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Preparation of an Impact Assessment on the Internalisation of External Costs

Consultation Document

With this consultation paper, the services of the Directorate General for Energy and Transport of the European Commission are calling for comments on their proposed approach to internalisation of external costs, with a view to preparing a European strategy on this matter.

An online questionnaire is available at:

http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=costs&lang=EN

1. BACKGROUND

The Commission is currently developing a model for the assessment of external costs of transport. This was requested by the European Parliament when it approved the 'Eurovignette' Directive in May 2006 which states that: "*No later than 10 June 2008, the Commission shall present, after examining all options including environment, noise, congestion and health-related costs, a generally applicable, transparent and comprehensible model for the assessment of all external costs to serve as the basis for future calculations of infrastructure charges*". The Directive adds that: "*This model shall be accompanied by an impact analysis of the internalisation of external costs for all modes of transport and a strategy for a stepwise implementation of the model for all modes of transport. The report and the model shall be accompanied, if appropriate, by proposals to the European Parliament and the Council for further revision of this Directive*".

Since, the Commission has launched a study aiming at reviewing the existing estimates of external costs in Europe[1]. On 15 March 2007, the Commission held a workshop with stakeholders to test the main assumptions and orientations undertaken in the ongoing study[2]. The study is under finalisation and will be available for a high-level stakeholder conference to be organised in the beginning of 2008.

The Commission is now carrying out an impact assessment which will support the strategy on internalisation of external costs.

2. WHAT IS THE PROBLEM: WHY SHOULD WE INTERNALISE EXTERNAL COSTS?

For many years, the Commission has been advocating the need to internalise external costs in transport[3]. The high and growing proportion of the external costs of transport endanger its sustainability, which calls for policy actions.

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1 *Internalisation Measures and Policies for all external Costs of Transport (IMPACT). Handbook on estimation of external costs in the transport sector*. CE Delft. 2007.

2 Summary and minutes can be found at: http://www.ce.nl/redirect/Workshop_IECT_index.htm

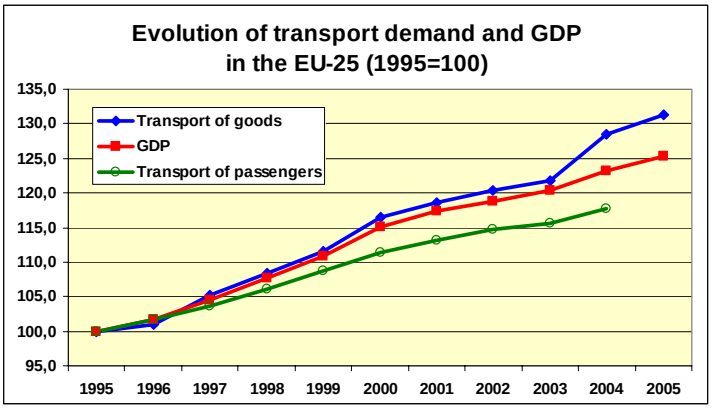
3 The Green Paper published in 1995 had given the opportunity to open the debate on the need to take into account external costs which was translated in policy strategy in the White Paper in 1998. The White Paper of 2001 and its mid term review in 2006 confirmed the need to implement efficient pricing. In parallel, the Commission has also financed research programmes in the field of transport pricing. Some projects have looked at the way to operationalise the concept of marginal cost pricing (TRENEN II, PETS, AFFORD) while other projects aimed at estimating the monetary value of private and external costs (FISCUS, QUITS, RECORD-IT, UNITE). Furthermore, research projects have been carried out in order to

2.1. Transport sustainability has to be improved

2.1.1. Transport growth in the economy…

Transport services play a central role in modern society and economy. Transport services account for 4.3% of EU25[4] value added and, employ about 8.2 million persons in the EU25. Societal evolutions (tourism, professional mobility….), industrial changes (fragmentation of value chain, increase in trade in goods, relative increase of light and high value goods, just-in-time production processes…) as well as technological progress have contributed to increasing the use of transport services. Over the past decades, transport has increased in line with economic growth. Thus, freight transport growth has been 2.8% per year on the period 1995-2005 while the real GDP grew by 2.3% per year on the same period, at the same time passenger transport has grown 1.9% per year. At the same time, freight transport demand has increased more strongly for modes offering greater flexibility, in particular road transport.

Chart 1



Source: EU Energy and Transport in Figures. DG Transport and Energy

2.1.2. …imposes nuisances/costs to society

Although the benefits of transport services are widely acknowledged, transport activities generate nuisances/costs to other transport users, but also to society in general, including local population and future generations. More specifically, transport growth may lead to the need to increase infrastructure capacity of several modes and is continuing to exert pressure on air quality, the climate and land use. Furthermore, noise is still a nuisance for many people, and fatal and serious accidents (in road transport) remain at unacceptably

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analyse the impact of efficient pricing (TRENEN, PETS, AFFORD, TIPMAc, IASON, TranSecon, TRANSPRICE, CONCERT-P, EUROTOLL). More recent, GRACE – Generalisation of Research on Accounts and Cost Estimation - is a research project funded by the EC sixth Framework programme. This project aims to support policy makers to develop sustainable transport systems by facilitating the implementation of pricing and taxation schemes that reflect the costs of infrastructure use. Among the areas of research, it proposes methods of evaluation of external costs. For more details on Commission research programmes, see *Efficient pricing in transport - overview of European Commission's transport research programme*. Catharina Sikow-Magny. Chapter 15. Acceptability of transport Pricing Strategies. 2003, ed by J. Schade and B. Schlag, Elsevier. On the same topic, environmental external costs have been analysed through the "ExternE" (External costs of Energy) European Research Network.

