction of new instruments that can differentiate very accurately. Significant technical progress is being made in this respect. A status report on electronic tolling systems, which in the long run would provide efficient tools for charging for infrastructure and congestion costs, is provided in Annex 4. The latest systems can fully respect the privacy of private motorists (by relying on smart card technologies). For other externalities a smart "black box" (or "green-box") which could register the relevant determinants (e.g. mileages, vehicle characteristics, emissions) would be a particularly efficient tool to determine the "internalisation charge" since it would allow to differentiate charges according to actual costs. Such instruments are under development for other purposes (e.g. "fleet management"), but clearly more research would be needed to develop appropriate equipment meeting technical, transport and other requirements. Also, the link with electronic road tolling systems would have to be investigated. Provided the operational costs are within reasonable limits, this would thus be an attractive long term solution.

The introduction of more differentiation in existing annual vehicle and fuel taxes to take account of air pollution and, possibly, noise costs would seem a promising option in road transport that could be phased-in in the near future. A revision of the levels of these charges should also be envisaged, but care has to be taken that "clean" vehicles are not penalised. Therefore, increases in the average level of charges should preferably only be introduced, whilst simultaneously introducing more differentiation. Again, these issues can be considered in the context of the current review of vehicle taxation. At the same time location specific tolls - preferably electronic - could be used for transport corridors with particularly high infrastructure, congestion or air pollution costs. Such systems are already operational and could provide a useful transition to more advanced systems of electronic road pricing. In view of the forecast, strong increase in congestion action should not be put off.

Accident related external costs could be internalised without major technological change by means of a risk related insurance system that would cover the full social costs. However, as indicated in Chapter 5, there are still a number of important points to be resolved before concrete steps in this direction can be taken. Moreover, this should not detract from the need to make parallel progress on other fronts such as vehicle safety legislation, training, rules on drinking and driving etc. In addition, the labelling of vehicles on the basis of their safety performance and the publication of this information would be a useful complementary measure to both approaches.

Whereas electronic tolling systems are already operational and are likely to be phased in on a larger scale as of the beginning of the next century, it is clear that a significant time will elapse until the whole network is covered (maybe around 2015). This suggests that serious thought should be given to intermediate solutions. For heavy goods vehicles, the introduction of a kilometre tax could be a promising option for bridging the gap between the existing system of charging and a more refined long term system. A kilometre tax can accurately take account of vehicle characteristics which determine noise, emissions and road damage and is, moreover, mileage based.

Although present systems cannot differentiate across time and space, a kilometre tax based on an electronic odometer or, coupled with the electronic tachograph, represents a significant improvement over existing systems. If the costs of an electronic version - currently estimated at some 300 ECU - could come down, then the introduction of these systems in private cars could also be contemplated. The technical devices used to implement a kilometre tax could evolve over time until they coincide with future electronic road pricing black box instruments.

Similarly, it should be seen to what extent existing charges in other modes could be modulated in line with differences in external costs and aligned with external cost levels, if need be. For example, individual train journeys could be taxed according to the type of rolling stock used, the particular route chosen (important for noise and emissions). Although complicated aspects of extra-Community competition play a role in aviation and maritime shipping, landing charges and port charges could be varied according to the same principle[16].

Table 8.3 : Possible Policy instruments for efficient and equitable pricing

	Short/Medium Term		Long Term	
	Road	**Other Modes**	**Road**	**Other Modes**
Infrastructure Costs & Congestion	- more differentiation according to use and damage in existing charging systems - kilometre tax for HGV (axle based) - tolls	- infrastructure use related charges	- electronic road pricing for congestion and infrastructure costs	- track charges and other infrastructure-use related charges
Accidents	- progress in gearing insurance systems to the desired long term structure - labelling		- insurance systems covering full social costs and differentiating according to risk (e.g. bonus/malus)	
Air Pollution & Noise	- for cars : emission (and possibly mileage) dependent annual taxes - for HGVs : surcharges on kilometre tax - differentiated excises according to environmental characteristics of fuel - CO_2 tax for global warming - identical across modes	- introduction of emission based charges e.g. landing charges in aviation based on noise emissions	- fees based on actual emissions/noise with differentiated costs according to geographical conditions (and, possibly, time of day)	

16 An example of this approach is the introduction of differentiated port charges for segregated ballast tankers - which are safer and more environmentally friendly; See EC 2978/94 OJ L319)

It is sometimes argued that an increase in fuel prices is an efficient way of internalising external costs. Whilst it is certainly easy to implement and fuel use is related to mileage, there are major disadvantages which suggest that, except for addressing the risks of global climate change, this might not be an attractive option: fuel use correlates poorly with accident risks, air pollution and congestion and various studies reported in this paper have shown that the reduction in underlying problems following the introduction of higher fuel prices is likely to be limited. Moreover, higher fuel prices only very partially reward "responsible behaviour" and could hit rural transport - which already seems to be paying its way - relatively hard. Therefore, equity, efficiency and implementation costs - as well as the role fuel taxes play in raising government revenues - will all have to be taken into account in making decisions on this issue.

Finally, a review of existing transport taxes and tax exemptions would be desirable to determine whether current rules fully contribute to the creation of equitable conditions of competition within and across modes in the Internal Transport Market.

9. THE COMMUNITY DIMENSION

9.1 When and why is EC intervention needed?

In view of the location-specific nature of many transport externalities, policy action is often best taken at the national or even local level. This applies to local traffic policies, regional and urban infrastructures and a host of complementary policies. Community action has nevertheless to be considered in four circumstances: cross-border externalities; effects on the Internal Market; the possibility of economies of scale and; policy spill-overs.

It is intuitively clear that the level of government responsible for the area affected by a certain problem is often likely to be best suited to deal with it. In a similar vein, the Community is likely to be the most appropriate level for policy action whenever a problem involves significant cross-border effects between a large number of Member States. On the other hand, where there are local externalities of significantly varying importance across the EU territory, the a priori case for Community intervention is fairly weak. The Internal Market adds another dimension to the problem. Even if a certain problem is local, there may be a justification for Community involvement, if solutions are likely to comprise product standards for tradable goods or could potentially affect the efficient functioning of the internal market. The former reason explains why tailpipe emission standards for cars have traditionally been set at the Community level. This latter reason seems relevant for the case of road pricing equipment. Thirdly, if there are significant economies of scale from a joint policy, this could also constitute a justification for a Community role. Joint R&D is a case in point and the transport and technology research in the Fourth Framework Programme, as well as the recently introduced R&D Task Forces - notably the Car of Tomorrow and Intermodality - should be seen in this perspective. This programme should also provide tools and a possible accounting framework to evaluate the impact of policy measures on external costs.

Finally, in cases of policy spill-overs, Community policies often already exist with respect to instruments which could potentially be used for internalisation strategies at the national or local level. This suggests that a certain agreement on broad principles of a policy approach is needed at the Community level. For example, common rules exist on minimum levels of annual circulation taxes, mineral oil excises and maximum rates of user charges in road haulage. In addition, the existing legislation lays down principles for toll rates. These rules, which have been introduced in order to promote equitable conditions of competition in the internal market, obviously constrain Member States in their freedom of fixing rates. Moreover, given cross border shopping for fuel in large parts of the Community, Member States have only limited possibilities to increase rates much beyond those in neighbouring countries. Therefore, if it was felt that increases in fuel prices were an efficient tool for cost internalisation, then some action at the Community level would be needed.

Similarly, the discussion on limiting air emissions from vehicles in Chapter 6 has shown that different combinations of economic instruments and standards are possible. Standards are set at the Community level, whereas most economic instruments would be introduced at the Member State level. It is, therefore, essential to carefully coordinate the overall policy strategy. This implies that in many cases broad agreement on principles will have to be arrived at between Member States, before an efficient policy at both Member State and Community level can be formulated.

