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Transport price signals

Monitoring changes in European transport prices and charging policy in the framework of TERM

European Environment Agency

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1 Background and purpose

1.1 Background

The European Environment Agency (EEA), jointly with the Commission's Directorate-General for the Environment, Directorate-General for Transport and Energy and the Statistical Office Eurostat, developed the transport and environment reporting mechanism (TERM). TERM aims to monitor progress in integrating environmental concerns into transport policy throughout Europe and comprises 40-odd indicators, which cover all relevant aspects of the transport and environment system (see Annex A for a complete list of TERM indicators and indicator groups). These indicators form the building blocks for regularly published environmental issue reports, such as TERM 2000 (EEA, 2000), TERM 2001 (EEA, 2001a) and TERM 2002 (EEA, 2002), and focus reports such as 'Road freight transport and the environment in mountainous areas' (EEA, 2001b).

One of TERM's seven indicator groups deals with transport 'price signals'. All indicators related to transport prices, charges, taxes, subsidies etc. feature in this group. Following the publication of TERM 2000, and an expert workshop on transport pricing indicators in 2001, it became apparent that this indicator group required a slight revision, to better reflect the scientific and political debate on internalisation of external costs. An alternative set of indicators was developed and used in the two succeeding TERM reports in 2001 and 2002. The most important change made to the set of indicators was the inclusion of a price *structure* element (that is, the tax- or charge-component of the transport user price or fuel price), complementing the information already available on price *levels* (that is, the actual price users pay for transport services).

After working for two years with this slightly altered set of indicators, the time has come for the next — and final — step towards a set of useful and understandable indicators dealing with transport price signals within TERM. The EEA therefore asked CE Delft to develop a technical report about indicators needed to monitor developments in transport prices and transport pricing policy, explaining in detail *why* and *how* certain indicators will support in future reporting on transport prices and transport charging policy.

1.2 Purpose of this report

The main purpose of this report is to provide the methodological description and technical background for the (revised) set of TERM indicators that optimally monitors trends in transport prices and transport charging policy.

1.3 Structure of this report

This report is structured as follows.

- Chapter 2 provides the theoretical and political background of transport prices and transport charging policy, explaining the different cost types and the role and aims of correct pricing in transport.
- Chapter 3 provides an overview of the currently used TERM indicators and an analysis of their strengths and weaknesses in monitoring trends in transport prices and transport charging policy.
- Chapter 4 focuses on the monitoring of transport charging policy and explains what indicator improvements are needed to do so in a meaningful matter.
- Chapter 5 to conclude gives a short overview of the new and complete set of price signals indicators.

1.4 Demarcation

This report takes the Commission's pricing principle 'marginal social cost pricing' as a starting point for analysis. This pricing principle is included in the White Paper 'Fair payment for infrastructure use — a phased approach to a common transport infrastructure charging framework in the EU' (EC, 1998).

The report does not aim at implementing the proposal, that is, to fully elaborate the indicator set by populating it with data. Of course, implementation aspects like data availability do play a major role in the proposal, as these determine the feasibility of actually developing indicators.

The report will cover the principal modes of transport: road, rail, air and waterway transport, for both passenger and freight transport.

Finally, it is worth noting that the pricing principles presented primarily apply to public infrastructure. Private companies will, where relevant, be more likely to charge for full infrastructure (fixed plus variable) costs for cost recovery, instead of marginal (variable) infrastructure costs for optimal pricing. In the case of public-private partnerships (PPP), the focus will probably shift to cost-recovery. If PPPs gain in importance, this could have an influence on some of the dimensions of the indicators proposed later in the report, in particular where they include information for which the currently chosen principle of marginal social cost pricing is relevant.

2 Theoretical and policy context of transport price signals

The aim of this chapter is to set the context for the discussion on transport prices and transport charging policy, by:

- presenting a graphical model that provides a simplified overview of the system of transport prices and charging policy in order to introduce terminology;
- describing in more detail the theoretical and political context of transport price signals;
- describing the indicator needs to monitor developments in transport price signals.

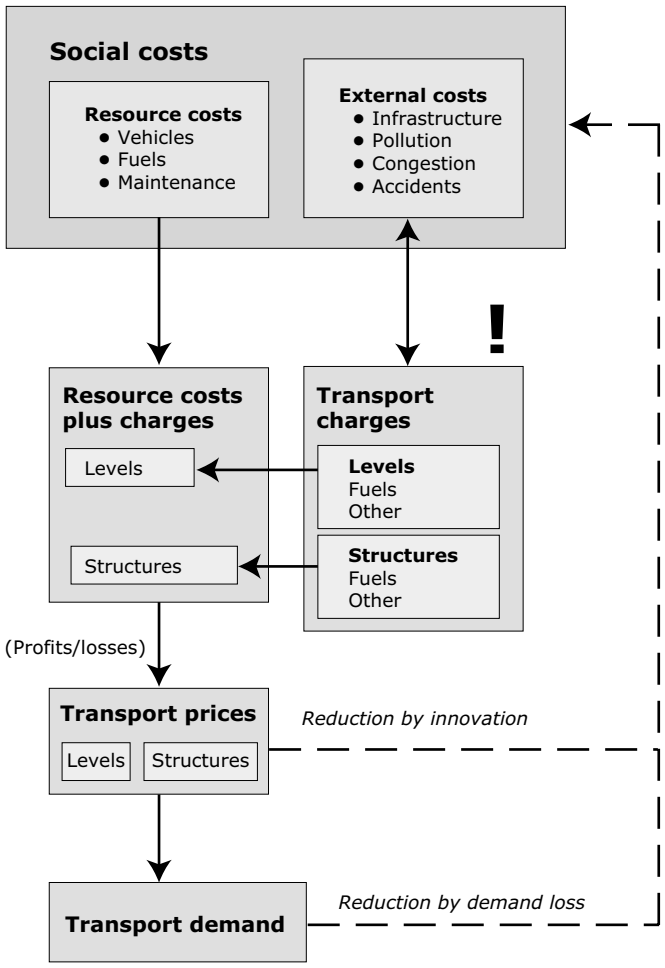
2.1 Graphic model and terminology

Transport price signals appear anywhere in the transport system, from market prices, via government taxes to tolls. The graphic model presented below provides a simplified overview of the system of transport costs, prices and charging policy. The model is further explained in the next section.

2.1.1 Explanation of the graphical model

Starting in the upper left corner, the model shows that all types of transport

Figure 2.1 Conceptual model describing the various price signals within the transport system



require investments in vehicles, maintenance of vehicles, and the purchase of fuel, which all cost money. These costs are called the *resource* costs of transport, borne by the users because they are incorporated in the prices paid. These costs are generally a result of market transactions.

The upper right corner reflects the costs of transport that are generally not or only partly borne by individual users. These are called *external costs.* They include costs of air pollution, noise, safety risks to others, infrastructure costs, and also the costs of congestion. Congestion is a special case. Taking the perspective of the transport sector as a whole, congestion costs are borne by transport users and hence are internal to the system. From an individual transport user's point of view, however, users that cause congestion are not necessarily the same as those who suffer from congestion, and hence congestion costs are at least partially external. Likewise, variable infrastructure costs are external to the user since those who cause such costs are not necessarily those who pay for it. This vision is further supported in this report, since it is in line with the supported vision on optimal pricing, for which the principle of marginal social cost pricing (see Section 2.4) forms the basis.

Resource costs and external costs together form so-called *social* costs. Social costs include *all* relevant costs to society.

Going down from the upper right corner, the government comes in with transport charges and taxes. Some are fixed, such as annual road taxes; some are use-dependent such as fuel taxes, primarily on petrol and diesel. But there are also other use-dependent taxes in place, such as tolls or the recently introduced London congestion-charging scheme. Current taxes and charges partly internalise external costs. Improved internalisation is achieved by adapting taxes and charges in two ways. By adapting charge or tax levels to bring them better in line with external costs, and by adapting charge or tax structures, for example, by making them use-dependent. Improved internalisation of external costs will result in reduced external impacts either through reduced transport demand, or via reduced effects per unit of transport service, for example, by innovation. Sections 2.3 and 2.4 further explain this.

Going to the left, a transport company (such as a road haulier or airline) will translate the resource costs it faces and the government taxes and charges imposed, into *transport prices* it charges to users, and it will incur profits or losses.

This graphical model is typically valid for transport service providers. Apart from the 'profits or losses' component, it is also relevant for individuals, using non-collective means of transport (private cars, etc.).

2.1.2 Terminology used in this report

As is already clear from the explanation of the graphical model, a correct understanding of the meaning and role of infrastructure and external costs, and of the 'marginal' concept is essential in this report. The line taken in this report is that the correct target of pricing policies is the individual user of infrastructure services, and that the correct way of pricing is that the individual user should be charged the additional (marginal) costs incurred but not paid for. Such costs include variable infrastructure costs (mainly wear and tear). They also include environmental costs, costs of accidents and costs of congestion, usually referred to as external costs. From the point of view of the individual user, variable infrastructure costs are also external costs. However, to stress that correct pricing includes these costs, the term used in the report will be 'marginal infrastructure and other external costs'.

The graphical model in the previous section and the remainder of the report use a number of other terms that are explained in Table 2.1.

Table 2.1 Terminology in this report

Transport prices	Prices users pay for transport services per unit of transport
Resource costs	Costs excluding government charges and taxes, paid for by the user
Fixed/variable costs	Fixed costs are use-independent; variable costs are use-dependent; this is particularly relevant for infrastructure costs
External costs of transport	Costs of transport not paid for by the user — generally includes costs of using infrastructure, and costs of congestion, accidents and environmental impacts
Social costs of transport	Full economic costs of transport, that is, resource costs plus external costs
Transport taxes and charges	Levies applied by the government to the transport system on top of existing costs, for example fuel taxes, vehicle purchase or ownership taxes, infrastructure charges
Transport and infrastructure charging policy	The way in which transport and the use of infrastructure are being charged by the government

2.2 Two dimensions of transport price signals

Prices are a main factor in a market economy. Prices of the various transport services, and their development both through time and vis-à-vis other economic parameters, such as income and general price developments (inflation), have an impact on the demand for transport services. Hence, prices as such, regardless of their composition, are important market signals. Their composition matters, however, or rather the way government charges and taxes reflect external costs in the preferred way. From this, two basically different dimensions of price signals appear:

- price signals related to transport prices;
- price signals related to transport charging policy.

Both the overall price signals and the part related to charging policies are relevant from an environmental point of view, and hence to monitor both types of price signals with indicators in the context of TERM.

2.3 Dimension 1 — changes in transport prices

Transport prices have an impact on transport demand and modal split, via so-called price elasticities. After all, when the price of transport decreases, it becomes cheaper to travel, and — given a certain budget available for travelling — allows for more travelling. If such a development only affects some transport modes (such as air and road transport), it will affect the attractiveness of these modes, and thus (again through price elasticities) the modal split. Transport demand and modal split are, in turn, important determinants of the transport sector's impact on the environment. This effect is indicated by the outer loop of Figure 2.1 'Reduction by demand loss'.

Indicators aimed at monitoring the effects of price signals on transport demand and modal split should help to answer the following key question:

> How are transport prices by mode evolving and what is the impact of that on transport demand?

2.4 Dimension 2 — changes in transport charging policy

Transport charging policy is the second dimension of price signals in the transport system. This section focuses on this second dimension — describing the possible aims of transport charging policy and the importance of not only knowing *how much* is charged (charge levels), but also *how* transport users are charged (charge structures) — and

ends with formulating the key question of how to address transport charging policy with indicators.

2.4.1 *Possible aims of transport charging policy*

Charging transport is not an aim in itself; it is done for a variety of purposes:

- for *fiscal* purposes: to achieve a certain contribution of the transport sector to fiscal revenues, in this case the levies are usually called taxes instead of charges;
- for *business* purposes: to cover the costs of (and possibly make a profit on) certain pieces of privately-owned infrastructure;
- for *cost-recovery* purposes: to make the transport sector as a whole pay for its infrastructure costs, environmental and safety costs, or to create a level playing field between sectors or States;
- for *efficiency* purposes (maximise socioeconomic welfare): by charging individual users for the extra costs they impose on others with their transport decisions (infrastructure, environment, safety).