[4] Including the share of inland transport, water transport, air transport and supporting transport activities. EU Industrial Structure, DG Enterprise and Industry, 2007.

high levels. These costs imposed by infrastructure use on society at large are not at all or unequally shouldered by different actors of the transport system. While some of these costs are felt already in the short term, the situation is also unsustainable in a long term perspective[5]. In road transport, these costs were estimated at 1.1% of EU GDP in 1998 (UNITE).

Congestion

Mobility in Europe has increased and is reflected in the growth of traffic in passenger and freight transport (see chart 1). At the same time, the growth of infrastructure network has been quite below the growth of traffic (on average, + 20% between 1992 and 2003 for all modes of transport). In other words, the density of traffic in Europe has increased over the past years, raising the probability of congestion in some areas.

Congestion imposes a cost every time the speed of transport users is limited by additional vehicles using the same infrastructure. In other modes of transport such as rail or air, it is reflected in unsatisfied demand due to slot scarcity. All citizens circulating in urban areas, travelling passengers or freight operators have already been involved in congestion situation. For example, between 18 and 25% of planes arrive late in European airports[6]. In ports, congestion exists when ships are queuing and waiting to obtain a berth. On average, people spend one hour per day in travelling. But time spent in transport may be increased with the simultaneous presence of numerous other users, for example when going to work in the morning or when leaving on holidays. Time loss is costly and may impose adjustment to the society and the economy at large. Congestion means not only loss of time but also inconvenience due to unpredictability and, for freight operators, lack of reliability in the delivery of their service.

Predicting and assessing the level of congestion is not an easy task because congestion is always defined in relation to "optimal" level of traffic (which definition may vary from one country to another). Congestion depends on timing and location and is not homogeneous through Europe. Congestion is mostly an urban problem everywhere[7]. Interurban road congestion also exists in dense areas, in particular in Germany, the Benelux and the southern part of the UK as a result of their large urban areas. In 1997 30% of the German motorway network was congested, in 2000, this share was 31%, and it is predicted to be 42% in 2015[8]. Congestion is also a problem in the Alpine countries, in the Pyrenees crossings and in other big cities such as Athens or Spanish and Italian cities. Major bottlenecks exist in other modes of transport, in ports in the North Atlantic

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5 Transport accounts for almost one third of final energy consumption. Oil dependency might expose the economy to price volatility or price shocks and imposes a cost to the economy. More generally, security of supply has a cost. It is not covered by this document.

6 CEMT/ITF(2007)6. Congestion: A Global Challenge. These figures vary slightly (24% of departure delays of more than 15 minutes in 2001 against 21% in 2005 and 25% and 23% respectively for arrival delays). It should be noted that the causes of delays may not be congestion. However these delays could lead to congestion.

7 COMPETE (2006). For example, the travel time index of English cities other than London has grown from 1.24 in 1993 to 1.32 in 2004. A travel time index of 1.24 indicates that a 30 minute trip in free flow takes 37 minutes in the peak; 1.32 indicates that a 30 minute trip in free flow takes almost 40 minutes in the peak. For other cities, comparison of 2004 values shows an index of 1.34 for Paris, Ile de France, 1.40 for Greater Copenhagen area and 1.84 for Greater London.

8 COMPETE (2006).

and Baltic ports which operate close to capacity, in railway in the East and Southwest of the Union[9].

Accidents

Road fatalities are unacceptably high although they have decreased by 21.4% between 2000 and 2004 in the EU as a whole. In 2005, there were still 41 274 persons killed in EU25. Besides high private costs due to loss of relatives or friends, accidents impose costs to society (medical costs, police costs, material damages…), which are only partially covered by existing insurance systems. Furthermore, accidents may also imply non recurrent congestion problems when traffic is dense, increasing travel time spent for other users.

Environmental impacts

Finally, although efforts have been made to reduce pollution, gas emissions and noise, some environmental damages continue to increase, affecting a large number of citizens (health) and the ecosystem (biosphere, soil, water…). Successful results have already been obtained, especially in the air pollution field (see below).

Noise emitted by transport has detrimental effects on health[10]. WHO works[11] recently showed that the magnitude of health effects from exposure to traffic noise is very significant. Although several Community measures have been taken to reduce noise pollution[12], there is no evidence that the exposure to transport noise has been substantially reduced as set out by the 6th environmental Action Programme[13].

Air pollution has impacts on human health ranging from minor effects on the respiratory system to reduced lung function, asthma, chronic bronchitis, and reduced life expectancy. It also damages landscape, ecosystem as well as buildings and historical sites through acid deposits (acidification). Air pollution emissions from transport have considerably decreased over the past years due to technology progress and regulation. However, air pollution still remains a challenge in dense and high traffic areas.