Table 9.1 : Upcoming EU policy initiatives relevant to making more progress on cost internalisation in transport

TIMING	DOCUMENT	RELEVANCE
1995	- Communication on CO_2 emissions from cars	- CO_2
First half of 1996	- Launch of studies (see annex 3) - Communication on the Auto/Oil Programme and concomitant proposals on vehicle standards etc. - Revision of Directive 93/89/EC ("Eurovignette Directive") - Environmental Framework for Transport	- General - Air pollution from motor vehicles (excl. CO_2) - Pricing in road haulage - Environmental pollution from road transport
Second half of 1996	- Airport charges - Railway track charges and finance - Corridor studies on selected number of TENs corridors - First results on a Strategic Environmental and Economic assessment of the TENs network - Review of existing Community legislation on pricing in transport - Revision of minimum excise rates of mineral oils - Re-examination of State Aid Rules and preferential tax treatment in inland transport - Communication on noise - Comprehensive review of vehicle related taxation - Review of aircraft fuel exemption - Elaboration of accounting frameworks for the external costs of transport	- Pricing in aviation - Pricing in rail - Infrastructure - Infrastructure - Removal of objectives to cost internalisation - Pricing in road transport - Road, rail, inland waterways and combined transport - Noise from transport - Pricing in transport/internal market - Pricing in aviation - Valuation of external costs
1997 (and beyond)	- Standards for Road Pricing and Route Guidance Equipment (?) - White Paper on further progress towards fair and efficient pricing in transport - Proposal on pricing in road haulage (1998)	- Pricing in road transport - Pricing in all modes of transport - Pricing in road haulage

The analysis in the second part of this paper - Chapters 4-7 - shows that this generally applies to policies which could be developed to cover infrastructure and congestion costs, to reduce air pollution and noise and to curb accidents. The introduction of economic instruments as complements - and in certain cases - substitutes for direct regulation, thus necessitates a wide ranging discussion that this Green Paper aims at triggering off.

9.2 Next steps

Progress towards fair and efficient pricing will bolster the Community's intermodal transport policy which aims to unlock the full potential of all transport modes. It will thus be an important complement to policies to strengthen combined transport - such as the PACT programme (Pilot Actions for Combined Transport), the Citizens' Network, as well as, the activities of the Research Task Force "Intermodality". Moreover, progress towards fair and efficient pricing should also further the introduction of public-private-partnerships, which should assist in speeding up the completion of TENs projects and is an important objective of the Community's policy for growth, competitiveness and employment.

Progress on pricing is thus urgently needed and the discussion above implies that both Member States and the Community have an important role to play. It is also clear that progress will have to be gradual and that a step-by-step approach is needed as more information becomes available and as technology develops.

Equally, it is important to ensure that future Community legislation does not obviate but, where appropriate, stimulate the introduction of cost internalisation policies. This is why the Commission intends to launch a review of possible obstacles in existing Community legislation and encourages Member States to embark on a similar exercise.

Table 9.1 contains a non-exhaustive list of upcoming Commission proposals that are of direct relevance in this context. The Commission intends to carefully review the possibility and usefulness of introducing elements of a fair and efficient pricing strategy in these proposals. Clearly, this exercise will take full account of the need to ensure the efficient functioning of the internal market and of the imperative to arrive at a balanced and complementary set of measures, including regulation, where needed. In addition to these initiatives the Commission will launch a number of studies that are listed in Annex 11. These studies aim at generating better information, both on the nature and the size of external costs in particular circumstances and possible policy instruments that can be used to target the underlying problem. The results of these studies will be used in drawing up the proposals mentioned in Table 9.1.

As can be seen from Table 9.1, the Commission intends, in keeping with the findings of this Green Paper, to initially concentrate on road transport. A series of policy initiatives falling under the so-called Auto-Oil programme will be of major importance in reducing air emissions from road transport. Moreover, following the annulment by the European Court of Justice of the Eurovignette directive (93/89/EC) which lays down common rules for taxes and charges in Road Haulage, the Commission will make a proposal for a revision early in 1996. The system that will be proposed, is intended to run for a limited number of years and it will be seen to what extent a closer linking of charges with costs at the level of the individual transport operator can be introduced. In the course of 1998 the Commission will make a follow up proposal on rules for a new system, that will take account of technical progress.

The Commission's second review of the minimum rates for excise duties on mineral oils (92/82/EEC) is due to be carried out in 1996. Also, a comprehensive review of vehicle taxation will be undertaken in the course of 1996. This review could provide a basis for drawing up a Community framework aimed at bolstering the efficient functioning of the internal market as well as furthering cost internalisation policies. In view of the need to ensure compatible technical system for road pricing equipment across the Union, the Commission is currently considering the usefulness of making proposals on interoperability of such equipment in 1996.

Table 9.1 shows that there are also possibilities to make more progress in other modes - new initiatives for rail and airport charging will be launched in 1996. The Commission will also review tax exemptions for aircraft fuels. Finally, the Commission is in the process of undertaking an environmental review of a number of infrastructure corridors as a run up to a more comprehensive strategic assessment of the economic and environmental consequences of the Trans European Transport Network. Progress on better measuring external costs will obviously be of significant importance to the success of this exercise.

10. FINAL POINTS

Transport policy is at the cross-roads. Whilst the fundamental importance of transport to modern societies and economies is generally recognised, concern about increasing congestion, environmental consequences and accidents is mounting. There is a growing realisation that, on current policies alone, transport trends are unsustainable. Without substantial change - in the levels and priorities of investment in systems and means of transport and changes in the use of different modes - increasing delays and costs are guaranteed. This insight has triggered a review of transport policies in many Member States and countless individuals and institutions, among which the European Parliament and the Economic and Social Committee, have called for a debate on this matter at the European level.

The outlines of a more comprehensive policy response to this situation are gradually becoming clear. Responsible infrastructure investments aimed at removing bottlenecks and linking individual modes into an intermodal system are an important ingredient. So are the efforts to complete the internal market in those modes of transport that are generally environmentally friendly and where there is spare capacity. Here increased competition should lead to increased competitiveness with respect to road transport. Joint R&D efforts are another ingredient to further the introduction of efficient and safe technologies.

This Green Paper looks at pricing. Transport policies have in the past largely focused on direct regulation. Whilst rules have brought significant improvements in some areas, they have not been able to unlock the full potential of response options that can be triggered through price signals. Price based policies give citizens and businesses incentives to find solutions to problems. The Community's objective of ensuring sustainable transport requires that prices reflect underlying scarcities, because otherwise these scarcities will not sufficiently be taken into account. Decisions made by individuals with respect to their choice of mode, their location and investments are based on prices. So prices have to be right in order to get transport right.

The evidence presented in this paper suggests that in transport - as a general rule - the relation between prices and costs is weak at the level of individual transport users. Some costs - related to infrastructure, environmental pollution, noise, accidents and congestion - are only partly covered or not at all. Some transport users seem to pay too much, others too little. This situation is both unfair and inefficient.

The question is, therefore, how progress towards fair and efficient pricing can contribute to solving some of the underlying problems by giving transport users incentives to adjust their behaviour. The aim of such a policy would obviously not be to raise taxes, but to use charges to curb congestion, accidents and pollution. If this policy is successful it will improve the competitiveness of the European economy by reducing the wastage of scarce resources, that currently occurs, at the tune of some 120 BECU per annum in congestion costs alone.

Various key characteristics of an efficient and fair pricing system emerge from this paper. In principle, prices paid for individual journeys should be better aligned with the costs of these journeys. As costs differ across time, space and modes, this implies a need for differentiation. The objective of this policy would be to relate charges to all costs society and other users are confronted with. Transparency is important and, ideally, accounts should be published identifying the relation between charges and costs.

This paper puts questions and suggests policy options, but does not contain definitive answers. It does, however, suggest that priority should be given to road transport and that concrete progress in tackling environmental problems and, more particularly, covering infrastructure and congestion costs in the near future is feasible.