Most transport charging strategies applied in the past and present are more or less a mixture of the four purposes, albeit the emphasis varies case by case, and gradually shifts in time. Originally, fiscal and/or business purposes were the most important reasons for transport pricing. With the increasing complexity of the transport system and the increasing tax burden on the sector, the equity issue (fair treatment of competing transport modes, infrastructure cost coverage) became more dominant. Over the last decade, transport charging has gained momentum as a means of increasing socioeconomic welfare, by reducing some negative impacts of transport, such as congestion, pollution, and safety risks, and the absence of payment for variable infrastructure costs, whilst respecting the benefits that users get from transport. In the event of an increasing number of public–private partnerships, cost-recovery will become more important again.

In this report, the fourth aim of transport pricing policy is the guiding principle: *to maximise socioeconomic welfare*, that is, reduce negative impacts of transport whilst respecting its benefits. Most recently published EU transport policy documents implicitly or explicitly do so (see ANNEX C — History of EU transport charging policy for details) and formulate the other purposes (fiscal, business and equity) more or less in terms of boundary conditions, as follows.

- The Commission's 1995 Green Paper on 'Fair and efficient pricing in transport' (European Commission, 1995) announced that *'infrastructure charging policy should, in principle, aim at full cost recovery, covering both capital costs (and not current expenditures) and operating costs'.*
- The Commission's 1998 White Paper on 'Fair payment for infrastructure use' (European Commission, 1998) introduced the so-called *marginal social cost* (MSC) ([1]) pricing as the leading principle for Europe's transport charging policy. The recovery of infrastructure cost was no longer an aim in itself, but was presented as a likely consequence of the MSC pricing strategy.
- The Commission's 2001 White Paper on the 'European transport policy for 2010' (European Commission, 2001) did not explicitly mention marginal social cost pricing as the leading principle, but it also did not explicitly change its strategy towards transport pricing.
- The recently proposed directive for road infrastructure charging (European Commission, 2003) would allow Member States to base their average charge levels on full infrastructure costs (excluding construction-related costs that have

([1]) MSC means marginal infrastructure and other external costs, where 'marginal costs' refers to the additional costs of one extra unit of mobility, one extra vehicle, vessel or aircraft kilometre.

already been covered) and external accident costs, and to differentiate these average levels on the basis of the number of axles, axle loads, engine Euro-class, time of day/level of congestion, environmental sensitivity, population density and accident risk. This proposal addresses only transport with heavy goods vehicles on main itineraries, that is, freight transport on all motorways that are part of the trans-European transport network and on trunk roads. The charge rates according to this proposal might deviate in level from charges calculated exactly following the principle of marginal social cost pricing. The differentiation options in the proposal accommodate a charging structure that fully reflects differences in categories of heavy goods vehicles and their external impacts.

- The European Parliament underlines the main principles of transport pricing policy as proposed by the Commission, but does not specifically favour *marginal cost* pricing (given the reference to the costs of infrastructure construction) and adds a few extra boundary conditions, such as taking into account the interests of remote regions, disabled people, public transport, etc.
- The ECMT supports maximising social welfare, or so-called 'internalisation of external costs', and it considers that the main aims, besides economic efficiency and sustainability, is to promote fair competition between modes and countries.

Maximising socioeconomic welfare implies that transport should only take place when the social benefits are larger than the social costs. This implies that transport should only take place when the user's benefits exceed the raw internal costs plus the taxes and charges. This implies that taxes and charges should ideally reflect the marginal costs of using infrastructure, including the external costs of congestion, accidents and environmental impacts. This is referred to in the remainder of the report as the *marginal infrastructure and other external costs.* This is shown with the exclamation mark (**!**) in Figure 2.1.

It is worth noting that economic instruments such as transport charges and taxes are not the only tools for reducing external effects from transport and increasing socioeconomic welfare. Extensive direct regulation, supported or not by financial incentives, has resulted in, for example, improved environmental characteristics of cars, trucks, fuels, etc., and hence has lead to reduced external effects. As a consequence, they have had an impact on transport price levels and transport price structures. However, economic instruments have the advantage over command-and-control type of instruments by leaving final transport decisions to the market instead of imposing them on the market. This flexibility in principle leads to more efficiency and thus greater socioeconomic welfare, because:

- measures are taken by those that face the lowest compliance costs, whereas command-and-control measures oblige everyone to take measures;
- those that perceive the greatest benefits from their trips will continue with these trips, whereas command-and-control measures apply to everyone under the regime.

2.4.2 Distinguishing between transport charge levels and structures

Not only the *level* but also the *structure* of transport user prices is relevant. If cleaner vehicles are cheaper to drive than dirty vehicles, the market will move towards greater utilisation of cleaner vehicles. Transport user price structures can thus drive innovations to cleaner, safer and more silent transport, and hence reduce the external costs of transport. An important basic principle of this report is therefore the strict distinction between transport price, tax or charge *levels* and *structures.*

Charge *levels* tell us *how much* transport is charged. This is relevant because transport charges may increase transport user prices and therefore reduce demand for transport of a specific mode. This could eventually lead to either a modal shift, or to a net loss of demand via the so-called price elasticity of demand, and hence to less negative impacts of transport.

Charge *structures* tell us *how* charging takes place, that is, what the charge base is, which components are included, and how the charges are differentiated. They therefore tell us what incentives are built in the charges. Via differentiation and modulation of existing transport taxes and charges, governments can stimulate transport innovation and efficiency, without necessarily making transport as a whole more expensive. For example, by charging relatively clean Euro 4 trucks less than the somewhat dirtier Euro 3 trucks, hauliers are stimulated to purchase and drive less polluting vehicles. Another example is the fuel tax, which stimulates the purchase of relatively fuel-efficient vehicles. This innovation also reduces negative impact of transport, but without necessarily decreasing demand for transport (inner loop in Figure 2.1).

2.4.3 Summary

The analysis in this section leads to the following conclusions:

- The main aim of efficient transport pricing policy is to reduce the external and infrastructure costs that each transport user causes whilst respecting the user benefits. In economic terms, this is also called *maximising transport efficiency or maximising social welfare.*
- A transport charging system with that purpose thus consists of changes in transport price, tax and charge *levels* as well as *structures.*

Hence, the indicators in the group on price signals should answer the following key operational question related to transport charging policy:

> Are transport taxes and charges, which are imposed on each individual transport movement, becoming better aligned (in terms of both their structure and level) with marginal infrastructure and other external costs?

The reference level for transport *user* costs to achieve the economic optimum is alignment with marginal *social* costs. *Marginal* because we are concerned with the additional costs of adding one more user to the system, *social* because, as well as in private costs, we are interested in the costs to other users of the transport system and to society as a whole, including impacts on safety and the environment.

2.5 Conclusion: two dimensions and two key questions

The indicators in the TERM group on price signals serve two functions:

- providing information on the development of transport prices, so as to explain changes in transport demand and modal split, and associated changes in environmental impacts (dimension 1 — changes in transport prices);
- providing information on the evolution of transport charging policy away or towards marginal infrastructure and other external costs (dimension 2 — changes in transport charging policy).

The indicators should answer two key questions:

- how are transport prices by mode evolving and what is their impact on transport demand?
- are transport taxes and charges, which are imposed on each individual transport movement, becoming better aligned (in terms of both their structure and level) with marginal infrastructure and other external costs?

The next chapter describes the current set of TERM indicators related to

price signals. The following chapter presents the required improvements and adjustments to this indicator set in order to become better usable in providing answers to the two key questions.

3 Current TERM indicator fact sheets

Before describing the required improvements to the current TERM indicators on price signals, an overview of these indicators — and their interrelationship — is provided ([2]).

The TERM indicator group on transport price signals currently contains seven indicators, which are related to each other as illustrated by Figure 3.1.

3.1 Transport prices (TERM 20)

This indicator — also called 'Real change in passenger and freight transport price by mode' — describes the real change in price indices of passenger transport (for all 15 Member States) and freight transport (Dutch case study only).

The main strength of this indicator is that it shows the development over time of one of the most important drivers for transport volume, namely transport prices. This indicator therefore helps to explain demand growth and modal shift developments.

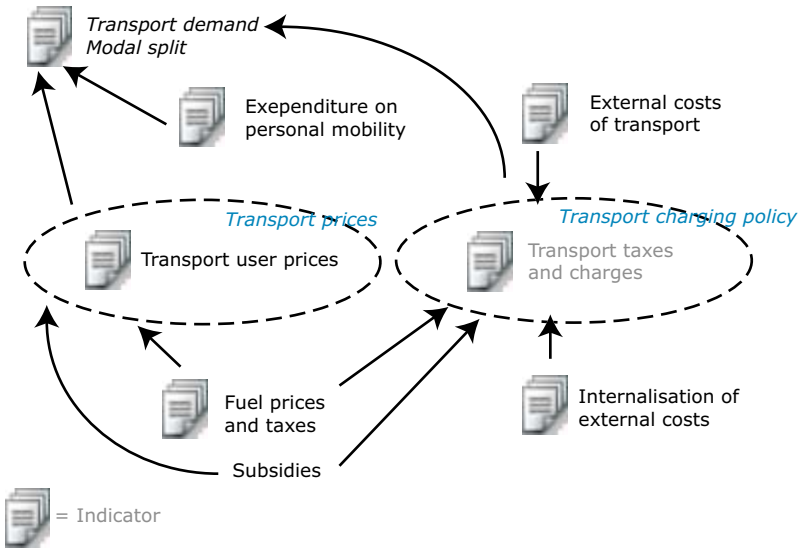
Its main weakness is that it does not explain where price developments come from: from market developments or changes in government charges, taxes or subsidies.

3.2 Fuel prices and taxes (TERM 21)

This indicator monitors developments of fuel prices and taxes in road transport, in all 15 EU Member States and four accession countries. Developments in absolute price levels, differences between petrol and diesel, and tax incentives for unleaded and low-sulphur fuels are monitored.

The main strength of this indicator is that it shows the development over time of one of the most important drivers for fuel consumption and hence of CO_2 emissions, and currently one of the most important government instruments to influence the price of transport (see Section 3.1). This indicator therefore helps to explain developments in energy efficiency of vehicles, CO_2 emissions by

Figure 3.1 Current TERM indicators in the group on price signals and their interrelationships



([2]) See Annex A for the list of all current TERM indicators.

mode, demand growth and modal shift developments.

Its main weakness is that developments are only shown for *road* fuel prices, and the fact that fuel taxes are increasingly being considered a rather blunt instrument for the internalisation of external costs. In Europe, the focus of transport charging policies shifts towards distance- and territory-based charging instead of fuel-based charging (captured in the indicator on transport taxes and charges, see Section 3.3).

3.3 Transport taxes and charges (TERM 22)

This indicator basically forms the umbrella for the indicator on fuel prices and taxes (see Section 3.2) and the indicator on subsidies (see Section 3.4). The indicator has never been fully developed due to lack of data.

3.4 Subsidies (TERM 23)

Subsidies are government interventions aimed at lowering the price of certain transport services. It is the balance of taxes, charges and subsidies that should be compared with the marginal costs in order to obtain a correct insight into the extent to which transport is efficiently priced. However, this indicator has also not yet been developed due to lack of data.

3.5 Expenditure on personal mobility by income group (TERM 24)

The indicator on expenditure on personal mobility has been developed for the TERM 2000 report (EEA, 2000, p. 75) and has not been updated since. This has to do partly with an absence of updated data and partly with the absence of a necessity to update the indicator, as the average share of income spent on transport is more or less stable.

The main strength of this indicator is that it provides the necessary information needed to understand the implications of changes in transport prices. After all, if transport becomes cheaper, while at the same time the share of income spent on mobility remains constant, one can buy more or better transport services. This means in practice — and given the fact that time spent on transport is a more or less stable factor — that one can buy faster and more comfortable transport. This has implication for both transport demand and the modal split ([3]).