Chart 2

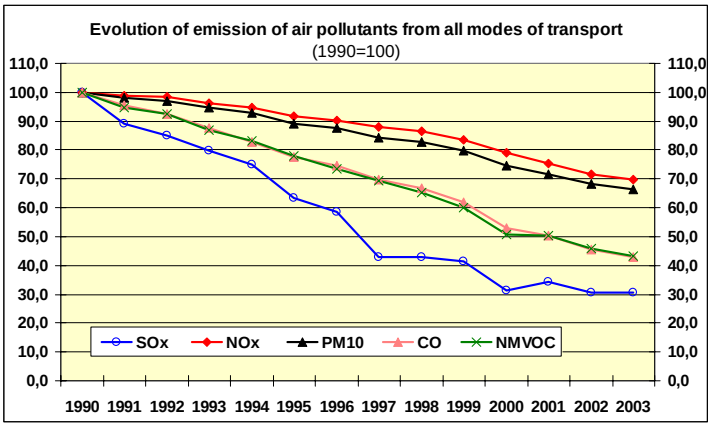
[9] COMPETE (2006). Panorama of congestion in Europe and the US.

[10] RANCH (http://www.wolfson.qmul.ac.uk/RANCH_Project/) and HYENA (http://www.hyena.eu.com/)

[11] http://www.euro.who.int/Noise/activities/20021203_3

[12] http://ec.europa.eu/environment/noise/sources.htm

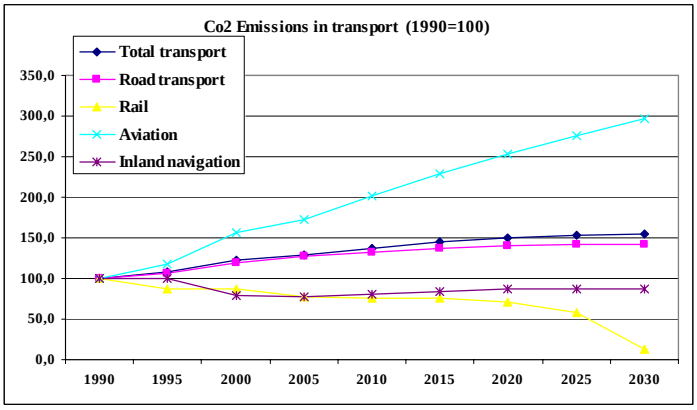
[13] http://ec.europa.eu/environment/newprg/legis.htm (see article 7)



Source: Eurostat

More worrying are the trends of greenhouse gases emissions. Global warming imposes costs to future generations and should be tackled from now as transport is a large contributor to greenhouse gases emissions, namely CO2 (26% of the latter come from transport; of which 84.1% are from road transport). CO2 emissions of transport have increased by 29% from 1990 to 2004 while CO2 emissions in other sectors of the economy (industry, households) have been reduced or stabilised. Projections show that CO2 emissions will continue to increase.

Chart 3



Source: DG TREN

Infrastructure use costs

It should be recalled that transport activities generate costs related to the need to build and maintain infrastructure. In general, the costs of infrastructure construction (fixed costs) are borne by the public budgets (i.e. taxpayers) or in some cases by the user (e.g. toll motorways, some ports and airports). Wear and tear infrastructure costs (approximated by maintenance costs) vary with the amount of traffic and can vary substantially depending on the type and characteristics of the vehicles.

Land use

Finally, transport infrastructure generates costs related to **land use**, which have different aspects in urban and non-urban areas. These costs include damage on nature (e.g. fragmentation of ecosystems) and on landscapes, and separation effects, which may affect residents along the transport axis as well as pedestrians, bicycles, or local traffic.

2.2. Efficiency problem

2.2.1. Acknowledging all the impacts of individual decisions

For efficiency as well as for fairness purposes, the costs and nuisances related to transport activities should be borne to a large extent by those who produce them. Time loss, health problems due to air pollution, CO2 emissions contributing to earth climate change cost to society. While the nuisances related to transport activities are unsustainable for society at large, it appears that some of them are not always borne by transport users and more importantly that there is no direct relation between the costs paid by users and the cost they impose on the society.

The costs of transport can be split into **private/internal costs** (those directly borne by the person engaged in transport activity) and **external costs** (i.e. those that are imposed on others but not supported by the user). The sum of private and external costs represents social costs. The boundary between internal and external costs is defined by the costs the person takes into account when deciding to use a transport. This means that when engaging in a transport activity, a person will incur private costs linked to the use of a mode of transport (vehicle purchase, tolls or fuel use), but will not be aware of effects imposed on others such as pollution or congestion. His/her decision will not be based on the full costs of his/her activity.

In other words, the costs imposed on others– environmental damages, accidents, congestion - generated by transport activities are external costs, more generally referred to as **externalities**. Most of them have increased over the past years despite technological progress.

The table below draws the line between both categories of costs.

Table 1: Classification of the costs of Transport

Cost of categories	**Social costs**	
	Internal/Private costs: borne by transport user	**External costs: borne by other transport users or society**
Transport operating expenditure	Fuel and vehicle costs Tickets/fares	Costs paid by other users or by society
Infrastructure use costs	Costs covered by infrastructure charge Costs covered by tickets/fares	Costs partly uncovered
Accidents costs	Costs covered by insurance, own accident costs	Uncovered accident costs (e.g. pain and suffering imposed on others), administrative and police costs
Noise costs	Own disbenefits	Costs borne by people exposed to noise (noise disturbance, health effects)
Air pollution costs	Own disbenefits (depending on individual situation)	Costs borne by people exposed to air pollution (health effects)
Climate change costs	Own disbenefits (including future generation, i.e. children)	Costs borne by society and by future generations
Congestion costs	Own time costs	Delays/time costs imposed on others

Source: adapted from Table 2.1. of the Green Paper "Towards fair and efficient pricing in transport. COM(95) 691 final.