Given the vital importance of transport to our economies and societies, the Commission believes that a debate on transport pricing is essential. Whatever the form of decisions, the transport system will clearly need time to adjust: location decisions have long lasting implications, technologies to meet customer requirements have to be developed over time and road vehicle stocks can only be replaced in a decade or so. It is precisely for this reason that, as businesses, people and governments are beginning to plan for the next century, a clear and urgent signal must be given that prices paid by individual transport users will have to more accurately reflect the full costs of transport, both in level and in structure. A wide and thorough discussion and consultation on how this principle can be implemented in practice is therefore urgently needed.

The Commission invites all interested parties, Member States of the European Union and the European Economic Area, states applying for membership to the European Union, the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions to comment on this Green Paper. It intends to carefully review submissions and to take these into account in the development of future initiatives in this field. Observations on this document should be submitted to:

The European Commission
Directorate-General for Transport
"Green Paper on Fair and Efficient Pricing"
200 Rue de la Loi
B 1049 Brussels
Belgium

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Annex

Green Paper Towards Fair and Efficient Pricing In Transport

__Annex 1__ **: Effectiveness of price based policies in transport**

Summary : The effectiveness of economic instruments depends on the reaction of people (citizens and businesses) to price changes. These behavioural changes can be measured by so-called price elasticities, which indicate the percentage change in transport volumes, following a 1% change in prices. Substitution elasticities measure the percentage change in the relative volumes of two transport categories (eg diesel and petrol) following a 1% change in relative prices (eg diesel and petrol price).

The basic price elasticities of interest for a discussion on behavioural change in road use as a result of a price based policy are substitution elasticities between different type of vehicles/fuels and own price elasticities. Elasticities with respect to fuel prices and tolls (eg road pricing) refer to changes in only part of the costs of transport and are therefore generally smaller than own price elasticities. Finally, substitution elasticities with respect to other modes are also of relevance.

Recent evidence on elasticities in transport suggests a much higher sensitivity towards price changes than what was previously thought. "In reality, competition between modes, routes or firms gives rise to a wide range of price elasticities, generally much more elastic than conventional wisdom would suggest."(Oum 1992).

The substitution elasticity between similar products can be almost infinite, as the example of fuel qualities suggests below. A minor price difference can generate major changes in consumption patterns. Total cost elasticities, which are relevant for evaluating the effects of road pricing, are generally estimated at approximately -1.0 with significant differences according to trip purpose, payment methods etc. Finally, the evidence on the cross-elasticity of public transport fare changes on car use suggests a low elasticity (not larger than 0.1). It should, however, be pointed out that this is largely due to the fact that the share of public transport in total mobility is relatively small (some 15%), implying that large percentage increases in public transportation are needed to decrease car use by 1%.

__**The conclusion to be drawn is clear: price elasticities in transport are sufficiently large for making price based strategies highly effective, especially if they induce differentiation.**__

__Price differentiation and behavioural reactions__: Substitution elasticities between vehicles/fuels which differ only in respect of environmental characteristics are generally very high: i.e. small charges in prices of dirty vehicles/fuels can lead to very strong increases in the market share of clean vehicles/fuels. There is abundant evidence on this matter from real life experiences such as the price differential between different fuel qualities. The intuition underlying this result is clear: if the only difference between two products is their "environmental" performance, then people will be very sensitive to price differences.

Figures A.1 and A.2 show substitution towards cleaner fuel due to tax differentiation in Sweden as reported in Chapter 6, Box 6.1. The tax differentiation for diesel fuel was introduced in 1991, increased in 1992 and 1993, and abolished for all non-transport sectors in mid 1994 : the effects of price changes can easily be seen in the market reactions. The tax reduction of 0.03 ECU/L for Class II (relatively clean) and 0.05 ECU/L for Class I (very clean) led to a price differentiation compared to the standard fuel of -4.3% (Class II) and -7.6% (Class I) in November 1995. Of the diesel fuel used in transport (66% of total consumption) almost 100% is of environmental class I or II. Tax differentiation between leaded and unleaded fuels has been in use since 1986. From 1994 unleaded petrol has been differentiated into Environmental Class II (very clean) and Class III (clean) with a differentness in taxation equivalent to less then 1% of the total price. Since its introduction in 1994, the tax differentiation has completely forced both leaded and Class III fuel out of the market.

Fig A.1 Substitution in the Swedish Diesel market 1992 - 1995

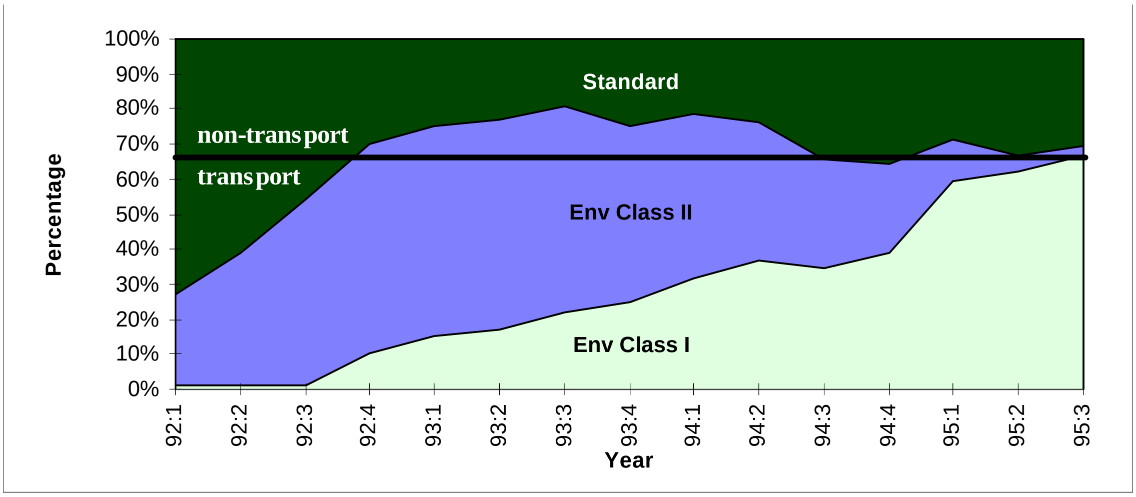
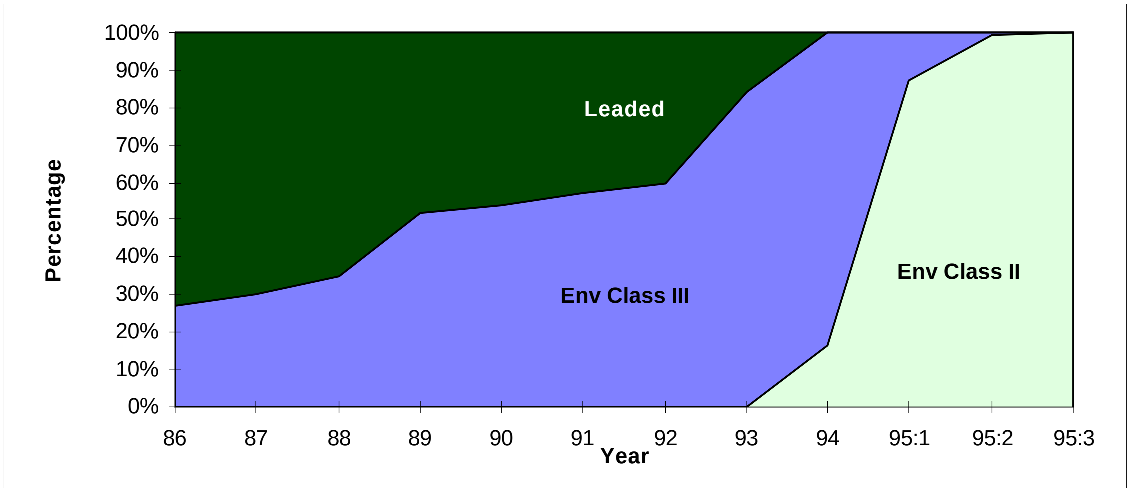


Fig A.2 Substitution in the Swedish Petrol market 1986 - 1985



Similar effects can be recalled regarding substitution between vehicle types. Generally, the smaller the differences between vehicle categories, the larger the substitution elasticities. Econometric evidence suggests that for most classifications of vehicle categories these elasticities are well above 1 in the long run. This can also be observed when comparing the market share of different size categories in the vehicle fleet with the differences in taxation levels across the fleet: the relatively small share of cars with large motor content in Italy is strongly related to the relatively very high taxes on these vehicles.