The main weakness of the indicator is that it cannot truly capture all elements of transport expenditure, because of the many different costs types that it should cover. In the case of private car transport, for example, it should contain vehicle purchase costs, maintenance, taxes, tolls, etc. In the case of public transport, it concerns the sum of all tickets used, plus costs associated with getting to the pick-up point and back. Such costs are difficult to determine on an average EU scale.

3.6 External costs of transport (TERM 25)

Since marginal infrastructure and other external costs differ from situation to situation, they can never be fully captured by a single indicator This indicator shows minimum and maximum estimates of these costs per vehicle-kilometre for all passenger and freight transport modes (minimum and maximum of the average values per country).

Its main strength is that this indicator indicates a level for efficient transport charging, as it shows the bandwidth of marginal external costs per vehicle-kilometre.

([3]) When choosing between two modes of transport, often only the perceived costs are taken into account (that is, only the extra costs of making a trip, thus not including fixed costs). This further affects the relation between transport prices by mode and the modal split.

Its main weakness is that the information is not based on statistics, which have not been developed yet, but on estimates made in different studies, which vary between studies. Neither does the indicator provide insight into the development of external costs over time.

3.7 Internalisation of external costs (TERM 26)

This indicator shows the degree in which Member States have introduced price signals that are *directly* related to external costs, such as air pollution, safety risks, or congestion.

Its main strength is that it is a powerful summary of very scattered and diverging information on the *structure* of transport charges.

Its main weakness is that the indicator tries to summarise very complex and highly divergent information. It therefore loses important information such as a description of what the actual signal is, how important it is, and whether any changes have been recently implemented.

4 Improving the indicators

Following the indicator description of the previous chapter, the question is how to revise this indicator set in such a way that it best reflects the theoretical principles and political discussions as set out in Chapter 2.

As discussed in Chapter 2, the price signal indicators should monitor changes in transport user prices on the one hand, and changes in transport charging policy on the other. These two dimensions of monitoring are the subject of discussion in the following two sections.

4.1 Monitoring changes in transport user prices

The key question related to transport user prices is (see Section 2.3):

How are transport user prices evolving by mode and what is the impact of that on transport demand?

From this key question, two sub-questions follow:

1. How do transport prices evolve by mode?
2. How much, on average, is spent on transport?

4.1.1 How do transport prices evolve by mode?

Despite having some weaknesses, the indicator already in use — 'Transport user prices (real change in passenger and freight transport price by mode)' (TERM 20) — provides sufficient information to answer this sub-question. This indicator will remain unaffected.

The indicator on fuel prices and taxes (TERM 21) provides a more detailed analysis than when looking solely at the total fuel price. The tax and charge components and their share in the total fuel price show the level of fuel prices after government intervention that is partly done for the purpose of internalising external costs (see 4.2.1 — *How to treat fuel prices and taxation?*).

4.1.2 How much on average is spent on transport?

The indicator 'Expenditure on personal mobility' (TERM 24) partly answers this question. However, the indicator touches upon passenger transport only. A similar indicator could reflect the average costs of the transportation of goods compared to other costs such as those related to the production and distribution of goods, but such discussion falls out of the scope of this report.

4.2 Monitoring changes in transport charging policy

The key question related to transport charging policy is (see Section 2.4):

Are transport taxes and charges, which are imposed on each individual transport movement, becoming better aligned (in terms of both their structure and level) with marginal infrastructure and other external costs?

Before discussing in detail what indicators need to be adjusted or added to the monitoring system in order to be able to answer this question, a few methodological issues need to be solved first.

4.2.1 Some methodological issues

How to treat revenues from transport charging?
The revenues of transport pricing play an important role in fiscal policy. Marginal social cost pricing implies that users should be charged for the additional costs they cause by using

transport services, but not for sunk costs, such as costs of infrastructure construction financed from public funds. Recovering these costs will discourage optimal use of capital stock that has already been paid. This raises the question whether transport charges for marginal infrastructure and external costs will suffice to fund investment in new infrastructure. This issue was investigated in several reports over the last years, for example in a recent ECMT report on optimal taxes and charges (ECMT, 2003b). The main conclusion from these studies is that — at the level of the transport sector as a whole — revenues from optimal charges would exceed the fixed and variable costs of infrastructure.

Revenues from transport pricing will not be included in the monitoring system, as these total revenues give no indication as to whether transport pricing policy is moving in the right direction or not.

How to treat subsidies, for example on public transport?
Some transport sectors are currently subsidised. In particular, public transport by bus and, generally to a somewhat lesser extent, by train is subsidised by national, regional and local governments. Subsidies influence the net charge levels that are levied upon transport. For example, subsidising train tickets on the one hand may cancel the financial effect of charges for the use of rail infrastructure. As such, subsidies could be classified as negative charges. This approach was, for example, followed in the study 'Efficient prices for transport' (CE Delft, 1999).

Transport subsidies will not be included in the quantitative analysis of transport charges and costs for two reasons.

- Including subsidies in the calculation of net charge levels would imply the statement that ideally no single form of transport were to receive subsidies. This is a statement that cannot be underpinned in the context of this report.
- It would require an enormous effort to gather and update data on subsidies given to all kinds of transport in all Member States. Usually such data are very hard to get and hard to assess. The current TERM monitoring system already contains an indicator on 'Transport subsidies', but this indicator was never implemented, due to lack of data. Although it would be useful to have this indicator implemented, no changes are expected with respect to data availability.

How to treat expenditure on infrastructure costs?
A second important category of government expenditures, besides subsidies, includes transport infrastructure costs.

Costs consist of investment cost and running costs, which need to be treated differently.

Infrastructure investments will not be included in the monitoring system for transport pricing, because the indicators on transport pricing should be limited to the transport costs and charges that are marginal, that is, directly dependent on infrastructure use. Infrastructure investment is typically a sunk, that is, non-marginal, cost of mobility and should therefore not be included in a charging system. In an economically efficient framework, decisions on infrastructure investment should be based on social cost-benefit analysis, taking into account the costs and benefits of additional infrastructure for the society, economy and the environment.

How to treat other fixed costs (parking), and fixed charges?
Not all external costs of transport do vary with traffic volume, and certainly many transport charges do not. For example, external costs of parking — those space costs that are not including in the parking costs — only apply to standing vehicles. Parking costs and fees can be considered as marginal fees as they vary with parking time and represent opportunity costs of the space

foregone. However, for reasons of scope and data availability, they will not be included in the monitoring system on transport charging.

Vehicle purchase taxes (in the countries where they are applied) and ownership taxes do not depend on traffic volume and hence cannot be used to price marginal costs, although they may vary with environmental characteristics of the car on which they are imposed. The revenues of these charges are a source of government income and are used in part for investment in and maintenance of infrastructure. When marginal social cost pricing results in (an increase of) variable charges, then the financial burden will increase and fixed charges may be used for offsetting (part of) the increased burden. Marginal social cost (MSC) pricing implies charging for marginal (variable) infrastructure and other external costs, hence fixed infrastructure costs are not covered under this principle. There is, however, evidence that optimal pricing according to this principle results in revenues from the transport sector that exceed the revenues of the traditional charging system (R. Roy *et al.*, 2003).

How to treat fuel prices and taxation?
We devote special attention to the issue of fuel taxation and fuel prices, as it can be considered from three possible viewpoints.

1. Fuel *prices* are an important variable behind transport user prices and therefore transport demand and modal split (see Section 4.1.1).
2. Fuel *taxation* influences transport price *levels.* Fuel taxation is, on a per-kilometre basis, currently one of the most important elements in EU transport pricing. An important advantage of the fuel tax above fixed taxes is that the charge to be paid varies with the mileage driven. Moreover, it is an instrument that is available for practical use in the short term.
3. Fuel taxation also influences transport price *structures.* Fuel taxes are, in some cases, directly linked to fuel-related emissions like CO_2 (related to carbon content), SO_2 (related to sulphur content), and to lead in the past. Differentiation of fuel taxes on the basis of these contents therefore can be considered a first-best instrument to make users pay for the costs of these emissions. Although fuel consumption of specific vehicles generally shows some statistical correlation with safety risks, other pollutant emissions, and infrastructure damage, fuel taxation is generally not considered a 'first-best' instrument to make users pay for these costs. The reason for this is that the fuel tax does not give direct incentives to reduce safety risks, pollutant emissions, or infrastructure damage costs (see, for an overview of possible instruments, Table D.1 in Annex D).

Currently, EU-wide developments in petrol and diesel prices and taxation are treated in the TERM indicator on fuel prices and taxes (TERM 21). This indicator will be maintained to serve two purposes:

- the total fuel *prices* will be used in determining the transport user prices (see Section 4.1.1);
- the fuel *tax* component — recalculated per kilometre for the various modes — will be used to determine the transport charge levels (see Section 4.2.4), whereas the fuel taxes per unit of CO_2 emissions will be treated for the analysis of transport charge *structures* (see Section 4.2.5).

How to treat VAT?
The question now arises whether VAT on excise duty and other charges ought to be included in the transport charging indicators.

From a tax law point of view, it could be contended that VAT on excise duty and other charges should be considered as a specific transport tax and therefore included here as a charge, because VAT on excise duty is a 'tax on tax'.

From an economic point of view, however, excise duty and fixed vehicles taxes should be assessed as payment for services provided by the government in accordance with the direct benefit principle — as intended in public revenue and expenditure statements. In this case, VAT on excise duty is general taxation and not a special tax on transport. The absence of VAT liability on some fixed vehicle taxes is a flaw viewed from this angle.

In seeking to achieve a proper allocation of costs to the transport user, the economic approach to VAT should be followed and not that of tax law. This is why we have not included VAT on excise duty in this study ([4]). The vast majority of other studies follow this approach.

With respect to the indicators of transport user prices, VAT is of course relevant as it increases these prices and hence affects behaviour. In these indicators, VAT is therefore included where relevant.

4.2.2 *Definition of three sub-questions*

After the methodological descriptions and principal choices following from the previous chapters, there is enough ground for defining the sub-questions falling under the umbrella of monitoring charging policy, to be answered with indicators.

The following sub-questions can be distinguished.

1. What are the marginal infrastructure and other external costs of different forms of transport and how much of these costs are reflected in the transport charges levied?
2. Are transport charge levels moving towards marginal infrastructure and other external costs?
3. Are transport price structures becoming better aligned with marginal infrastructure and other external costs?

Each of the three sub-questions will be further dealt with in the next sections.

4.2.3 *Answering sub-question 1: External costs and charges per vehicle type*

The question to be answered is: *What are the marginal infrastructure and other external costs of different forms of transport and how much of these costs are reflected in the transport charges levied?* The indicator used will be 'External costs and charges per vehicle type'. The indicator will provide an overview of the current knowledge of marginal infrastructure and other external costs of different transport modes and vehicle types in the EU, and an overview of current charges levied on them. The indicator provides a *static* image of the current degree of integration of costs and charges, and serves as a basis for the other two indicators.

This indicator is probably the toughest one to implement — seen from the many different transport modes and transport 'circumstances' — while at the same time it is also a very important one to implement, as it forms an information basis for the other charging policy indicators (see Section 4.2.4 and Section 4.2.5). It is exactly this information basis — the external costs per vehicle type under various circumstances — that raises a lot of discussion. If this information basis is agreed upon, disagreements on the other two indicators will be much smaller.

The nature of the sub-question furthermore implies that one single graph can never give enough information. Marginal external costs vary by time, by location, by vehicle type, etc. Only a rather sophisticated charging system will

([4]) In reality, charges that do not attract VAT should also be corrected for the lack of VAT. In this case, however, we have elected not to do so because the government shows, through the absence of VAT liability, that they deem these charges to be fiscal rather than economic in nature.

be able to optimally deal with these differences. Therefore, any indicator that aims to monitor *external costs and charges per vehicle type* should contain a set of graphs, providing a best compromise between accuracy and comprehensiveness.