2.2.2. Failure to apply the "user pays" and "polluter-pays" principles

While transport choices are influenced by transport prices, the gap between prices and underlying costs may lead to an inefficient situation. In a number of cases, part of the costs generated by transport users is not fully borne by them but is paid for by other transport users or by society. As a consequence, the "user pays" and "polluter pays" principle fails to be applied in transport activities.

In a majority of cases, congestion costs are not fully borne by transport users. Infrastructure and accident costs are partly borne by tax-payers; environmental costs are partly borne by nearby populations (local pollutions and noise) and society at large and future generations (climate change and global pollutions).

It is true that transport activities, including vehicle purchase, ownership and use, are already subject to numerous taxes and charges, which may overall compensate, and in some cases even over-compensate, for some of their social costs. However, many of the existing taxes have not been established for this specific purpose, and consequently there is often no direct relation between the costs paid by individual transport users and the additional costs they impose on society.

Also, the situation varies widely depending on each country, energy mix and transport mode. Some Member States are already applying specific tax or charges to cope with external costs such as CO2, air pollution or noise (see table in annex). In addition, fuel taxes and vehicle taxes account for the majority of transport related revenues (see also 5.3). Although these taxes do not always aim at internalising external costs, they cannot be ignored as transport users are already paying for them in many Member States and can take them into account when making their decisions (i.e. fuel taxes). The lack of harmonisation may lead to market distortions and hamper the good functioning of the internal market. Moreover, in the case of international transport, these taxes, collected often in the origin country, will not always reflect the extraterritorial external costs.

2.2.3. Prices should convey the right signal

If prices do not appropriately reflect social costs, they fail to convey the right economic signals, thus leading to situations where transport activities generate excessive costs as compared to an efficient situation. Consequently, each mode will not be used in an optimal way and the final equilibrium will not lead to maximum benefits to society.

Each mode of transport has its own characteristics and needs, which leads to different external costs. These should appear in price formation mechanisms in order to convey the right information to users.

Table 2: Most important specification of different costs according to transport modes

Cost component	*Road*	*Rail*	*Air*	*Water*
Costs of scarce infrastructure	Individual transport is causing individual congestion	Scheduled transport is causing scarcities (slot allocation) and delays (operative deficits)	Scheduled transport is causing scarcities (slot allocation) and	If there is no slot allocation in ports, congestion is individual

Cost component	*Road*	*Rail*	*Air*	*Water*
			delays (operative deficits)	
Accident costs	Individual risks of drivers might be treated as internal, insurance covers compensation of victims (excluding value of life).	Insurance is covering also parts of compensation of victims	Insurance is covering also parts of compensation of victims	No major issue
Air pollution costs	Roads and living areas are close together	The production of electricity has to be considered as well as diesel trains.	Air pollutants at all relevant altitudes have to be considered	Air pollutants in harbour areas should be considered
Noise	Roads and living areas are close together	Rail noise is usually considered as less annoying than other modes (so-called rail bonus of 5 dB(A))	Airport noise is usually considered as more annoying than other modes	Not relevant
Climate change	All GHG relevant	All GHG relevant, considering electricity production	All GHG relevant (including at altitude)	All GHG relevant

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

2.2.4. Keeping the balance between centre and periphery

The level of external costs varies across regions, depending on the density of traffic and also on the density of people (see table 3). Regions at the periphery have mainly low traffic volumes and are less impacted by congestion or other nuisances. Accordingly, the level of external costs strongly varies between urban, rural and other areas. An efficient pricing system should better reflect the various situations and adapt prices to the level of costs.

Table 3: External costs (Source: RECORDIT)[14]

Route type	*Description*	*external costs (eurocent/km) for EURO-III heavy goods vehicle*
Rural	Rural regions with low population density and very little congestion	5-10
Normal	Average population density regions	10-25
Mountain	Routes in environmentally sensitive mountain regions	20-40
Urban	Urban areas with high population density	20-40
Metropolitan	Metropolitan areas	40-70

[14] Variable infrastructure costs are covered in these estimates. Subsidiarity and Transport Policy Co-Ordination in the European Union. Catharina Sikow-Magny. In Transport Infrastructure Charges and Capacity Choice. Round Table 135, 2007.

2.3. Why the Community should act?

Internalisation is a way to impute external costs to users and to ensure that prices paid by transport users reflect social costs, i.e. private and external costs. The internalisation of external costs is a way to apply the "user pay" principle and the "polluter-pays" principle as it has been requested by the European Parliament (see above). The "polluter-pays principle" principle is treaty-based: article 174 of the Treaty states that, "environmental damage should as a priority be rectified at source" and that "the polluter should pay".

In addition, the Community has to ensure the proper functioning of the internal market and the absence of distortions of competition between transport undertakings in the Member States. The current situation as regards taxation and charging in transport reflects a wide variety between Member States' approach and between different modes of transport, despite a number of directives on taxation and infrastructure charging (Directive 2003/96/EC (energy taxation), Directive 2006/38/EC (Eurovignette), Directive 2001/14/EC (rail)). Such a variety can endanger the proper functioning of the internal market and the objectives of the Common Transport Policy set out in article 70 of the Treaty. This recently led the Commission to propose a better coordination of the taxation of motor fuels[15].

To summarise:

Transport users impose costs to society which are damaging and not sustainable. Some of these costs are not borne by them, but by other transport users and society at large. The failure of market prices to reflect overall social costs leads to inefficiencies and non optimal use of transport modes.