<u>Fuel price elasticities</u>: For car use, all available evidence suggests an increasing elasticity over time. The long term elasticity is in the order of twice as high as the short non-elasticity. An increase in the fuel price of 10% will, after a couple of years, reduce traffic by 3%. A comprehensive summary of fuel price elasticities (Goodwin 1992) suggests that traffic volume elasticities with respect to fuel prices are -0.16 in the short run and -0.33 in the long run.

The short run elasticity on fuel consumption is most probably around -0.30 and, in the long run, around -0.70. The changed fuel consumption can be divided into the effect on traffic and increased fuel efficiency of the vehicle fleet. Elasticities of fleet size and type with respect to fuel cost seems to have a central value around -0.2. The evidence above suggests that there are behavioural adaption, both in short and long run, that effect fuel consumption more than traffic when the fuel price is changed. An example of the dynamic effects of an increased fuel price can be illustrated with the following summary of elasticities (Jansson)

Tab. A.1 Fuel price elasticities in short and long run.

	Month	Year	5th Year
Car ownership	0.00	- 0.05	- 0.10
Trip length	- 0.10	- 0.15	- 0.20
Vehicle kilometre	- 0.10	- 0.20	- 0.30
Fuel consump. per vehicle	- 0.10	- 0.10	- 0.40
Total fuel consumption	- 0.20	- 0.30	- 0.70

An important implication of these results is that changes in fuel prices are much more effective in reducing fuel use than in curbing congestion.

Road pricing: The fuel cost is only a small proportion of the users total transport cost; in transport the idea of generalised cost is used to describe the user's total costs, mainly vehicle operating costs including fuel cost and time cost. The fuel cost can be estimated at around 25% of the user's total cost which means that the elasticity based on total cost should be much higher. The elasticity depends on the time period, trip purpose, method of charging, the absolute level of price change and the income level. When analysing the different trip purposes, it is generally found that, the elasticity is lowest for business trips, higher for commuting to work and highest for shopping and leisure trips. Empirical evidence from toll-roads suggest that elasticity of around -1.0 seems to be a reasonable central estimate.

From a Norwegian study (Tretwik, T. "Inferring variations in value of time from toll route diversion behaviour", TRR 1395, 1993) some conclusion can be drawn on toll elasticities in Norway. The frequent traveller has a high elasticity, -0.87 for daily travellers and -0.77 for weekly travellers, compared to the casual traveller, -0.3. The method of payment has a large influence on the elasticity, users with a "card ticket" have half the elasticity of the users paying for cash. Finally the elasticity can be divided between trip purpose, commuting -1.1, business -0.6 and other trips -1.2. The average toll elasticity seems to be around -0.8 in the study.

The importance of the price structure has been emphasised in a study for the planned Stockholm road pricing scheme and Ring road investment package. The construction of the ring road is estimated to reduce traffic in central Stockholm by some 17%. If a toll ring is placed immediately inside the Ring road (F1) then traffic will decrease by an additional 10%. A larger reduction can be achieved if a charge is included for driving between districts within the Stockholm area (F2). If also the ring road is included in the pricing structure the cost to the road users will increase while the traffic would only diminish slightly (F3). If the toll ring is placed outside the ring road (F4), the same amount of money can be raised but the traffic reduction would be less. Collecting the fees on only the new road sections (F5) would increase rather than reduce the traffic. A doubling of the toll charge would increase the traffic reduction by 30 - 40%. Finally, a more differentiated pricing system is estimated to reduce traffic by the same amount as the double toll, while the revenues, and the cost to the road users, will be reduced by 50% (Johansson, B. and Mattson, L-G 1995).

Tab. A.1. Estimated effect of different pricing schemes in Stockholm

Pricing Scheme	Traffic volume	Toll revenues (thSEK/ hour)	Pricing Scheme	Traffic volume	Toll revenues (thSEK/ hour)
F1	- 25%	200	F2 Double	- 45%	450
F2	- 35%	250	F3 Double	- 45%	600
F3	- 35%	350	F4 Double	- 35%	600
F4	- 25%	350	F6	- 40%	300
F5	- 7%	100			

Annex 2 : The monetary valuation of external costs

In order to implement policy initiatives aimed at the internalisation of the external costs of transport it is necessary to assign a monetary value to such external costs. A number of different evaluation methods have been used in the past, providing a range of empirical estimates concerning the external costs of transport. It may therefore be useful to briefly discuss the main options and their respective advantages and disadvantages.

The starting point for a discussion on valuation has to be a definition of what is understood by "economic value". In a market economy, we tend to value goods and services according to their market value. Thus, the value of a car, for example, is the price one has to pay for purchasing it (or how much one receives on selling it). This market price reflects what consumers (or producers) are willing to pay, i.e. "what it is worth to them". Observing market prices is therefore a very convenient way to determine the economic value. However, there are rarely markets for cleaner air or a reduction in noise levels. This is what makes the monetary valuation of external costs so difficult. It is exactly because external costs are not properly reflected in market prices that we have difficulties in identifying their size in monetary terms.

Economists have developed and widely used a number of different approaches to overcome this problem of a lack of observable market transactions. In doing so, they tried, either to infer information from existing markets and transfer it to the externality in question or, to rely on alternative methods for directly identifying peoples' preferences. The main methods applied to the measurement of the external costs of transport in the literature can be summarised as follows.

Damage function/dose-response approach: With this method, no attempt is made to directly measure peoples' preferences. Instead, a "dose-response" relationship is taken as the basis and a relationship is established, based on scientific knowledge, between the observable environmental pressure (e.g. particulate emissions or noise) and the observable impact (e.g. in terms of increased morbidity or mortality). It is only with respect to the latter that a monetary valuation is attempted. This method is appealing due to its reliance on established scientific knowledge. However, the monetary valuation is limited to the costs that are visible in the market (hospital costs, labour productivity, etc.). Thus, this approach has the important disadvantage of being unable to provide an answer on the question of how much people would be willing to spend in order to reduce the risk of damage in the case of scientific uncertainty (precautionary approach). In practice, a damage function approach can therefore often be expected to underestimate the welfare costs of a given externality. On the other hand, it may be particularly suitable in cases where people are unaware of a certain dose-response relationship and would therefore probably not have well established preferences.

Avoidance costs approach: This frequently used technique takes the costs of measures to reduce transport externalities as an approximation for the value of the externality. The logic behind this approach is that, in a Parliamentary democracy, people express their preferences not only on the market, but also during elections. Thus, if a tighter environmental norm has been adopted, this reflects the fact that, via their elected representatives, the electorate has expressed its preferences.

The main advantage of this approach is that avoidance costs are comparatively easy to establish, as the costs of end-of-pipe technologies (like catalytic converters) or other defensive expenditure (e.g. double glazing for sound-proofing) are usually well known. The main disadvantages of this approach are twofold. Firstly, and most importantly, there is the risk of a circular reasoning when one would like to establish policy priorities in the first place. In fact, one cannot undertake an *ex ante* cost/benefit analysis of alternative policy proposals if the benefits can only be inferred *ex post* after the political decision has been taken. Secondly, due to the characteristics of the political processes in a democratic system, not only will there be a time lag between a change in people's preferences and a change in political decisions, but the political process will normally only capture preferences in an aggregate way ("more environmental quality" rather than "reduction in particulate emissions by 40%").