The indicator is for information purposes only and will not receive a judgement (☺, 😐 or ☹). After all, the indicator provides an overview of the status quo: no trends away or towards objectives can be deduced from that.

Current indicators

Currently, the indicator on external costs of transport (TERM 25) shows minimum and maximum (of per-country-averages) marginal infrastructure and other external cost estimates of a selected number of vehicle types for all passenger and freight transport modes under a selected number of circumstances. A sub-indicator shows that total external costs are large (approximately 8 % of GDP).

Modifications

The main modification is that information on transport *charges* will be added. Furthermore, the number of vehicle types to be assessed will increase.

The key chart of the indicator should present:

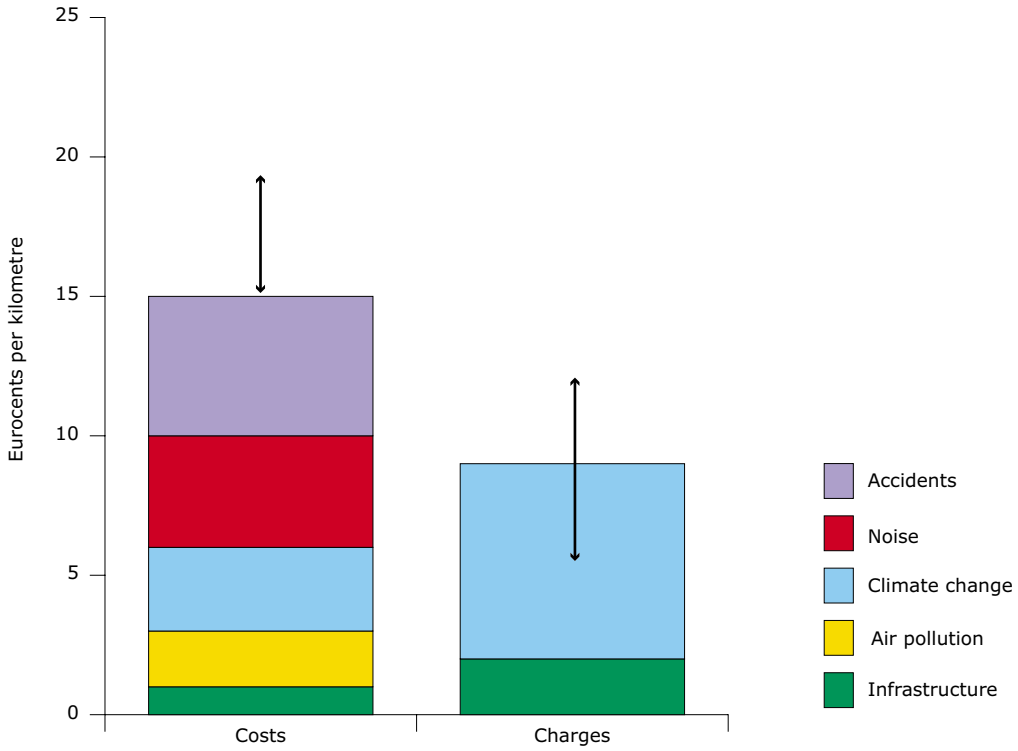
- Costs: 'worst' and 'best' case (see Table 4.1) estimates of external and infrastructure *costs* of different modes of freight transport, for one vehicle-kilometre travelled. Freight is chosen because EU-wide transport charging is largely focusing on freight, for internal market reasons. The following marginal cost items will be included:
  — infrastructure;
  — safety risks;
  — air pollution;
  — climate change;
  — noise.
  Congestion costs will not be included as these vary too widely depending on the actual capacity utilisation (the costs may vary between zero and something like EUR 1 per kilometre);
- Charges: current distance- or fuel-dependent European *charges,* per vehicle-kilometre, for Member States with lowest and highest charges.

A possible sub-indicator could be an identical presentation for passenger transport. In addition, the information on total external costs, in billion euro or percentage of GDP, will be retained as a second sub-indicator. The last sub-indicator has, strictly speaking, nothing to do with changes in charging, but is included to outline the importance of external costs.

Table 4.1 Vehicle categories and traffic conditions to be included in the indicator 'External costs and charges per vehicle type'

Freight transport (main indicator)	Passenger transport (sub indicator)
• Road best case: a Euro 3 vehicle (produced 2001–06) travelling 1 km on a motorway outside peak hours	• Passenger car best case: a Euro 3 vehicle (produced 2001–06) travelling 1 km on a motorway outside peak hours
• Road worst case: Euro 1 (produced 1993–97) vehicle travelling 1 km inside an urban area during peak hours	• Passenger car worst case: a Euro 1 vehicle (produced 1993–97) travelling 1 km inside an urban area during peak hours
• Rail best case: an electric train running outside urban areas	• Diesel bus: 1 average estimate
• Rail worst case: a diesel train running inside urban areas	• Rail short/medium distance; 1 average estimate
• Inland vessel: 1 average estimate	• High-speed rail; 1 average estimate
• Sea vessel: 1 average estimate	• Passenger aircraft: 1 average estimate
• Freighter aircraft: 1 average estimate	

Figure 4.1 Fictitious overview of the main indicator for freight transport (40-tonne lorry)



A fictitious example of such an indicator is shown above.

From this graph the following information can be deduced:

1. With respect to the level of *costs* (the marginal infrastructure and other external costs) available studies show that minimum and maximum estimates, excluding congestion, are EUR 0.10 and 0.19 per vehicle-kilometre respectively depending on the Member State.
2. With respect to the level of *charges,* available evidence suggest that current charges are generally too low.
3. With respect to the structure of *costs,* all cost categories have about the same order of magnitude.
4. With respect to the structure of *charges,* it appears that this does not at all correspond with the structure of *costs.* In the case of road, the largest part of charges is captured by the fuel tax that only has a direct and causal link to CO_2 emissions, which contribute to climate change. Other costs are hardly reflected in charges, with the exception of the new German kilometre-charging scheme, which is partly dependent on the emission class of the vehicle. In the case of rail, most charges are related to the use of infrastructure capacity. No countries have charges differentiated with respect to traction type, noise emitted, etc.

4.2.4 *Answering sub-question 2: Progress in charge levels*

The question to be answered is: *Are transport charge levels moving towards marginal infrastructure and other external costs?* The indicator used is called 'Progress in charge levels' and provides a more dynamic image of the level of use-dependent charges levied upon transport in Europe. If this indicator develops according to plan, up- or downward trends in the total level of use-dependent charges will become visible in a few years' time.

The aim of this indicator is to assess whether the average level of use-dependent charges per vehicle-kilometre is getting closer to the best available

estimates of marginal infrastructure and other external costs. Note that 'getting closer' does not automatically imply that taxes or charges should always be raised. There are situations where the total level of taxes exceeds marginal costs, for example for passenger car travel in rural areas outside rush hours. Taxation and marginal costs could be brought more in line when fixed taxes and charges are reduced.

Current indicator
TERM currently contains an indicator called 'Transport taxes and charges' (TERM 22), but this indicator is never implemented due to lack of information and a clarity on the most suitable methodological approach.

Modifications
As a main indicator, the mode-average trend in distance and fuel dependent taxes and charges in freight transport will be developed. The indicator on fuel prices and taxes will provide the basis for calculating the fuel dependent taxes and charges.

The assessment of the indicator (is an upward trend positive or negative?) depends on the results of the indicators developed under the heading of the previous key question (Section 4.2.3). If the taxes and charges generally appear too low, an upward trend is deemed positive, and vice-versa.

Technically, the elaboration of such an indicator is rather complex for the following reasons.

- No specific studies have been done on this issue. No complete overviews of current transport taxes and charges are available for all EEA Member States. The OECD database on environmental taxes and charges is one of the sources, but was not developed specifically for this purpose. Therefore, much new data collection work needs to be done.
- With respect to the calculation of fuel tax per vehicle-kilometre, the bottleneck is primarily developments in the fuel efficiency of the various transport modes. This information is rather incomplete. The transport and environment database system — developed by the Directorate-General for Transport and Energy and Eurostat — might play an important role in delivering such data.
- With respect to other use-dependent road transport taxes and charges, such as French, Italian, Spanish and, especially in the near future, German and Austrian motorway charges, the bottleneck is that information on the percentage of kilometres driven on the motorway network is incomplete, and thus a weighted average price development is hard to calculate.
- With respect to the acceding and candidate countries and non-road modes, the data availability is expected to be even more limited. Therefore, priority goes to developments in EU-15 road charges, with the highest priority to freight transport. Acceding and candidate countries, and non-road modes can follow at a later stage.

It can be expected that it will not be technically feasible to calculate the development of charges per kilometre in exact percentages per year. But, it will probably be possible to provide assessments like (fictitious numbers).

- Available evidence suggests that the average level of charges paid per kilometre driven in a petrol-fuelled car has dropped by more than 1 % per year, which is considered as a strong negative trend.
- Average charges paid by trucks on motorways have risen between 0 and 1 %, which is considered a slightly positive development.

These assessments can be compared with a desired trend that is derived from the previous indicators (external costs and charges per vehicle type, see Section 4.2.4). Based on the example *Fictitious overview of the main indicator for freight transport (40-tonne lorry)* (see Figure 4.1), an upward trend is positive, a downward trend is negative.

Table 4.2 Overview of possible score table for the freight transport modes

	Trend in gap between MIEC and variable charges
Light lorry, motorways	0
Heavy lorry, motorways	+
Light lorry, other roads	–
Heavy lorry, other roads	…
Freight train, electric	
Freight train, diesel	
Inland shipping	
Sea-borne shipping	
Air freight	

Notes: – gap is becoming larger
0 gap stays roughly equal;
+ gap becomes smaller

The final assessment is a ☺ when for all modes the assessment is at least zero and at least a quarter of al modes shows progress, ☹ when there is no progress, and a neutral score in other cases.

In addition to the European average trend, more detailed information can be provided for by splitting up the situation for different Member States (for example, Germany shows good trends with introduction of the kilometre-charge and increase of fuel taxes).

A possible sub-indicator could be an identical analysis for passenger transport.

4.2.5 Answering sub-question 3: Progress in charge structures

The question to be answered is: *Are transport price structures becoming better aligned with marginal infrastructure and other external costs?* The indicator used is called 'Progress in charge structures'. This indicator provides a more dynamic image of the degree in which various transport charges in various transport modes are becoming more differentiated or modulated on the basis of external costs, such as emissions or congestion.

The purpose of this indicator is to assess whether transport pricing in Europe develops from flat, fixed or variable, undifferentiated taxes that do not relate to external costs, to a more refined (diversified) system that takes infrastructure, safety, environmental and congestion costs of specific vehicles in different times and places into account.

Current indicators
This question is currently assessed with the indicator 'internalising of external costs' (TERM 26). This indicator consists of a number of tables with tick-marks (✓) that indicate whether instruments that directly apply to an external cost component are introduced in different transport modes.

Modifications
The table with tick-marks needs to be improved and the analysis behind it needs to be expanded. The indicator on fuel prices and taxes will provide the basis for filling in the table concerning fuel dependent taxes and charges.

Firstly, the table with ticks will be made more dynamic, so that it can be easily seen whether any new refinements have been introduced, or abolished. For example, ticks for new instruments become green, and ticks for abolished instruments become red. In this way, good and bad trends become visible. Examples of new developments include the German kilometre-charge system (November 2003), the London congestion charge system (February 2003), and the Dutch abolition of purchase tax breaks for fuel-efficient vehicles (January 2003). In addition, the total EU score of ticks could be calculated and compared with last year's score.