Transport externalities would require government measures to correct those failures. Based on the treaty's "Polluter-Pays" principle and on the need to ensure the well functioning of internal market, the Community may be entitled to act, once the subsidiarity principle taken into consideration.

3. OBJECTIVES

The general objective of the Commission initiative is to propose a strategy to internalise external costs generated by transport according to the principle of "polluter pays" as it has been requested by EP. By internalising external costs, transport prices would give the right signal to transport users and would improve the efficiency of infrastructure use and reduce negative externalities.

Other tools such as regulation, infrastructure policy or research support may be used to curb externalities. Lots of cost drivers depend on vehicles categories, speed characteristics or driving characteristics. Regulation may help change transport users' behaviour (ex: safety rules enforcement) while research support may lead to

[15] COM(2007)52 Proposal for a Council Directive amending Directive 2003/96/EC as regards the adjustment of special tax arrangements for gas oil used as motor fuel for commercial purposes and the coordination of taxation of unleaded petrol and gas oil used as motor fuel.

environmental-friendly innovation (ex: cleaner vehicles), which could entail subsequent measures to modify supply. Infrastructure investment and intelligent transport systems using information, communication and navigation technologies may improve routings and modal choice. Public information and education can also play an important role.

All these instruments have their own qualities and limits, like pricing instruments. They should be used in a complementary and mutually reinforcing way. However, the objective of this document is to focus specifically on the role of pricing instruments.

At this stage, the internalisation strategy aims at improving efficiency in transport users' decision by reflecting external costs in price mechanism in consistency with the principle that the user pays for the costs it produces. However, the acceptability of the reforms by transport users is also crucial for the implementation of any internalisation scheme. This will require that internalisation measures are introduced as part of wider packages of measures that take into account the need to reduce external costs and the economic and social effects. These policy packages will also consider the earmarking of internalisation revenues to fight externalities and facilitate clean mobility.

4. ASSESSING EXTERNAL COSTS

The characteristic of externalities is that they are not borne by the user. One of the reasons may stem from the fact that it is often difficult to identify precisely the physical impact as such. Assessment is also made difficult as there is often no market and no monetisation. For example, air pollution and noise affect health; time loss imposes adjustments and waste. But these costs are indirect and there is not market as such to monetise them. As a result, internalising these costs require **making estimates of these costs**.

Box 1: Methods to estimate external costs

Several methods exist to monetise to external cost.

One method is **damage costs** which estimates the consequences of nuisances and monetise them. The first step is to estimate the consequence of the nuisance in physical terms. The second stage is then to monetise the physical damage of the nuisance. In general, a dose-response function is used, measuring the relationship between exposure to pollution as a cause and specific outcomes as an effect. This outcome can be related to market prices.

A similar method is the **avoidance cost** approach which tries to assess the costs of measures needed to reduce externalities down to a socially accepted target. This method may lead to a less efficient outcome, but can be used when there is too much uncertainty surrounding the estimation of damages. The physical impact is first measured in terms of physical units, and the cost of repairing the damage is then estimated.

Another method is the use of **surrogate markets** in order to try to assess the changes in price of goods as they become exposed to a specific nuisance. The hedonic price method can be used, meaning that the price of a marketed good is related to its characteristics

(including environmental characteristic s), or the services it provides. For example, the price of houses exposed to noise could give an indication of the cost of noise. Such a method may sometimes underestimate (or overestimate) the true external costs as hedonic prices may reveal the costs of people are aware of (i.e. people living in houses exposed to noise may be less sensitive to noise).

Another method is linked to the **willingness to pay** (contingent valuation). This method relies on interviews or questionnaires asking people how much people would be willing to pay to avoid nuisances. In the same remit, people may be asked their **willingness to accept**, i.e. how much financial compensation they would accept to compensate for the noise.

As regards environmental costs, the **impact pathway method** which has been developed by ExternE project is commonly used. In this method, several steps are needed to assess the physical process (emissions, transformation in the atmosphere, effects on health and ecosystems) and then the monetisation of losses. During the monetisation phase, market prices are used when available (which is often the case for material losses). Otherwise, valuation methods described above are used to monetise losses (willingness to pay, willingness to accept, avoidance costs, damage cost).

The study to be published by the Commission will review existing estimates for each external costs and best practices per cost category.

Here, the external costs are limited to congestion, air pollution, climate change, accidents and noise.

4.1. Congestion costs

Congestion cost is linked to the limited capacity of infrastructure and the time/delays imposed on other transport users. As a result, when demand is too high for a fixed capacity, there is congestion. For road, more vehicles are added to traffic flows, particularly car traffic flows which increase time of travel. For rail or aviation, other operators will not be able to get the slot they want, leading to slot scarcity and unsatisfied demand.

Congestion is heavily dependent on time and location. More specifically, congestion will be different between urban and non urban areas, and between different types of roads. Estimates of congestion costs should take into account these parameters and should be differentiated.

Table 4: External Congestion cost: steps for measurement

Formula	External Congestion Cost = Speed reduction * Value of time
Steps (road transport)	Differentiation of the traffic network (urban/interurban, single/multiple lanes) Speed flow function Valuation of speed losses with a valuation of time approach. Estimation of traffic reactions by charging the external congestion costs
Steps (other modes of transport)	Estimation of delays and scarcity costs. Difficulties to differentiate between scheduled and non scheduled transport.