Hedonic pricing approaches: This approach looks for a market on which goods or factors of production are traded and observes how environmental attributes affect the market prices (so-called surrogate markets). The most frequent forms of hedonic pricing use observed property values (e.g. house prices) or wage rates for estimating the monetary value of external costs. This method has often been applied to estimate the costs of traffic noise, the underlying logic being straightforward. As people prefer not to live near a noisy road or airport, house prices tend to be somewhat lower than they would have been in the same location without the noise. The comparison of house prices between a location with noise and one with otherwise identical or at least similar characteristics but without noise therefore provides an implicit valuation of the economic costs of noise. Clearly, the hedonic price method can only reveal the costs of impacts people are aware of. Moreover, it assumes the existence of smooth, continuous trade-off possibilities among all characteristics. These and other reasons would suggest that hedonic pricing will often tend to underestimate the size of the external costs in question. There are other measures (such as the travel cost method) which adopt a methodology similar to hedonic pricing, but are less applicable to the specific problem of transport-related externalities.

Contingent valuation/stated preferences approach: Conceptually, this approach is the closest to what, from the economic point of view, one would ideally like to have - namely an expression of preferences in monetary terms on a market. In a nutshell, this method usually relies on interviews or written questionnaires for quantifying how much citizens feel their well-being is being reduced by exposure to a given amount of externality. In such comprehensive willingness-to-pay (WTP) studies, individuals would be asked how much they would be willing to pay in order to no longer be the victim of a certain level of externality (e.g. traffic noise). Analogously, in or willingness-to-accept (WTA) studies, people are asked how much financial compensation they would require due to a deterioration in their environment in order to be as well off as before. Both approaches do not necessarily arrive at the same monetary value. Which of the two methods should be applied in a particular case largely depends on the role of existing property rights in the case of the problem being studied. If one considers that people have the right to a clean, quiet and safe environment, then it would be appropriate to compensate those being affected by a deterioration in the quality of the environment resulting from the behaviour of others. In this case, willingness-to-accept would be the more appropriate approach. If, on the other hand, the environment is already damaged and the policy question is by how much the pressure on the environment should be reduced, willingness-to-pay seems to be the more adequate methodology. One important point to keep in mind is that willingness-to-pay depends on ability-to-pay (e.g. income), which is less so in the case of willingness-to-accept.

The choice of the method of valuation can have a significant impact on the results in terms of the size of the monetary value. Generally speaking, contingent valuation/stated preferences studies tend to arrive at higher monetary values for external costs than alternative approaches. This is due to the fact that many more components of the economic value are included than for the case of other methods. This can best be explained with the help of an example. Most countries use monetary values for a statistical life in order to economically evaluate traffic safety measures. However, the official valuation varies significantly between countries. It is interesting to see that those countries where the economic valuation adopts a comprehensive willingness-to-pay approach including, for example, the pain and suffering of relatives, tend to use monetary values that are more than twice those of countries that limit their approach to easily measurable items like physical damage and value of the production lost. In fact, countries relying on the willingness-to-pay approach value a fatal traffic accident on average at around 1.3 million ECU. If there were something like a "market for traffic safety", the "market price" would most likely be close to this comprehensive value, i.e. including quality of life aspects.

One of the disadvantages of willingness-to-pay or willingness-to-accept studies is that, due to the necessary field work, they tend to be comparatively more costly to undertake than studies based on other valuation methods. Attempts are therefore often made to transfer benefit estimates from one study or location to another. Furthermore, the interviews/questionnaires have to be carefully designed in order to minimise strategic answering behaviour and other differences between stated and "true" preferences.

Despite these and other shortcomings, contingent valuation is, from the economic point of view, often likely to be the most desirable method for valuing external costs or benefits due to its comprehensiveness and direct, preference-based approach. It is also likely to be the only approach that could, in principle, allow the value people attach to the mere existence of rare environmental assets or to the option of using such assets in the future to be measured in monetary terms. Its validity is by now generally accepted (see the conclusions of an expert panel of eminent economists recently set up by the US National Oceanic and Atmospheric Administration, NOAA) and guidelines for its use have been established.

Annex 3 : Criteria for selecting policy instruments to curb transport externalities

Effectiveness : It is clear that any policy instrument should reach its intended objective of reducing a specific transport externality. There can be significant differences in the degree of certainty with which alternative instruments are likely to reach their target. It has to be emphasized, however, that a high degree of effectiveness in precisely reaching a target is not always an asset. In particular, when there is a high degree of uncertainty concerning the actual costs of reaching the target, effective instruments will increase the economic penalty of not having chosen the right target. In such a situation, it may be preferable to choose an approach that puts more emphasis on keeping the costs of the policy under control than on precisely reaching the target.

The Principle of Welfare Costs

The principle of welfare costs is fairly straightforward. Individual citizens feel that the more they can live according to their individual preferences, the larger is their well-being. Whenever the Government overrules these preferences (for example by introducing traffic bans) this represents a "cost" in terms of well-being to the individual (which has of course to be compared to the benefits of this policy intervention, e.g. in terms of reduced accidents). This cost can be measured in monetary terms by the monetary compensation an individual would require in order to feel as well-off as before the government intervention; the concept of welfare costs is the basis of the use of the willingness-to-pay approaches discussed in section 2.4.

Cost-effectiveness : Cost-effectiveness is a key criterion which suggests selecting an instrument that is able to reach a predefined target at least cost. In this context, it is crucial to have a comprehensive notion of "costs". Often, costs are understood to be merely the costs of technologies (e.g. a catalytic converter). It should be clear, though, that there are many policies where the technology costs only represent a small or even negligible part of the true costs to society. This means that the only economically valid cost concept is total welfare costs (see box above). It goes without saying that this comprehensive cost concept also includes administrative and transaction costs. In particular the latter can be quite important. It is this welfare cost that is the true economic cost of a policy intervention.

Static and Dynamic Cost Effectiveness

The difference between static and dynamic cost effectiveness can easily be illustrated for the case of product standards. Assume, for example, that the government introduces emission standards for car engines and power stations. Static cost-effectiveness would in this case require the additional cost of saving one unit of emissions from a more environmental friendly power station is equal to the cost of saving this unit emission from a more environmental friendly car. Dynamic cost-effectiveness requires that this is not only the case at the point in time when the product standards are decided upon, but during the entire period that the standards are binding. This would imply among other things that both standards are permanently adapted to technical progress. It is clear that, in the case of the example chosen, neither static nor dynamic cost-effectiveness is likely to be given. It is precisely one of the key advantages of market-based policy instruments that they are more likely to guarantee static and dynamic cost-effectiveness.

Transparency : Externalities seem to be one of the most important areas where governmental interventions are justified and strongly needed to achieve an efficient economy. To assure that the interventions are justified, understood and accepted it is important that the necessary interventions are transparent. Simple instruments should be favoured as much as possible.

Distributional equity : Considerations of fairness should play a major role in devising efficient and equitable policies. It should be avoided that those who are least able to shoulder the consequences of a policy are hit hardest. However, sometimes, distributional effects are misused in the public policy debate. For example, equity considerations need not be an argument against introducing cost-effective policies, but rather suggest that additional measures should be introduced. This is because the efficiency gains from choosing a cost-effective instrument over an inefficient instrument can be used to compensate those who are faced with an unfair burden due to the policy and still make society as a whole better off. For example, if it were found that a certain policy had especially adverse impacts on poor households, then compensation could be found through lower income taxes or housing subsidies. If it were very difficult to devise sufficient additional measures, then, of course, the formulation of the transport policy itself could be modified to reduce negative distributional impacts. Moreover, any assessment of the distributional incidence of policies should also take account of the distribution of the overall benefits of a policy. It is indeed often the poor who suffer particularly from the external costs of transport (bad air quality, noise etc.).