Table 4.3 Indicator on internalisation of external costs: transport tax structures in EU Member States

Non-fuel-related taxes and charges		Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	UK	EU total
Air pollution	Rail transport				✓												1
	Aviation														✓		1
	Water transport				✓							✓	✓	✓	✓	✓	6
	Road — freight	✓	✓	✓			✓				✓	✓		✓	✓	✓	9
	Road — passenger		✓	✓			✓					✓		✓	✓		6
CO_2	Rail transport				✓		✓										2
	Aviation																
	Water																
	Road — freight																
	Road — passenger	✓		✓								✓				✓	3
Noise	Rail transport																
	Aviation		✓			✓	✓			✓		✓			✓	✓	7
	Water transport																
	Road — freight	✓					✓										2
	Road — passenger																
Congestion	Rail transport																
	Aviation																
	Water transport																
	Road — freight															✓	1
	Road — passenger															✓	1
Total number of measures (excluding fuel taxes)		**3**	**3**	**3**	**3**	**1**	**6**			**1**	**1**	**4**	**1**	**2**	**5**	**6**	**39**
Fuel related taxes and charges																	
Lower tax for low-sulphur fuel			✓	✓	✓		✓					✓			✓	✓	
Carbon tax on diesel and petrol					✓					✓							

Note: A tick in the above table means that tax and charges have been framed to provide a direct link between the tax/charge and the specific external cost addressed. It does not necessarily mean that this external cost has been fully internalised. It also gives no information on the absolute size of the charge or its revenues.

Source: EEA (National Reference Centres); Boeing, 2002; ACEA, 2001.

Secondly, categories will be added to the table for special urban pricing schemes that have multiple purposes, such as reducing urban congestion, improving urban air quality, etc. (for example, London) and for shifts from fixed to variable taxation. The lines on leaded petrol will be removed because this fuel type is phased out in the EU and close to becoming phased out in the acceding and candidate countries.

Thirdly, the ticks will be weighed with respect to their importance and effectiveness. This weighing will be based on a number of criteria, as follows.

- The quantitative importance of the instrument concerned: how large is the total incentive provided by the instrument?
- The degree in which the differentiation is directly linked to environmental impact. For example, environmental differentiation of fixed motor vehicle taxes is less directly linked to environmental

impacts than environmental differentiation of variable charges; also differentiated harbour dues better reflect environmental impacts than fixed dues.

- The degree in which the differentiation is roughly sufficient to account for the external costs as mentioned in the previous fact sheets.

Important changes will be marked bold red or bold green and count for two, less important ones red or normal green. The ticks could stay that colour for a period of three years or so.

5 Summarising the revised indicators for transport price signals

There are two different types of transport price signals. One type of signal is related to transport (user) prices and the other to transport charging policy. The TERM indicators dealing with price signals should be able to monitor trends within both dimensions.

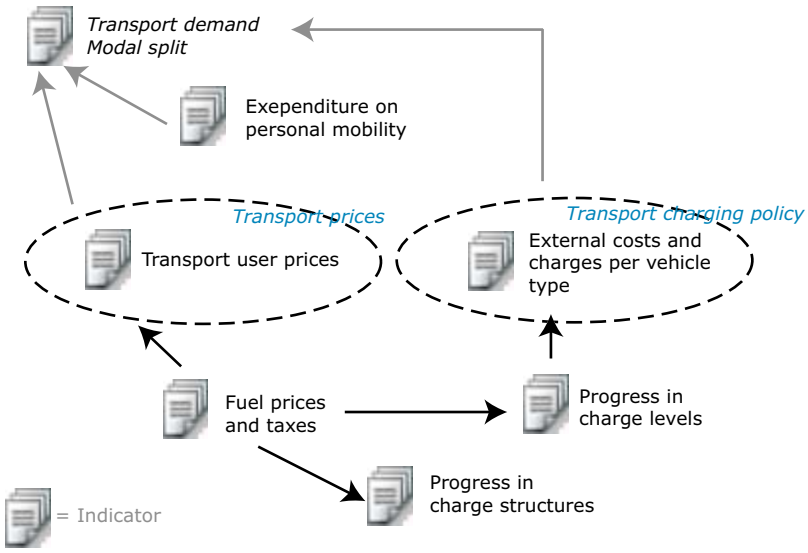
One key question is defined for each of the two price signal dimensions. For each of these key questions a number of sub-questions with indicators linked to them are defined. The key questions, sub-questions and indicators on price signals are all summarised in Table 5.1.

The graphical overview of the indicators in TERM's price signals group has now slightly changed compared to the previous version (see Figure 3.1 on page 14) and is presented in Figure 5.1.

Table 5.1 Overview of key- and sub-questions and the revised indicators to provide the answers

Key question	Sub-question	Indicator(s)	Static or dynamic
1. How are transport user prices evolving by mode and what is the impact of that on transport demand?	1.1 How do transport prices evolve by mode?	Transport user prices (real change in passenger and freight transport price by mode)' (TERM 20) *with input from fuel prices and taxes* (TERM 21)	Dynamic
	1.2 How much on average is spent on transport?	Expenditure on personal mobility (TERM 24)	Dynamic
2. Are transport taxes and charges, which are imposed on each individual transport movement, becoming better aligned (in terms of both their structure and level) with marginal infrastructure and other external costs?	2.1 What are the marginal infrastructure and other external costs (MIEC) of different forms of transport and how much of these costs are reflected in the transport charges levied?	External costs and charges per vehicle type	Static
	2.2 Are transport charge levels moving towards marginal infrastructure and other external costs?	Progress in charge levels *with input from fuel prices and taxes* (TERM 21)	Dynamic
	2.3 Are transport price structures becoming better aligned with marginal infrastructure and other external costs?	Progress in charge structures *with input from fuel prices and taxes* (TERM 21)	Dynamic

Figure 5.1 TERM indicators in the revised group on price signals and their interrelationships



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7 List of terms and abbreviations

EUR	Euro
CO_2	Carbon dioxide, the principal greenhouse gas
Environmental costs	Financial value assigned to negative environmental effects, based either on the costs of damage or on the costs of prevention, reduction or restoration
External costs	An external cost is a cost not included in the market price of the goods and services being produced, that is, a cost not borne by those who create it
External effects (of mobility)	Effects not taken into account by users in their transport decision; in this report, the following are designated external effects: noise nuisance, emissions, traffic accidents (in part) and congestion
Greenhouse gas	A gas that contributes to the natural greenhouse effect, that is, warming of the atmosphere due to the reduction in outgoing solar radiation resulting from concentrations of such gases
HC	Hydrocarbons; in this report, all hydrocarbons
Internalisation (of infrastructure and other external costs)	Incorporation of external effects into the market decision-making process through pricing or regulatory interventions
Marginal costs	Additional costs of one extra unit of mobility, one extra vehicle, vessel or aircraft kilometre
MIEC	Marginal infrastructure and other external costs
NO_x	Generic term for oxides of nitrogen (NO, NO_2, and many other), which contribute to acid rain, eutrophication and tropospheric ozone formation and indirectly to global warming and ozone layer changes
Efficient transport pricing policy	A pricing policy in accordance with efficiency principles, where the marginal social costs are imposed on the infrastructure users through appropriate taxes and charges
Passenger-kilometre	passenger-kilometre, unit of passenger transport provision: one person moved one kilometre
Transport (user) prices	The price users pay per passenger kilometre of vehicle-kilometre of a certain transport mode
Transport charging	A system in which governments impose specific transport taxes and charges, for example, on fuels, vehicles, and infrastructure use
SO_2	Sulphur dioxide
Social costs (of mobility)	All costs, including external costs entailed by transport mobility.
Tonne-kilometre	Tonne-kilometre, unit of freight transport provision: one tonne moved over one kilometre
Vehicle-kilometre	Vehicle-kilometre, unit of transport: one vehicle moved over one kilometre

Annex A — List of TERM indicators

Code	Indicator
Group I — Environmental consequences of transport	
TERM 01	Transport final energy consumption by mode
TERM 02	Transport emissions of greenhouse gases by mode
TERM 03	Transport emissions of air pollutants (NO_x, NMVOCs, PM_{10}, SO_x) by mode
TERM 04	Exceedances of air quality objectives (due to traffic)
TERM 05	Exposure to and annoyance by traffic noise
TERM 06	Fragmentation of ecosystems and habitats by transport infrastructure
TERM 07	Proximity of transport infrastructure to designated areas
TERM 08	Land take by transport infrastructure
TERM 09	Number of transport accidents, fatalities and injured (land, air and maritime)
TERM 10a	Accidental oil spills from marine shipping
TERM 10b	Illegal discharges of oil from marine shipping at sea
TERM 11a	Generation of waste from end-of-life vehicles
TERM 11b	Waste oil and tyres from vehicles
Group II — Transport demand and intensity	
TERM 12	Passenger transport demand by mode and purpose
TERM 13	Freight transport demand by mode and group of goods
Group III — Spatial planning and accessibility	
TERM 14	Access to basic services (average passenger journey time and length per mode, purpose and location)
TERM 15	Regional accessibility of markets and cohesion
TERM 16	Access to transport services
Group IV — Supply of transport infrastructure and services	
TERM 18	Capacity of transport infrastructure networks
TERM 19	Investments in transport infrastructure per capita and by mode
Group V — Transport costs and prices	
TERM 20	Transport prices (real change in passenger and freight transport price by mode)
TERM 21	Fuel prices and taxes
TERM 22	Transport taxes and charges
TERM 23	Subsidies
TERM 24	Expenditure on personal mobility by income group
TERM 25	External costs of transport
TERM 26	Internalisation of external costs
Group VI — Technology and utilisation efficiency	
TERM 27	Overall energy efficiency and specific CO_2 emissions for passenger and freight transport (per passenger-km and per tonne-km and by mode)
TERM 28	Emissions per passenger-km and per tonne-km for NO_x, NMVOCs, PM_{10}, SO_x by mode
TERM 29	Occupancy rates of passenger vehicles
TERM 30	Load factors for freight transport
TERM 31	Uptake of cleaner and alternative fuels
TERM 32	Size and composition of the vehicle fleet
TERM 33	Average age of the vehicle fleet
TERM 34	Proportion of vehicle fleet meeting certain emission standards (by mode)

Code	Indicator
Group VII — Management integration	
TERM 35	Number of Member States that implement an integrated strategy
TERM 36	Institutional cooperation in transport and environment
TERM 37	Number of Member States with a national transport and environment monitoring system
TERM 38	Uptake of strategic environmental assessment in the transport sector
TERM 40	Public awareness and behaviour

Annex B — Current TERM transport pricing indicators

This annex presents a brief overview of the TERM indicators that belong to the indicator group price signals and that have so far been produced (for a full list of indicators see Annex A):

- transport prices (real change in passenger and freight transport prices by modes);
- fuel prices and taxes;
- expenditure on personal mobility per person by income group;
- total amount of external costs by transport mode (freight and passenger); average external cost per passenger-km and tonne-km by transport mode;
- implementation of internalisation instruments (that is, economic policy tools with a direct link with the marginal external costs and the use of different transport modes.

Transport prices (real change in passenger and freight transport prices by modes)

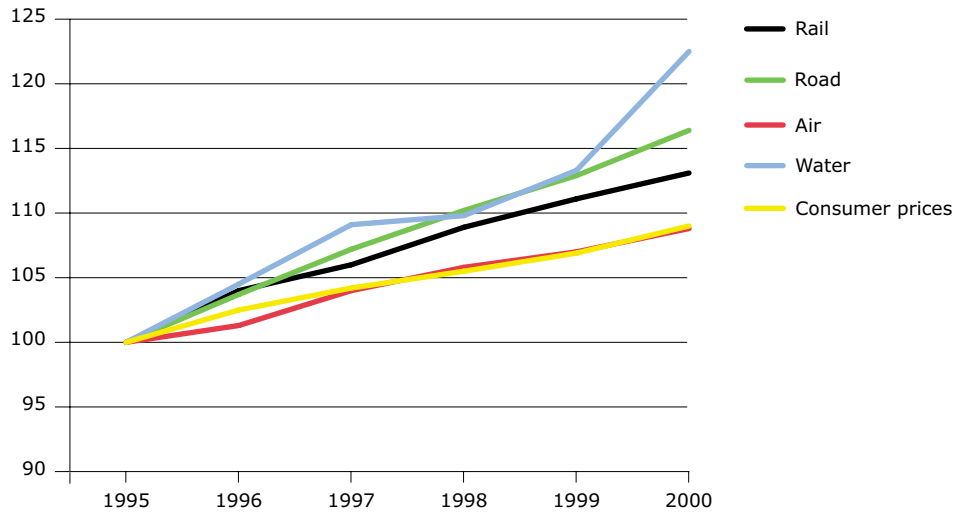
Indicator title:
Transport prices (real change in passenger and freight transport prices by mode)

Code:
TERM 20

Key message
On average, passenger transport prices have increased at a higher rate than consumer prices over the past five years — a rather short period of time. In three countries (Denmark, Italy and Luxembourg), the opposite has occurred. Air transport prices have shown the lowest increase in price of all transport modes. For freight transport prices, no EU-wide data exists, but a Dutch example shows that the prices of road, rail and inland waterway transport have decreased by 36, 45 and 52 % respectively over the past 20 years.