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

4.2. Accidents costs

Accidents costs are already partially internalised by vehicle drivers. External accidents costs are those costs which are not covered by risk oriented insurance premiums. The level of external costs depends on the level of accidents, but also on the insurance system. Besides human suffering, most of the costs are material damages, administrative costs, medical costs, production losses and risk value.

Table 5: External Accident cost: steps for measurement

	Bottom-up Approach	Top down approach
Formula	External Accident Cost = Accident risk * Risk Elasticity * unit cost per accident * external share	External Accident Cost = Accident figures * unit cost per accident * external share
Steps	Estimation of the risk for injurers and victims corrected for underreporting Apply a risk elasticity approach Estimate cost of unit value per type of damages (considering part covered by insurances) Assumption on external share of accidents costs Estimation of marginal cost.	Collect accident statistics Estimate cost of unit value per type of damages (considering part covered by insurances) Total cost calculation of total accident costs per mode and allocation of total cost to different vehicle categories. Average cost calculation based on total cost per mode and vehicle country.

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

4.3. Noise costs

Noise costs are costs for annoyance (connected with specific effects such as the necessity to close windows in order to avoid sleep disturbance) and health (e.g. heart attack, high blood pressure). They depend on the time of the day, on the existing noise level and on the receptor density close to the emission source. They also vary among modes of transport.

Table 6: External Noise cost: steps for measurement

Formula	External Noise Cost = Specific noise emission*number of people affected*damage per dB(A)
Steps	Top down approach Noise function per mode Provide geographical information on noise exposure (receptor density) Assess the willingness to pay per dB(A) and health unit cost per person.

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

4.4. Air pollution costs

Air pollution costs refers to the costs of emission of particulate matter, carbon monoxide (CO), lead, volatile organic compounds (VOC), nitrogen oxides (NOx) and sulphur dioxide (SO2). These emissions create damages on health and the ecosystem which are

translated into costs. Air pollution costs depend on the characteristics of vehicle/aircraft engine/vessel, and on speed, operating practice and fuel type.

Table 7- External Air Pollution cost: steps for measurement

Formula	External Air pollution Cost = Specific Emission * cost factor per pollutant
Steps	Assess transport flows. Emission factors for all vehicle, train, plane and ship technologies Geographical information (receptor data) and meteorological data to assess concentration and impacts. Monetary valuation based on WTP/WTA or damage cost.

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

4.5. Climate change costs

Climate change costs are difficult to assess given the huge variety of physical impacts[16] and their global pattern. At the same time, climate change costs have to be estimated in a long term perspective, meaning the need to take into account the welfare of future generations.

Table 8: External Climate Change cost: steps for measurement

Formula	External Climate Change Cost = Specific GHG-emissions*shadow price of CO2 equivalent
Steps	Assess total vehicles kilometres of different vehicle categories for an area/region/country Multiplication of vehicle kilometres by emission factor for the various greenhouse gases Adding various greenhouse gas emissions to a total CO2-equivalent greenhouse gas emission using Global Warming Potentials**. Multiplication of the total tonnes of CO2 equivalent greenhouse gas emission by an external cost factor expressed in €/tonne to estimate total external costs related to global warming***.

Source: Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Handbook on estimation of external costs in the transport sector

*** The handbook highlights that this step is not formally correct as some authors (Watkiss) have calculated separate costs for CO2 and CH4 and the ratio between these two is not the Global Warming Potentials and is not constant over time.*

**** For aviation, the approach the Commission has proposed bringing the sector into the EU Emission Trading System: if enacted, the cost would be determined by the overall cap on CO2 and the behaviour of the market.*

To summarise:

Before internalising, there is a need to assess the physical impact of nuisances and to monetise them. Based on these common foundations, there is a large variety of methodologies to estimate external costs.

[16] The Stern Report published in 2006 gives a list of potential impacts from floods to drought and disparition of species…. Greenhouse gases (mainly carbon dioxide – CO2) have an impact on the earth's climate, resulting in increased desertification, raised sea levels, serious harm to agriculture and other destructive environmental and health-related side-effects.

External costs change over time for instance as a result of the introduction of cleaner vehicle standards or stricter climate change reduction target. These values need therefore regular updates. At the same time, the methodologies for measurement are refined over time, although there is already a substantial amount of research results which is available.

5. POLICY TOOLS

The objective of internalisation is to improve fairness and efficiency. As a result, the optimal internalisation strategy will try to optimise economic efficiency as far as possible using marginal cost pricing and relying on market-based instruments.

5.1. Marginal cost pricing

It is widely acknowledged that the charging approach that would respond to efficiency and fairness principles would be the marginal social cost approach[17]. Such an approach means that prices in transport should be equal to the short-run additional cost created by an additional user of the infrastructure. In theory, this approach should include price-relevant user cost (infrastructure use cost, congestion, scarcity costs) and marginal external costs (environmental costs, external accidents costs). Marginal social cost pricing would then lead to allocative efficiency for the use of existing infrastructure. Furthermore, as the user would pay for the additional cost he imposes on society, this would contribute to fairness across transport users and non users.

Nevertheless, given the wide variety of locations and time, it is in practice very difficult to assess precisely all marginal costs. As a result, some simplification is inevitable, in particular when assessing congestion costs. Furthermore, the marginal cost approach alone does not consider the possible use of pricing revenues in the context of infrastructure provision and the possible financial implications of the pricing scheme[18], i.e. the cost recovery of infrastructure. In case marginal social cost pricing is not sufficient to fully cover infrastructure costs (i.e. in case of high fixed costs or low traffic density areas) and if this is considered necessary, complementary approaches could be implemented, e.g. a premium can be added. This also may contribute to ensuring fairness between transport users and society at large. At this stage of the exercise, cost recovery will not be considered (see box 2).