Subsidiarity : It is only common sense to require that, in the Union, each level of government should deal with those issues it is most qualified to deal with. Put differently, legal competencies should only be allocated to a "higher" level of government, if it is better suited to solve the problems than the lower level authorities. In the European Union, this principle (subsidiarity) is enshrined in the Treaty (Art. 3b). It is important to stress that in all cases the need for Community intervention has to be convincingly demonstrated, rather than merely claimed.

Spill-overs/secondary benefits : Any policy intervention to correct a specific transport externality is likely to impact also on other externalities or policies. These so-called spill-overs can be either positive or negative. The catalytic converter, for example, significantly reduces conventional vehicle emissions, but also raises carbon dioxide emissions. On the other hand, carbon taxes not only reduce CO_2 emissions, but simultaneously also reduce conventional emissions. It is clear that such linkages have to be included in the evaluation of alternative policies.

Annex 4 : Electronic fee collection systems

Many European countries are considering the use of Electronic Fee Collection (EFC) for the payment of transport services. The main focus of the new technology is on Road Tolling, but there is also interest in urban road pricing (congestion charging), public transport and other related services.

Introduction on existing toll roads (basically, single lane introduction): EFC is currently feasible and operational in Europe under certain conditions. Specific lanes at existing Motorway Toll Stations have been designated for automatic (non-stop) payment by vehicles fitted with the necessary electronic equipment. Vehicle speeds are limited by the physical restrictions of the entry lane to ensure sufficient time for the electronic transaction. Systems can be designed to stop vehicles at the toll station if the transaction fails for any reason.

Multi-lane EFC introduction: Several European countries are interested in using EFC technology to implement tolling on existing roads without toll barriers. This means that the equipment is required to be able to handle high speeds and multi-lane operation. Multi-lane operation means that no restrictions are placed on the position of vehicles at toll stations. While the tolling transaction has been demonstrated to work under these circumstances, there are still technical problems to be overcome before fully automatic high speed tolling systems are available for widespread commercial use. There are no such systems operating in Europe at present. It is therefore difficult to estimate their costs for the moment.

Technologies being proposed for EFC: There are three main technologies being proposed for EFC : Microwave, Infrared and GSM/GPS. Microwaves and Infrared technologies are similar. Both technologies have been included in the German and UK tolling trials. Microwaves are electromagnetic waves with wavelengths in the range 1mm-1m, corresponding to frequencies of 0.3-100Ghz. A 5.8Ghz standard has been proposed for roadside-vehicle microwave transmission and most European systems are being designed to this standard. It is expected that systems in the future will be developed to use new standards based on 63Ghz. Microwaves will penetrate non-metallic and non-transparent materials, including accumulated dirt and snow to a depth of 1-10cm. Infrared uses higher frequencies than microwave. It is more susceptible to absorbtion in bad weather and the penetration is generally less than 1cm. However, it may be cheaper to implement.

The third technology being proposed for use in EFC is GSM/GPS. GSM is the European cellular telephone system and GPS is Global Positional System. Such systems work without the need for road-based infrastructure. Vehicles establish their location by means of the GPS. Positional accuracy to within 100m is straightforward and would probably be sufficient, although further refinement down to 10 metres is possible at additional cost. The higher specification systems are referred to as Differential GPS (DGPS). The on-board equipment would need to include a simple digital map to determine whether the vehicle was in a tolled zone. Information would be stored within the vehicle and transmitted by GSM when convenient for processing centrally. This technology is highly flexible and could apply to both inter-urban and urban situations, or even a system based on mileage travelled, such as that proposed for Switzerland. However, existing operators are concerned about the potential loss of revenue through failures and the difficulty of enforcement without roadside infrastructure. The cost structure of GSM/GPS systems is quite different from all the other systems and will need to be demonstrated in practice to show that such systems are cost effective.

Exception handling: The technical problems focus on the exception handling. The detection (localisation) and identification of vehicles which do not complete the tolling transaction successfully is still difficult. There is a consensus on the use of video cameras for exception handling, but the identification of number plates is not yet reliable.

Vehicle Classification: Related to this is the issue of automatic vehicle classification. Tolls are invariably related to vehicle characteristics and operators are, therefore, required to check that the declared vehicle characteristics are accurate. This is straightforward if the toll stations are staffed and manual checks are possible. For this reason, traditional toll operators tend to rely on physical characteristics - eg height, length and number of axles. These can also be measured automatically at the toll station using sensors under the road or mounted on the toll station.

Most multi-lane high speed toll systems are based on gantries over the road. It is impossible to measure and confirm physical characteristics in these circumstances. This raises the need for other means of checking the classification. One possibility is a fixed electronic tag containing fixed vehicle characteristics which could be interrogated remotely for enforcement purposes. If such tags were to be used, the vehicle characteristics could be extended to include more than the visual characteristics, such as axle loading and fuel type. Extending this further, it might at some stage be possible to include dynamic parameters, such as the actual weight. Although it would be desirable to be able to measure emissions dynamically, it is unlikely that this will be feasible in the foreseeable future. There is no agreed vehicle classification system within Europe.

Transaction processing: One of the main problems associated with the roadside-vehicle link is the short time available to complete the transaction. The bandwidth currently available (10MHz) at 5.8Ghz is considered too narrow to be capable of ensuring complete accuracy in busy multilane situations. Some compromises are necessary and central account processing is particularly difficult within a single transaction. However, a possible extension of the currently available bandwidth of 10MHz should not be excluded. If such an extension were to be established, it would remove some of the basic technical design limitations important for the development of multi-lane EFCs.

Legal and institutional problems: Countries who wish to introduce tolling on existing toll-free roads will face legal and institutional problems. The technical difficulties associated with the equipment and its introduction make the prospect far from straightforward. The considerable uncertainties surrounding the introduction of EFC and consequential risks to industry make this area particularly difficult to predict.

Problems related to financial institutions: Financial institutions are rapidly exploiting technologies for electronic payment. The contractual arrangements for the payment and distribution of revenues between operators will depend greatly on the role which the financial institutions establish for electronic money.

Enforcement across internal European borders : At present it is not necessary to enforce payment of tolls across European borders. However, EFC systems will introduce the requirement to do this and there will be resulting requirements for agreements to ensure that the systems will work in a European context. Technical standards for European electronic number plates would be required, if these were to be used for automatic enforcement.

Interoperability: The key issue, either raising or exacerbating the above mentioned problem areas, is the need to ensure the interoperability of multi-lane EFC systems for motorway tolling planned for introduction in different EU countries. Interoperability is a fundamental requirement on which R&D work is focusing, through a number of projects (CARD-ME, MOVE-IT, VASCO etc) at European level included in the 3rd and 4th Research Framework Programme. The development of road pricing (congestion pricing) EFC systems for use in urban situations is seen as a second priority (subordinate) activity in view of the fact that interoperability between such systems and EFC motorway tolling systems is certainly highly desirable, but can only come after the problem of interoperability among motorway tolling systems across the EU has been successfully resolved.

Annex 5 : Road expenditure, taxation and damage costs

Table 5.1 : Expenditure on roads and Revenue from vehicle and fuel taxes and tolls (MECU)

MEMBER STATE	EXPENDITURE ON ROADS	REVENUE FROM GOODS TRANSPORT vehicle, fuel taxes and tolls	TOTAL TRANSPORT REVENUE vehicle, fuel taxes and tolls
Belgium	1 290 (1994)	691 (1994)	3 916 (1994)
Denmark	806 (1989)	183 (1990)	1 434 (1990)
Germany	15 000 (1994)	9 577 (1994)	38 304 (1994)
Greece	423 (1988)	-	1 331 (1989)
Spain	3 380 (1989)	1 613 (1989)	4 824 (1989)
France	11 441 (1986)	5 475* (1989)	18 642 (1989)
Ireland	406 (1989)	210 (1988)	953 (1988)
Italy	-	-	-
Luxembourg	143 (1988)	-	146 (1989)
Netherlands	2 953 (1989)	582 (1989)	3 417 (1989)
Austria	1 374 (1994)	843 (1994)	3 506 (1994)
Portugal	749 (1989)	39 (1987)	902 (1989)
Finland			
Sweden			
United Kingdom	8 298 (1994)	3 482 (1994)	23 152 (1994)

Source: Information supplied by Member States directly to the Commission.