Environmental context
Increases in transport prices can have an impact on the environment. The reduction of environmental impacts can come either from substitution between modes, or from improved environmental performance of transport modes. An electric locomotive produces much lower emissions than a diesel-powered one, and a Euro 5 lorry produces 80–90 % lower emissions than a Euro 1 lorry. Fair and efficient

Key graph Real average EU-15 passenger transport price indices, 1995–2000 (1995=100)



Source: Eurostat, 2002.

prices should reflect such differences. Higher across-the-board transport prices may also result in lower demand for transport.

Fuel prices and taxes

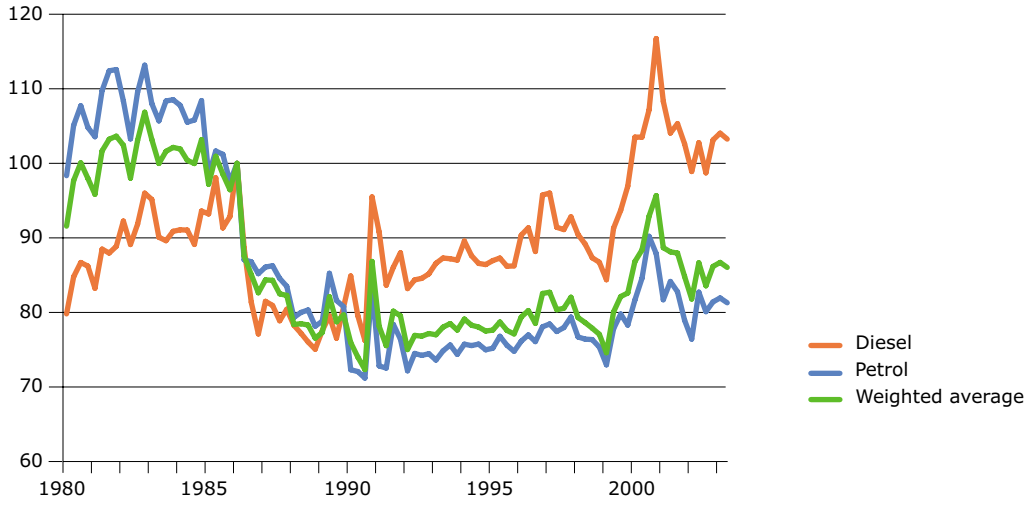
Indicator title:
Fuel prices and taxes

Code:
TERM 22

Key message
The inflation-corrected EU average price of road fuel in January 2002 was about 5–10 % lower than in the first half of the 1980s. However, some incentives have been given to reduce total fuel consumption and CO_2 emissions, because the share of taxes in the fuel price has increased. The price differential between petrol and diesel has become smaller. Petrol became about 15–20 % cheaper, diesel about 10 % more expensive, primarily due to higher diesel taxes. In rail transport, fuel taxes are much lower; inland and seaborne shipping and aviation pay no fuel tax at all.

Environmental context
Fossil fuel consumption is directly linked with CO_2 (the primary greenhouse gas). The links with other pollutant emissions (for example, NO_x, HC, NMVOC, etc.) and noise also depend on vehicle technology (Euro and noise classes) and trip conditions, as well as the type of fuel. Therefore fuel taxes, originally instruments of fiscal policy, are also seen as instruments to reduce emissions from transport, in particular CO_2. First, fuel taxes stimulate reductions of fuel consumption, for example, by stimulating fuel efficiency within all modes. Secondly, they can stimulate a shift towards cleaner fuels, for example from leaded towards unleaded petrol, or to low-sulphur fuels.

Key graph **Real average EU-15 prices of a) diesel b) petrol (weighted average leaded/ unleaded), and c) weighted average petrol and diesel, over the period 1980–2002 (January 1986=100)**



Note: Prices are those applicable in the middle of January, April, July and October each year.

Source: Eurostat, different volumes.

Expenditure on personal mobility per person by income group

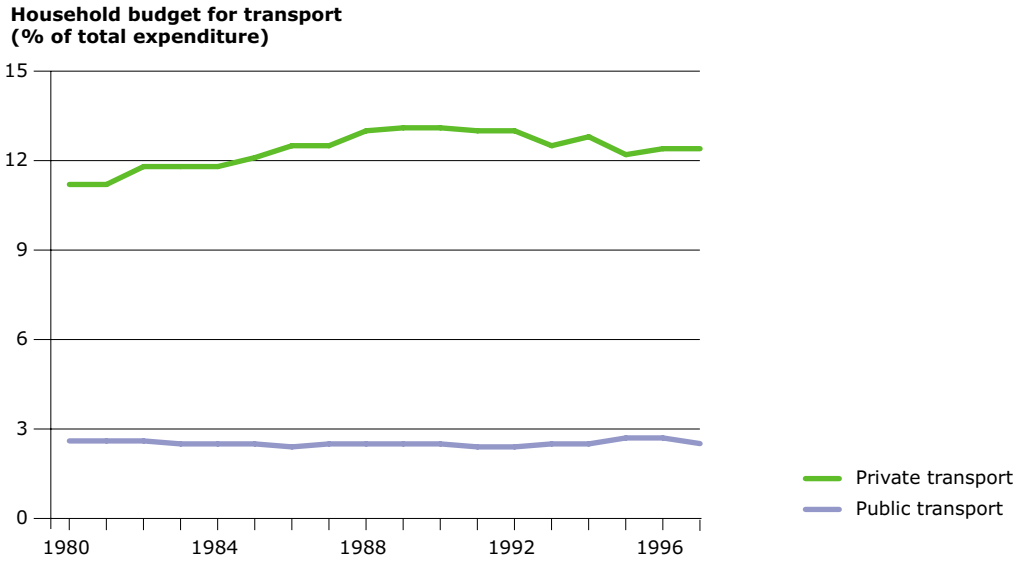
Indicator title:
Expenditure on personal mobility per person by income group

Code:
TERM 24

Key message
The proportion of household expenditure on transport reflects changes in income and consequent changes in lifestyle, as well as price increases. Household expenditure on transport is dominated by the purchase and operation of private cars, and amounted to about 12 % of total expenditure in 1996 (EU average). Such expenditure increased in the 1980s, but declined again in the 1990s. Household expenditure on public transport was less than 3 % in 1996 and has been more or less constant since the 1980s.

Environmental context
Not available.

Key graph Household expenditure on transport as share of total expenditure



Source: Eurostat.

Total amount of external costs by transport mode (freight and passenger); average external cost per passenger-km and tonne-km by transport mode

Indicator title:
External costs of transport

Code:
TERM 25

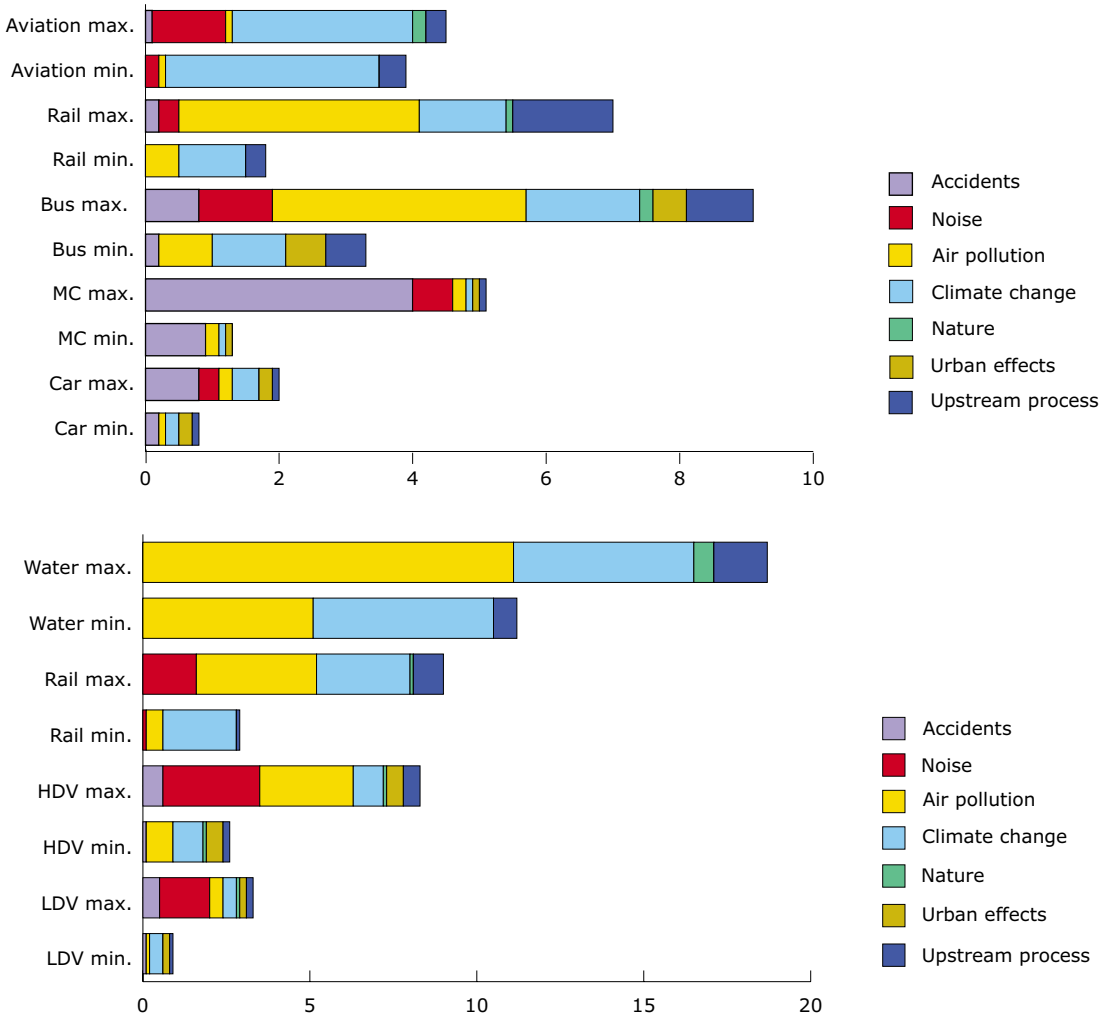
Key message

The external costs of transport are large and uncertain (estimated at about 8 % of EU GDP). The most important categories of external cost are accidents, air pollution and climate change. Congestion is the largest component in many urban areas. The variation of the marginal external costs is as great within transport modes as between modes. This indicates that the level of marginal costs depends heavily on the type of vehicle and the traffic situation considered.

Environmental context

Not available.

Key graphs **Marginal external costs of passenger and freight transport, minimum and maximum (average-per-country) values per transport mode (euro/vehicle km for aviation; euro/10 vehicle km for other modes)**



Note: MC = motorcycle; HDV = heavy-duty vehicle (3.5–40 tonnes); LDV = light-duty vehicle (< 3.5 tonnes). Values given are averages for EU-15 plus Norway and Switzerland. Congestion and infrastructure costs are not included. Nature costs are costs caused by infrastructure and, hence, zero in the short run. Urban effects refer to costs of separation and space availability (the latter is related to infrastructure and zero in the short run).

Source: Infras/IWW, 2000.