Box 2: Infrastructure costs and cost recovery principle

Traditionally, infrastructure costs have been borne by public authorities or by operators linked to public authorities. In most cases, it is still true nowadays although some infrastructures are increasingly provided by the private sector (subject to public-private partnership contracts) in some Member States and some modes (motorways, airports).

[17] Marginal social cost refers to the additional private and external cost of engaging in a transport activity. An optimum situation would be when the price paid by users equals marginal social costs, including private and external costs.

[18] Apart from the case of congestion pricing which under some circumstances may allow infrastructure cost recovery.

The issue of the financing of infrastructure and its cost recovery is not developed here as it is assumed to be independent of the internalisation of external costs. This "separation" assumption is quite realistic for most external costs (air pollution, noise, accidents) as cost recovery payments are weakly related to the costs drivers of these externalities (e.g. vehicle characteristics, population density, etc). As to congestion and climate change (and to a lesser extent other external costs), cost recovery pricing may reduce traffic through higher transport costs and therefore lower these external costs.

Cost recovery schemes differ widely among Member States, among different kinds of infrastructure (e.g. motorways, rural roads, streets) and among modes of transport. The Eurovignette Directive (2006/38/EC) envisages the possibility to take account of infrastructure construction, operating, maintenance and development costs and states that tolls should be based on the principle of recovery of infrastructure costs. The directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification states that infrastructure charging should be set at the cost that is directly incurred as a result of operating the train service and envisages the possibility of mark-ups to recover costs.

The assumption of separation between efficient infrastructure use and efficient infrastructure provision, including cost recovery is needed to allow the theoretical analysis of internalisation to proceed. When it comes to implementing instruments, it should be acknowledged that there are many linkages between both as for example, the differentiation of cost recovery charges according to environmental criteria in the Eurovignette Directive. Finally, it has been demonstrated that under certain restrictive conditions, congestion pricing allows to finance efficiently infrastructure.

This paper deals with external costs and does not address infrastructure.

The marginal cost approach is efficient and could be combined with other existing pricing schemes.

5.2. The use of market-based instruments

As required by the Eurovignette Directive, the Commission focuses on the internalisation of external costs, i.e. on pricing instruments. In addition, tradable emission permits are also considered as they are another way of influencing pricing.

A tax[19] based on an external cost can contribute to making the transport user pay. However, a tax cannot differentiate between different locations and different hours. Accordingly, tax might be used to internalise some external costs, but not all of them.

A charge[20] based on distance or other criteria such as time or location is another way to internalise some costs. Compared to taxation, charges allow differentiating, but it requires special equipment (e.g. tolls). As an example, some countries such as Italy or

[19] A tax is a required payment of money to governments that are used to provide public goods and services for the benefit of the community as a whole. Examples are fuel tax, circulation tax, registration tax.

[20] A charge is a proportional payment required in exchange for a clearly defined service. For example, a toll charge will give access to the use of a specific infrastructure (bridge, motorway, etc…).

France already have infrastructure tolled throughout the country whereas other countries such as Austria or Hungary use the motorway vignette system. When no equipments already exist, implementation and transaction costs could be high. However, these could be substantially reduced by the use of electronic charging. This option will be scrutinised.

Finally, tradable permits are another way of influencing pricing. Permits allow a certain level of pollution and can be exchanged between economic agents. Here again, implementing a trading scheme imposes costs.

The Commission will analyse different possible combinations of market based instruments in the envisaged policy options.

5.3. Existing taxes and resources

One cannot ignore the existing charges and taxes across Member States which entail sometimes a possible situation of internalisation. The current situation as regards taxation and charging reflects a wide variety between Member States and between different modes of transport, despite the existence of directives on taxation and infrastructure charging (Energy taxation (2003), Eurovignette).

Transport taxes were mostly established for revenue-raising purposes or to contribute to financing transport infrastructure, although some of them are related to environmental aspects. Most of them flow to the general budget. In 2004, environment related taxes represented approximately 2.4% of EU25 GDP, of which 1.9% were energy taxes (mostly petrol and diesel taxes) and 0.5% were transport specific taxes (related to the ownership and use of motor vehicles).

The Commission intends to take existing charges and taxes into account in order to avoid double charging.

6. POLICY OPTIONS

The difficulty of the identification of external costs in all times and places imposes a trade-off between the level of differentiation and the cost and feasibility of its implementation. Policy options will envisage the use of different market based instruments for each external cost. Each policy options will have to be assessed according three principles: (1) fairness, (2) efficiency; (3) reduction of externalities. In addition, the European value added will be analysed with regards to the internal market functioning and cohesion.

As mentioned above, the Commission will consider the following external costs: congestion, air pollution, climate change, accidents and noise (see box 3).

Box 3: Other external costs: infrastructure use costs and land use

Infrastructure use costs correspond to the variable part of infrastructure costs. Although it is often difficult to distinguish the variable cost from the fixed costs, it is generally

considered that variable infrastructure costs cover maintenance and operating costs (expenditures for road maintenance, expenditure for dredging a canal or a harbour). These costs vary with traffic volumes, vehicles weight per axle and weather conditions.