If it is assumed that the expenditure and tax figures in Table 5.1 are stable over time, then total road expenditure in the early nineties in EU-13 (the Union excluding Italy, Finland and Sweden) can be estimated at some 1.0% of GDP and total tax revenues from road users at approximately 2.0% of GDP.

If these percentages also hold for Italy, Finland and Sweden, then the excess of road taxation over infrastructure expenditure can be roughly put at some 65 BECU for the Union as a whole.

Table 5.2 : Calculation of relative damage factors

Based on standard axle load of currently used vehicles and vehicle combinations of 10 tonnes. Weight distribution over the axles is according to the limits of Directive 85/3/EC (as amended) and under the assumption of an ideal distribution. In reality, loading will be less ideal, overloaded axles will occur and damage will be greater.

Vehicle Type		Damage factor per vehicle	Damage factor per 10 tonne
Two axle motor vehicle with three axle trailer (40t)		2.94	0.74
Three axle motor vehicle with two axle trailer (double-drive axles) (40t)		2.75	0.69
Three axle motor vehicle with three axle trailer (40t)		1.21	0.30
Three axle motor vehicle with three axle trailer (44t)		2.08	0.47
Road trains with four axles consisting of a two axle motor vehicle and a two axle trailer (36t)		2.99	0.83
Two axle motor vehicle (18t)		1.70	0.94
Three axle motor vehicle (25t)		1.65	0.66
Three axle motor vehicle with air suspension (26t)		1.99	0.76
Passenger car		0.0001	-

Annex 6 : Road accident statistics
Selected Risk Values for the Year 1993 (with exception of footnotes (1), (2), (3) and (4))

	n° Killed	Killed per 10^9 pass. kms	Killed per GNP	Killed per 10^3 ECU GNP per capita	KILLED PER 100 000 POPULATION						
					Total	0-14 years	15-24 years	25-64 years	65 years and more	OUTSIDE URBAN AREAS	MOTOR WAYS
B	1660	18	10	11	16.5	3.4	31.4	16.6	17.9	-	9.4
DK	559	8	5	6	10.8	3.6	15.8	8.8	21.2	17.3	3.5
D	9949	12	7	7	12.3	3.4	26.9	11.4	13.2	-	6.4
GR	2249	118	37	37	20.4	3.8	32.2	20.6	26.0	-	-
E	6378	27	14	20	16.3	3.9	25.3	17.3	15.4	-	-
F	9568	14	9	10	16.6	3.7	31.3	16.9	18.7	-	8.1
IRL	431	-	11	12	12.1	4.0	20.3	10.8	17.6	13.2	-
I	7110	10	8	8	12.6	2.3	20.50	10.9	15.7	-	11.9(2)
L	76		10	10	19.2	10.0	43.7	16.7	20.8	-	-
NL	1252	8	5	5	8.2	3.2	13.9	6.5	16.0	10.9	3.1
A	1437	21	10	12	16.2	3.8	32.8	14.8	20.3	30.7(3)	11.2
P	2727	31	37	44	32.9(1)	9.5(1)	51.8(1)	32.8(1)	39.0(1)	-	39.3(4)
FIN	484	8	5	6	9.6	3.1	15.3	8.7	17.0	13.0	1.7
S	632	6	3	4	7.3	1.6	10.6	6.7	12.4	-	-
UK	3957	6	5	6	6.8	2.5	11.8	5.9	10.8	10.0(1)	3.1

Source : Statistics supplied by Member States for DG VII / ECMT/ UN

(1) based on 1992 figures (2) based on 1991 figures
(3) based on 1988 figures (4) based on 1989 figures

Annex 7 : External accident costs

Studies show that the transport user is "willing to pay" a higher cost to reduce the risk in traffic than the "hard" costs discussed in Chapter 5 (i.e. health care, lost consumption etc.). Some Member States have introduced a "risk value" component in the accident evaluations for cost-benefit assessments. Using these studies, we can conclude that road users could have a willingness to pay of over 100 Billion ECU in order to reduce all the accidents in the Union during one year. Thus, taking into account the total costs associated with injury causing road accidents alone - ie. the costs of medical care, the individual's replacement and/or reintegration into society and the workplace, production losses, the valuation of risk reduction - society as whole seems to have a willingness-to-pay to reduce all the accidents in the Union of some 150 Billion ECU p.a. Fatalities constitute 36% of the total cost and severe injuries 45%. Not all of these costs are however external.

It is not straightforward to determine which part of these costs are not taken into account by individual transport users (and are "external") and should, therefore, be imputed to them. Some costs of accidents - such as material damage - are paid through the insurance system, reflected in premiums and are therefore already internalised.

At the same time it is clear that a significant part of the hard costs (i.e. lost production) are fully external. Studies also suggest that the accident costs of pedestrians and cyclists are mostly external. But determining which part of the "human grief" costs of killed and injured motorists are external requires information on the extent to which increases in traffic levels raise accident risks. The stronger this relation is, the higher are the external costs, because making an additional trip would lead to a significant increase in accident rates for all other road users. In the absence of detailed studies on this matter, the external part could probably be put at, at least, half of the total "human value" costs. This would suggest an external cost of some 1.5% of GDP in the Union, given that total costs amount to some 2.5% of GDP. More research on this matter is, however, needed.

Annex 8 : Leverage points for reducing air pollutant emissions from road transport

VEHICLE AND FUEL CHARACTERISTICS	
1. Fuel type	Fuel quality influences the emission factors (grams/litre) of pollutants such as the lead or benzene content in gasoline or the sulphur content in diesel
2. Fuel efficiency (litres per kilometre)	Lower fuel consumption per kilometre reduces global climate change directly. Diesel vehicles are more fuel efficient than gasoline vehicles but diesel fuel has a higher carbon content than gasoline. The impact of fuel efficiency per kilometre on other forms of pollution is unclear and probably very small
3. *Emission controls (vehicle technology)*	Other things equal, vehicles equipped with emission controls (e.g. catalytic converter, particulates trap, exhaust gas recirculation) have substantially lower emission factors than vehicles without emission controls.
4. *Age*	Other things equal, older vehicles tend to have higher emission factors than new vehicles due to the normal deterioration of the engine and the emission controls
VEHICLE OWNERSHIP AND USE	
5. Location	Pollution costs are higher in urban areas (including city access) because of the higher population density and exposure compared to non-urban (rural and intercity) areas. The exception are emissions which have the same potential impact irrespective of location (e.g. CO_2).
6. *Time of day*	Driving in peak-hour congested traffic increases the average emission factors of primary pollutants and CO_2.
7. *Speed*	Improvements in speeds reduce emission factors of CO and VOCs but can increase the emission factors of NOx.
8. *Load*	Other things equal a vehicle with a higher load emits more pollutants per kilometre than a vehicle with less load.
9. *Average trip length and annual distance driven*	Cold-start emissions per kilometre are much higher than running or evaporative emissions and thus represent a large proportion of total emissions in short trips. Other things equal, 4 trips of 5 kms each produce higher emissions than 1 trip of 20 kms. Other things equal, the more distance a vehicle is driven the more pollution it generates.
10. Size and composition of vehicle fleet	A smaller fleet will bring down emissions. A larger share of less polluting vehicles has the same effect.
11. Vehicle maintenance	Other things equal, a well maintained vehicle with a tuned up engine pollutes less than a badly maintained vehicle or a vehicle with emission controls that have been tampered with.

Annex 9

Internalisation applied to NOx Emissions from Cars. The cost-effectiveness of different fiscal instruments

A least-cost approach to reducing NOx emissions should explore as many leverage points as possible (see Annex 8). The results of a simulation exercise recently undertaken within the so-called Auto Oil programme show that incentives which trigger changes in only a few of the 11 channels listed in Annex 8 are systematically less cost-effective than those that trigger reactions in a larger number of factors.