Implementation of internalisation instruments (that is, economic policy tools with a direct link with the marginal external costs and the use of different transport modes

Indicator title:
Internalisation of external costs

Code:
TERM 26

Key message
An EU pricing framework is under development for better internalisation of external costs. A number of Member States, notably Germany and the UK (London), are taking initiatives to

Key table Transport tax differentiation in EU Member States

		Austria	Belgium	Denmark	Finland	France	Germany	Greece	Irelland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	UK
Non-fuel-related tax and charges																
air pollution	Rail transport				✓											
	Aviation														✓	
	Water transport				✓							✓	✓	✓	✓	✓
	Road freight	✓	✓	✓			✓				✓	✓			✓	✓
	Road passenger		✓	✓			✓					✓			✓	
CO_2	Rail transport				✓		✓									
	Aviation															
	Water															
	Road freight															
	Road passenger	✓		✓								✓				✓
Noise	Rail transport															
	Aviation		✓			✓	✓			✓		✓			✓	✓
	Water transport															
	Road freight	✓					✓									
	Road passenger															
Congestion	Rail transport															
	Aviation															
	Water transport															
	Road freight															
	ROAD passenger															
Total number of measures (excluding fuel taxes)		**3**	**3**	**3**	**3**	**1**	**5**			**1**	**1**	**5**	**1**	**1**	**5**	**4**
Fuel taxation																
Lower fuel tax for unleaded petrol		(*)	(*)	(*)	(*)	(*)	(*)	✓	(*)	(*)	(*)	(*)	(*)	(*)	(*)	(*)
Lower fuel tax for low-sulphur fuel			✓	✓	✓		✓					✓			✓	✓
Carbon tax on diesel and petrol					✓					✓						

(*) Leaded petrol is no longer on the market

Note: A tick in the above table means that tax and charges have been framed to provide a direct link between the tax/charge and the specific external cost addressed. It does not necessarily mean that this external cost has been fully internalised. It also gives no information on the absolute size of the charge or its revenues. For more detailed information on tax and charging structures, see the tables at the end of this fact sheet.
Detailed information on fuel tax levels, structures and trends is provided in the fact sheet 'TERM 2002 21 EU — Fuel prices and taxes'.
More information on external costs is provided in the fact sheet 'TERM 2002 25 EU — External costs of transport'.

Source: Boeing, 2002; ACEA, 2001.

restructure transport taxes and charges. Some differentiation of taxes charged is currently done, concentrating mainly on air pollution in the road sector and noise in the aviation sector. Very few measures have yet been taken to internalise costs of congestion and CO_2 emission, and rail and road noise (some aviation and rail charges, and some urban parking fees are exceptions as regards congestion). In most urban areas, internalisation of external costs is still far from complete.

Environmental context

It is not easy to calculate the environmental impact of the internalisation of external costs. This is because internalisation requires a refined set of incentives, be it charges, taxes or regulations, to take into account the environmental and safety impacts of mobility. Clean and safe traffic on quiet roads at off-peak hours could become cheaper, whereas polluting and unsafe traffic, driving in congested areas in peak hours, would become (much) more expensive. Besides, marginal social cost charging will have an upward impact on load factors.

To our knowledge, currently no studies have been carried out that capture all these changes in vehicle types, modal share, driving times, spots and styles, etc. In any case, the environmental impact of internalisation of external costs is much higher than the environmental impact of an equivalent 'flat rate' increase in transport prices.

The earmarking of revenues for environmental investments could increase the effectiveness of pricing policies for the environment. In this case, due care should be taken that the fund is spent cost-effectively. Another option is to use transport pricing revenues to lower existing taxes, particularly those on labour. In this case, the so-called 'double dividend' — less pollution, more employment — comes into play.

Annex C — History of EU transport charging policy

In this annex a brief overview is presented about the history of EU transport charging policy and how this gradually evolved from the mid-90s. It includes European Commission, European Parliament and ECMT statements.

European Commission

Towards the 1995 Green Paper: 'Fair and efficient pricing in transport'

In the first half of the 1990s, the issue of transport pricing started to play a major role in Europe's transport policy. Some first studies on the subject appeared. In 1995, the Commission issued its landmark 1995 Green Paper 'Towards fair and efficient pricing'. In this Green Paper, pricing was presented as a major tool to reduce environmental impacts and congestion, and as a possible tool for infrastructure financing.

Due to its very nature, the Green Paper did not contain concrete policy choices, but expressed a preference for the principle of full cost recovery: *'The infrastructure charging policy should, in principle, aim at full cost recovery, covering both capital costs (and non-current expenditures) and operating costs.'*

The 1998 White Paper 'Fair payment for infrastructure use'

The 1998 White Paper 'Fair payment for infrastructure use' marked a slight change. So-called marginal social cost (MSC) pricing was presented as the leading principle for Europe's transport charging policies. Transport charges should as closely as possible reflect the extra congestion, accident, and environmental costs caused by additional infrastructure use. This also implies that sunk infrastructure costs should, in principle, not be charged to users, as this would discourage usage of the infrastructure that was already paid for. According to the White Paper, the combination of charging for marginal infrastructure costs and charging for marginal external costs *'is likely to lead to a high, possibly complete, recovery of infrastructure capital costs at the level of the transport system as a whole'.* This is an important change: infrastructure cost recovery is not an aim in itself anymore, but is presented as a likely consequence of the strategy promoted.

The 2001 White Paper 'European transport policy for 2010'

In the following text, a number of citations from the common transport policy are given. Although these citations do not explicitly mention marginal social cost pricing as the leading principle, the 2001 White Paper also does not explicitly change its strategy on transport pricing. The author of this report made the selection of these citations and added the emphasis to them.

On principles

[…] 'The paradox is that transport has too many taxes: registration tax, road and insurance tax, fuel taxes and infrastructure charges. But while transport may be heavily taxed, it is above all badly and unequally taxed. Users are all treated alike, irrespective of the infrastructure damage, bottlenecks and pollution they cause. This failure to spread the burden fairly between infrastructure operators, taxpayers and users causes considerable distortion of competition both between transport operators and between modes of transport. For the modes to enjoy a level playing field, taxation should work according to the **same principle regardless of mode** and ensure a fairer distribution of the burden of transport costs, which are generally borne more by society, i.e. taxpayers and companies, than by users. Applying the 'user pays' and 'polluter pays' principles, it should be the case, as Mr Paolo Costa, MEP, so rightly said in a recent report, that 'transport users should pay for the quantifiable components of transport costs arising from the use, the

quality and the safety of infrastructure…' […].

On instruments and price structures
[…] 'The thrust of Community action should therefore be gradually to replace existing transport system taxes with more effective **instruments** for integrating infrastructure costs and external costs. These instruments are, firstly, charging for infrastructure use, **which is a particularly effective means of managing congestion and reducing other environmental impacts**, and, secondly, fuel tax, which lends itself well to **controlling carbon dioxide emissions**. The introduction of these two instruments, which will allow greater differentiation and modulation of taxes and rights of use, needs to be coordinated, with the first being backed up by the second.

Price **structures** must better reflect the costs to the community. […] Tariff schedules can […] be more targeted and be drawn up according to infrastructure category (national, international) and use (distance travelled, length of time used). Other objective factors can also be taken into account, e.g. vehicle category (environmental performance, factors influencing infrastructure deterioration, even the loading ratio), level of congestion (period of the day, week or year) and location (urban, suburban, interurban or rural)' […].

On private versus commercial transport
'In the case of **private** vehicles, cross-border traffic is, however, limited, and infrastructure charging raises issues of freedom of movement and the need not to reintroduce frontiers. […] In the case of **commercial** transport, on the other hand, in order to avoid distortion of competition the Community needs to establish a framework that will enable the Member States gradually to integrate external and infrastructure costs and guarantee consistency in their initiatives.'

Conclusions
EU policies in the field of internalisation of external costs should, according to the White Paper, focus on a **restructuring** of transport charges so as to better reflect infrastructure and external costs, establishing a **level playing field** between modes, and initially on commercial transport for reasons of distortions of the internal market.

The 2003 proposal for road infrastructure charging
In July 2003, the Commission presented a long-awaited proposal to amend the so-called 'eurovignette' directive on the charging of heavy goods vehicles for the use of certain infrastructures. The proposal allows Member States to introduce distance-related charging for heavy goods vehicles over 3.5 tonnes. The proposed charge calculation methodology is a mix of an average cost and a marginal cost approach, as shown below:

'The weighted average tolls shall be related to the costs of constructing, operating, maintaining and developing the infrastructure network concerned, including any infrastructure costs designed to reduce nuisance related to noise and costs of actual payments made by the infrastructure operator corresponding to objective environmental elements, such as, for example, soil contamination, and to the direct or indirect costs of accidents which, not being covered by an insurance system, are borne by society.

Without prejudice to the weighted average tolls referred to in paragraph 9, Member States may vary the toll rates according to:

(a) vehicle type, based on its road damage class […] and its Euro emission class […]
(b) time of day and level of congestion on the road concerned, provided that no toll is more than 100 % above the toll charged during the cheapest period of the day;
(c) the particular road in the network, depending on the environmental sensitivity of the area, the population density or the accident risk'.

In brief, Member States are allowed to base their average charge levels on full infrastructure and external accident costs, and to differentiate these average

levels on the basis of number of axles, axle loads, engine Euro-class, time of day/level of congestion, environmental sensitivity, population density and accident risk. Member States may, however, only introduce such charges on the main itineraries (that is, basically the trans-European transport network) and only for trucks with a gross weight of 3.5 tonnes or more.

At the time of writing, the proposal was not yet discussed in the Transport Council or the European Parliament.

European Parliament

In 2000, the European Parliament issued a resolution on transport infrastructure charging in response to the 1998 White Paper of the European Commission, and awaiting a common methodology for infrastructure charging the European Commission was due to present. The resolution stated, *inter alia*, that:

- Transport users should pay for the quantifiable components of transport costs arising from the use, the quality and the safety of infrastructure and that all users should as a priority be charged for the resulting transport infrastructure costs (for construction, maintenance, expansion and improvement) […];
- Underlines that the methodology for transport infrastructure charging to be proposed has to show signs of pricing proportionate to the use being made of the infrastructure concerned, the cost it imposes on society as a whole, the ability-to-pay principle and the need to sustain remote, rural and island communities, as well as the particular needs of disabled people […];
- Recognises that such methodology for transport infrastructure charging should move in the direction of environmental sustainability, while preserving and enforcing the right to mobility of all citizens and accessibility of transport services with a public-service interest;
- Considers that the new methodology for transport infrastructure charging should be dynamic and flexible enough to provide incentives for new technological improvements; calls also on the Commission to look into the impact of such methodology on the choice of transport mode and demand for transport;
- Takes the view that external costs of transport, as well as costs from the use of infrastructure, should be covered in accordance with the methodology to be defined by the Commission in a common, practicable and comprehensive way, provided that this is done for all sectors of the industry in order to avoid distortions of competition among the different modes of transport.

In brief, the European Parliament underlines the main principles of transport pricing policy as proposed by the Commission, but:

- does not specifically favour marginal cost pricing (given the reference to the costs of infrastructure construction);
- adds a few extra boundary conditions, such as taking into account the interests of remote regions, disabled people and public transport.

European Conference of Ministers of Transport (ECMT)

The European Conference of Ministers of Transport (ECMT) is an intergovernmental organisation in which ministers responsible for transport, and more specifically the inland transport sector, can cooperate on policy. In the ECMT 43 countries participate to integrate transport knowledge and research and to search for political common ground. The ECMT has no legal powers but plays an important role in the political discussion on transport policy with its research and its ministerial resolutions.

The ECMT policy towards the reform of transport taxes and charges is set out in two resolutions, adopted by ministers of the ECMT Member States. The first is Resolution 1998/1 on the policy approach to internalising the external

costs of transport. This resolution states, *inter alia*, that:

- in the interests of improving economic efficiency, reducing the social costs of transport and increasing economic welfare, internalisation is an important transport policy objective;
- full internalisation should be viewed as a long term objective, taking account of the wide gap that exists between the present structure of costs and prices in transport markets and the ideal in many countries (and particularly in some transition economies);
- internalisation policies should be implemented through economic instruments and/or regulations, designed to provide effective incentives for reducing externalities while not resulting in a net increase in taxation in the economy as a whole;
- governments must cooperate to develop effective instruments for internalisation that do not discriminate between citizens or companies of different countries;
- internalisation policies should not discriminate between different modes of transport or between transport and other sectors of the economy;
- where public financial support for the provision of public goods is necessary, it should be provided, but only through transparent payments under contract;
- internalisation policy should be implemented in a gradual step-wise manner in order to avoid economic shocks;
- these gradual changes should be coordinated between modes to avoid shifts in modal split that would prove uneconomic in the long term.

The second is Resolution 2000/3 on charges and taxes in transport and particularly international road haulage, which recommends:

Gradually shifting the structure of taxation in transport to increase the share of more territorially based taxes and charges (e.g. tolls and km-charges) — that is, taxes that are not related to the place where a haulier is established or to the type of transport operation carried out — as this contributes at the same time to:

- ensuring non-discrimination;
- improving efficiency;
- avoiding problems of competitiveness between national haulage industries;
- and promoting sustainability.

In brief, ECMT ministers support maximising social welfare, or so-called 'internalisation of external costs', and consider that the main aims, besides economic efficiency and sustainability, is to promote fair competition between modes and countries.

Annex D — Instruments for charging for social costs

Once it is decided to internalise the various external cost items by means of a pricing policy, the question is then how this can be achieved. The two fundamentals of efficient pricing are:

- the amount of the charge is to match the amount of the costs;
- the charges are to apply directly to the cost items so as to provide an incentive to reduce them.

An optimum internalisation strategy can be set up per cost item on the basis of this principle.

Marginal infrastructure costs
Infrastructure upkeep and operation can best be charged by means of a differentiated charge per kilometre (except in aircraft). Such a charge can be differentiated according to the variables which most directly affect upkeep and operation, such as the size of the vehicle or vessel, its weight or for instance with goods vehicles and trains, the number of axles and the axle loadings.

For aircraft, the current charging structure (landing and take-off fees based on the weight of the aircraft and the numbers of passengers) is expected to be quite closely related to costs.

Safety risks
The charge per kilometre is also an attractive instrument for charging the external costs of road traffic accidents. The disadvantage is that the differentiation can only be made according to vehicle and infrastructure characteristics but not according to user characteristics, a third significant variable to explain accidents.

Insurance premiums are differentiated according to the user, however. Although the purpose of the system is to spread the risk (which is precisely the opposite of internalising cost), competition between insurers has forced them (by means of no-claims bonuses, discounts for women and the like) to achieve the best possible cost allocation. In this way insurance offers interesting pointers for efficient internalisation policy. Consideration may be given to:

- the introduction of an insurance premium that is (partly) distance-based instead of time-based, and possibly differentiated with respect to location and time;
- the introduction of an extra charge on premiums to account for unpaid costs;
- enhancing liability legislation.

A more detailed description of the possibilities of these instruments can be found in the report from the experts to the High Level Group on Infrastructure Charging (High Level Group, 1999a).

Greenhouse gas emissions
For the costs resulting from the emission of CO_2, the fuel excise duty is the optimal instrument, because CO_2 emission is directly proportional to fuel consumption. A differential charge per kilometre is only a second option here because the amount of the charge with this instrument is based on calculated rather than actual consumption.

Pollutant emissions
A differentiated charge per kilometre is the optimum instrument for the costs of emissions that pollute the atmosphere (excluding CO_2, SO_2 and lead), due to the ability to differentiate according to the environmental class of the vehicle, vessel or aircraft.

Fuel excise duty is a second-best option. There is a link between the external costs of emissions and fuel consumption. A disadvantage is the impossibility of differentiating according to environmental (Euro) class or location. The vehicle ownership tax can be differentiated according to emissions,

but does not in turn vary with transport performance.

Noise nuisance
A differentiated charge per kilometre is a suitable instrument for the costs of noise nuisance. This instrument offers the ability to differentiate according to vehicle characteristics, location and time, as a result of which efficient internalisation can be achieved. In aviation, internalisation by means of noise charges on take-off and landing is the optimum instrument.

Overview
The foregoing is summed up in Table D.1.

It should be noted that this table works differently in the case of aviation because here most cost items are not related to distance but to the numbers of take-offs and landings.

'Congestion charge' is taken to mean a charge per vehicle-kilometre that depends on the utilisation of vehicle capacity, the time of day and the location, such that infrastructure capacity is utilised at its optimum. A second observation is that the preference of the options is based on theoretical considerations. Implementation and upkeep costs do not play a part in that.

It is therefore preferable that marginal social costs be charged through variable charges, which can be implemented as flexibly as possible.

Table D.1 First, second and third preferences for instruments to charge marginal social costs in traffic and transport

Cost item	1st preference	2nd preference	3rd preference
Marginal infrastructure costs	Differentiated charge per kilometre	Excise duty	Ownership tax
Safety	Through insurance premiums	Differentiated charge per kilometre	Excise duty
Greenhouse effect	fuel excise duty	Differentiated charge per kilometre	
Atmospheric pollution	Differentiated charge per kilometre	Fuel excise duty	Ownership tax
Noise	Differentiated charge per kilometre	Fuel excise duty	Ownership tax
Congestion	Congestion charge	Differentiated charge per kilometre	

Annex E — Overview of EU studies

This section briefly describes the most important European research projects on the topic of transport charging that will be used for the improvement of the monitoring system.

Only projects aiming at improving the knowledge base are summarised; projects that aim at dissemination of knowledge or information are not mentioned.

EU fifth framework programme

UNITE
UNITE is part of the EU's fifth RTD framework programme (1998–2002). It builds on previous European research such as the concerted action on transport pricing research integration (CAPRI) and the high level group on infrastructure charging. At the empirical level, projects such as ExternE, QUITS (environment), TRENEN and PETS have provided valuable evidence on the nature and valuation of costs.

The purpose of UNITE is to develop answers to the following policy questions.

- How should the structure and level of charges for infrastructure use be calculated?
- What financial and social cost coverage considerations are relevant for calculating charges, and what are current levels of cost coverage?
- How can fair charging be promoted between and within modes while avoiding discrimination among users from different nationalities?

In the framework of the study at hand, the first question is especially relevant.

The project is due to be finished by the end of 2003. A number of deliverables are already available, but a full overview of the results is still expected.

MC-ICAM
MC-ICAM is also part of the European Union's fifth RTD framework programme (1998–2002). MC-ICAM examines optimal implementation (or transition) paths from a situation with low pricing of transportation to a situation with socially optimal pricing, in which users bear the full marginal social cost of their activities.

MC-ICAM evaluates the different implementation paths by examining how they affect social welfare over time, the technological and institutional changes that they generate or require, and the political support for marginal cost pricing which they induce over time.

The project is due to finish by the end if 2003. A number of deliverables are already available, but a full overview of the results is still expected.

TRENEN
The TRENEN model, developed under the fourth RTD framework programme, is a model designed to calculate marginal costs for transport (especially congestion costs) and to evaluate the impacts of optimal transport pricing on transport volume, modal split, welfare, travel speeds, and other relevant indicators.

The TRENEN model has been used on a broad range of occasions, two of which are explained a little further.

In 2000, a joint UIC/CER/EC study was executed with the help of the TRENEN model, which had the aim of estimating the impacts of efficient pricing policies in the UK, France and Germany, in particular the impacts on fiscal revenues (Roy, 2000). In 2003, a study from the ECMT and European Commission together updated these results and added two extra countries: the Netherlands and Finland (ECMT, 2003b).

Other studies

INFRAS/IWW: External costs of transport (INFRAS/IWW, 2000)
In 2000, the Swiss consultancy INFRAS and IWW from the University of Karlsruhe in Germany published the study 'External costs of transport; accident, environmental and congestion costs in western Europe'. The study is an update and extension of a former study on external costs in the year 1995 at the request of the International Rail Union, UICF (INFRAS/IWW, 1995). Detailed results are given for the base year 1995 and a rough prognosis for 2010, using emission forecasts from the TRENDS model. Cost categories are assessed for all EU Member States, plus Switzerland and Norway, with some functional and regional differentiation. Road, rail, air and waterborne transport are taken into consideration, with (several) passenger modes, except for waterborne, and freight modes. There are two output data sets: total and average (per person- or vehicle-kilometre) costs per country; and marginal costs per traffic situation (European average). Congestion costs are treated as a separate issue throughout the study. The aim of the study was primarily to develop a method for bottom-up allocation of environmental externalities.

INFRAS/Herry, External costs of transport in eastern Europe (INFRAS/Herry, 2002)
The aim of this study was more or less identical to the previous one, but the regional scope is shifted from western to eastern Europe.

ECMT, Efficient transport for Europe, policies for the internalisation of external costs (ECMT, 1998)
This report is a compilation of studies for the base year 2000. The aim of the report was to evaluate which methods of internalisation are most appropriate and what improvements are needed with a view to developing transport policy options. Hence, the report gives an extensive assessment of the methodologies used in major studies and arrives at 'best estimates'.

Details per study

In this section a qualitative overview of EU studies on marginal costs of transport is presented.

Table E.1 Overview of European studies on marginal costs of transport, and differentiations applied in the case of passenger cars

	UNITE	TRENEN	ECMT 1998	INFRAS 2002	INFRAS 2000
Approach					
Marginal costs	X	X	X	X	X
Average costs				X	X
Impacts					
Infrastructure costs	X		X		
Accidents	X	X	X	X	X
Air pollution	X	X	X	X	X
Climate change	X	X	X	X	X
Noise	X	(1)	X	X	X
Differentiations					
Diesel/petrol	X	X	X	X	X
Euroclass	X	X	X	X	X
Rural/urban	X	X	X	X	X
Peak/off peak	X	X		X	X

Note: (1) = only in urban transport

Table E.2 Overview of European studies on marginal costs of transport, and differentiations applied in the case of lorries

	UNITE	TRENEN	ECMT 1998	INFRAS 2002	INFRAS 2000
Approach					
Marginal costs	X	X	X	X	X
Average costs				X	X
Impacts					
Infrastructure costs	X	X	X		
Accidents	X	X	X	X	X
Air pollution	X	X	X	X	X
Climate change	X	X	X	X	X
Noise	X	1	X	X	X
Differentiations					
Vehicle size					
Euroclass			X	X	
Rural/urban	X	X	X	X	X
Peak/off peak	X	X		X	X

Table E.3 Overview of European studies on marginal costs of transport, and differentiations applied in the case of trains

	UNITE	TRENEN	ECMT 1998	INFRAS 2002	INFRAS 2000
Approach					
Marginal costs	X	X	X	X	X
Average costs				X	X
Impacts					
Infrastructure costs	X		X		
Accidents	X	X	X	X	X
Air pollution	X	X	X	X	X
Climate change	X	X	X	X	X
Noise	X		X	X	X
Differentiations					
Vehicle size					
Diesel / electric				X	X
Rural/urban			X	X	X
Peak/off peak					

Table E.4 Overview of European studies on marginal costs of transport, and differentiations applied in the case of ships

	UNITE	TRENEN	ECMT 1998	INFRAS 2002	INFRAS 2000
Approach					
Marginal costs	X	X		X	X
Average costs				X	X
Impacts					
Infrastructure costs	X		X		
Accidents	X		X	X	X
Air pollution	X		X	X	X
Climate change	X		X	X	X
Noise					
Differentiations					
Vehicle size					
Emission class					
Rural/urban					
Peak/off peak					

Table E.5 Overview of European studies on marginal costs of transport, and differentiations applied in the case of aircraft

	UNITE	TRENEN	ECMT 1998	INFRAS 2002	INFRAS 2000
Approach					
Marginal costs	X			X	X
Average costs				X	X
Impacts					
Infrastructure costs	X				
Accidents	X			X	X
Air pollution	X			X	X
Climate change	X			X	X
Noise				X	X
Differentiations					
Vehicle size					
Emission class					
Rural/urban					
Peak/off peak					

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