One of the most frequently cited options to reduce transport externalities is an increase in fuel excises. However, fuel excises only have a direct impact on the fuel efficiency of vehicles (which generally come at a cost) and, indirectly, reduce mileage. Fuel taxes are largely ineffective on the emission of NOx, because a vehicle's specific fuel consumption is more or less independent from its NOx emissions per kilometre. The reason why fuel taxes reduce conventional emissions slightly, is because they reduce driving. In terms of the list presented in Annex 8, the tax targets none of the factors directly, but has some effect on factors 2, 9 and 10. Overall, an increase in fuel taxes that reduces NOx emissions from vehicles by 1.5 percent, causes EU-wide welfare reductions of 25 billion ECU (in discounted costs over the period 2000-2010 and leaving aside benefits).

A somewhat better instrument for NOx reduction is simply increasing existing annual circulation taxes. Its main effect is that it induces people that drive old and therefore often highly polluting cars to scrap these vehicles. This is, because compared to the low value of old cars the tax is proportionally higher than on new cars. Although the tax is a general tax, it therefore hits hardest the group of car owners most responsible for emissions. The tax therefore influences in a major fashion factor 4 of the list, with some minor impact on factor 10. As can be seen in the table, by increasing circulation taxes, a 3 times larger NOx emission reduction can be achieved at the same cost (Minus 4.9 percent for 25 b ECU). The problem of existing circulation taxes is that they do not encourage the purchase of cleaner cars. Basing the circulation tax on a vehicle's emission factors produces a quantum leap in the scheme's effectiveness, because it induces changes in technology (it becomes attractive for manufacturers to equip vehicles with anti-pollution equipment because demand for these vehicles increases), which in the case at hand, are relatively cheap. At a cost of 25 BECU, emission reductions of 21 percent can be achieved.

Finally, emissions are obviously also a function of the annual mileage. A circulation tax that takes not only emission factors but also mileage into account, leaves people more choice in how they can reduce emissions. This system generates lower costs because the fee is tailored both to people who do not want to change their driving and buy cleaner cars and to those that want to keep a somewhat dirtier vehicle, but reduce their driving. Such a tax scheme lets people choose the optimal combination between factors 3, 4, 9, 10, and 11. Extending choice allows a 26 percent emission reduction to be achieved at the same cost. Such a fee could be implemented, for example, within the framework of an annual inspection program that checks the vehicles emissions factors and registers the driven km from the mileometer.

This tax can theoretically only be improved upon by a tax on actual emissions, which opens changes in the driving style and speed as further channels through which adjustments can take place, would make people demand low emission fuels, and change their travelling plans to avoid traffic jams, possibly avoiding also reduce driving in winter. An tax on actual emissions would add the missing factors 6 and 7 to the list of possibilities. The fees in the example were ranked such that the base for the tax increasingly approximates the externality (NOx emissions). With every step, consumers are given more options through which they can adapt to the tax incentive and pick the least cost combination. The example shows clearly that the efficiency loss of a bad proxy can be substantial. In our example, a fuel tax is a 17 times more expensive option than that of a circulation tax based on mileage and vehicle emission factors.

How much NO_x emissions reduction can be "bought" for 25 billion ECU (in discounted costs over the period 2000-2010 - excluding the value of environmental benefits)	
- Increase in fuel tax - Increase in annual vehicle tax - Restructuring of and increase in annual tax on circulation - depending on vehicle emission parameters - Restructuring of and increase in annual tax on circulation - depending on vehicle emission parameters times actual mileage driven	- 1.5% - 4.9% - 21% - 26%

Source : Commission Services. Doc II/576/95

Annex 10 : Estimates of external costs

External Costs of Transport in EU-15[a] 1991 by Type of Effect (in 1000 million ECU/a)

EFFECT	ROAD				RAIL		AVIATION		SHIP.	TOTAL	
	Cars	Buses	Motor Cycles	Freight	Pass.	Freight	Pass.	Freight	Freight	Pass.	Freight
Accidents	106	4.2	16	21	0.5	0.2	*	*	*	126	22
Noise	15	1.9	4.4	12	0.9	1.2	2.1	0.7	*	24	14
Air Pollution & Climate[b]	44	3	0.9	23	1.4	0.5	10.3	3.3	0.7	59	27
Total	164	9.1	21	56	2.8	1.8	12	4.0	0.7	209	63
EFFECT	Cars[1]	Buses[1]		Freight[2]	Pass.[1]	Freight[2]	Pass.[1]	Freight[2]	Freight[2]		
Accidents	32.3	9.4		22.2	1.9	0.9	*	*	*		
Noise	4.5	4.2		12.7	3.1	4.7	3.0	16.5	*		
Air Pollution & Climate	13.2	6.8		23.6	5	1.8	14.8	76.8	6.1		
Total	50.1	20.4		58.4	10	7.3	17.8	93.2	6.1		

Source : INFRAS/IWW (1995)

* Statistics not available
(a) Including Switzerland and Norway
(b) Including climate change
1 ECU/1000pkm
2 ECU/tonne km

Annex 11 : List of studies to be launched.

List of studies to be launched by the Commission to analyse issues discussed in this Green Paper :

- A review of possible obstacles towards a cost internalisation policy in existing Community legislation
- Measuring road infrastructure capital and maintenance costs in the European Union: methodologies, evidence and cost allocation options. Including principles for detailed accounts on transport fiscality.
- Infrastructure cost imputation for inland waterway transport.
- Railway infrastructure : cost imputation and charging.
- An electronic kilometre charge for heavy goods vehicles.
- Potential for bringing accident cost closer to the individual through insurance premiums.
- Internalising external costs in transport : consequences for industry.

In addition, many of the issues discussed in this Green Paper are already analysed in the EU's Fourth Framework Programme for Research and Development (notably the Joule, Environment and Transport Research Programmes). The results of this programme will be made available on completion of the individual research projects. The following work programme tasks in the Transport Research Programme are relevant to pricing:-

(a) Strategic Research Sector

Economics of transport systems :

Task 14: Methodologies for valuation of transport systems. (1st Call)
Task 15: Pricing of transport systems (impacts of alternative pricing policies on transport demand and modal split). (1st Call)
Task 16: Financing of infrastructure investments. (2nd Call)
Task 17: Economic impact assessment of transport sector activities on Member States' economy. (1st Call)

Developing intermodality :

Task 20: Methodology for strategic multimodal/intermodal modelling. (1st Call)
Task 21: Policy instruments for improved intermodality and optimum modal split. (1st Call)

(b) <u>Road transport sector</u>

Sustainable Mobility :

Task 1: Assessment of the socio-economic and cultural factors affecting all types of road travel demand, travel behaviour, travel patterns and cost elasticities in different Member States. (1st Call)

Task 2: Development of strategies designed to avoid the need for travel. (1st Call)

Task 3: Development of assessment tools, to evaluate the effects of TDM. strategies on accessibility, economic conditions, and the environment. (1st Call)

Task 7: 'Essential' road users: their definition, assessing their levels of demand, and devising appropriate measures to meet their needs. (1st Call)

Pricing and Financing :

Task 23: Integrated policy survey and development of policy instruments for shifting private traffic to public transport. (1st Call)

Task 24: Specification, demonstration and evaluation of integration of pricing measures (urban and suburban) to change modal split in urban areas, inc. the concept of congestion pricing and evaluation of the implication of different fee structures. (1st Call)

Task 25: Study on financing schemes for Urban Transport Systems with emphasis on the relation between real costs and their actual financial treatment. (3rd Call)

Task 26: Development of a European guide (methodology) for the evaluation of real transport costs. (3rd Call)

Task 27: Investigation of the opportunities for the private sector to contribute to the optimisation of the Urban Public Transport system. (2nd Call)