However, only a part of these variable costs can be considered as external cost insofar as they are imposed by some users on other users. Damage costs by vehicles could be considered as external costs. According to economic studies, these costs are far lower than congestion costs and other costs such as environmental costs (UNITE (2003)).

At this stage of the analysis, it is considered that infrastructure use costs are taken into account in existing pricing schemes in Member States. Therefore, no policy options will be proposed although the policy options proposed below for congestion costs or environmental costs could be applied as well.

For some other costs such as those related to **land use** or damage to nature, it has been considered that evaluation methodologies would still need to be refined in order to allow standardised approaches.

Internalisation of these costs should be applied to road, rail, aviation, maritime and inland waterway. When possible, differentiation between urban and non urban transport will be made[21]. This is particularly relevant for the different external costs of road and rail transport and should help to get an understanding of the urban dimension in the external costs of these modes. A particular problem however is that urban areas are different among themselves, for example in their spatial development, network design and geographical setting.

6.1. Policy options: congestion costs

6.1.1. Congestion in road transport

No new action ("business as usual" - BAU). Over the past decades, congestion has increased all over Europe. Congestion is not homogeneous throughout Europe or even within countries and regions as it is heavily dependent on location and time. Apart specific cases where national public authorities deliberately aim at reducing congestion (differentiated road charges such as in France, motorway A1, cordon toll in London), there are no specific measures tackling congestion costs.

At European level, the Eurovignette Directive deals with road charging for heavy goods vehicles using the trans-European network (TEN). However, the application of these charges is optional and very little of the existing total network is actually tolled or "vignetted" at the present time. The directive allows but does not oblige Member States to differentiate the existing charges for the

[21] The general principle of internalisation of external costs in transport does not separate transport in urban and non-urban contexts and therefore the model for the assessment of external costs will implicitly also cover urban areas.

purpose of tackling congestion.[22] For passenger cars Member States are free to charge as they wish.

Existing actions are not sufficient to tackle the congestion problem in Europe. Unless individual initiatives are taken at national, regional or local level, the situation will worsen with increasing transport demand and congestion will remain as one important problem in Europe.

Differentiated charges for congestion. A charge corresponding to marginal congestion cost could be levied on all roads (and not only on the TEN so as to avoid displacing congestion costs to other roads). It could be implemented in the short term through modulation of existing tolls and in a longer term through electronic pricing for all vehicles. Technology could help differentiate between different level of external costs. Electronic tolls allow differentiating in function of time, distance, location and road type, which is close to the principle of marginal social cost pricing.

Within this policy option, a differentiation between users could be made between a) freight transport, b) passenger transport (including private car), c) passenger and freight transport.

Tradable permits: auctioning of the right to pass could be envisaged as a way to reduce congestion. In this case, a number of vehicles would be identified and the price for using a road would essentially depend on the volume or demand for a particular period. This option could be applied to freight transport in some specific links or corridors.

6.1.2. Congestion/scarcity in rail transport[23]

No new action (BAU). In rail transport, congestion does not lead to queues, but can lead to delays and problems of arrival or departure time. In addition, scarcity in rail transport corresponds to the inability of a train to obtain a given path in terms of departure time, stopping pattern or speed. While delay of a given train has a negative impact on other trains, scarcity of infrastructure prevents other trains from operating.

The Directive 2001/14/EC allows charging external costs and congestion under certain conditions. More specifically, the infrastructure charge may include a charge which reflects the scarcity of capacity of the identifiable segment of the infrastructure during periods of congestion according to article 7.4. In such a case, the rail infrastructure manager needs to demonstrate through a "capacity

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22 Toll rates may be varied according to the time of day, type of day or season, provided that (i) no toll is more than 100 % above the toll charged during the cheapest period of the day, type of day or season; or (ii) where the cheapest period is zero-rated, the penalty for the most expensive time of day, type of day or season is no more than 50 % of the level of toll that would otherwise be applicable to the vehicle in question.

23 As regards scheduled transport, there are other options which could also tackle scarcity problem. Slot allocation is one of them. Given that the ongoing exercise focuses on internalisation, the choice has been made to leave this option. Furthermore, in order to simplify, it is assumed that demand meets capacity through normal market mechanism, i.e. prices.

analysis" that capacity is full in order to set scarcity charges and to decide on a "capacity enhancement plan". At present, this provision is only applied in a limited number of cases. Removing the requirement for a capacity analysis and/or a capacity enhancement plan risks monopolistic price setting and discrimination of railway undertakings, especially because the level of scarcity charges are based on opportunity costs, which are difficult to verify against the accounting system. It was for these reasons that the EU legislator introduced these conditions.

Generalised scarcity charge. Charges corresponding to the scarcity of slots could be systematically applied when the scarcity of capacity is clearly identified. They would reflect excess demand on capacity utilisation and would allow allocating existing capacity to the most valuable uses.

6.1.3. Congestion/scarcity in air transport

No new action (BAU). Congestion in air transport is similar to congestion in rail transport and may lead to delays and queues. Scarcity is also similar to rail. The use of slots can help to tackle congestion. Here again, leaving the situation as it is would not solve the problem of congestion in air transport. In order to alleviate this problem, the Commission intends to clarify and/or amend the existing legislation (Regulation (EEC) No 95/93 on common rules for the allocation of slots at Community airports, as amended).

Scarcity charge. One way of dealing with congestion would be to modulate landing charges to take into account the loss each plane imposes on other planes. One way would be to make the charge dependent on the number of other planes and to the desired time.

6.1.4. Congestion in maritime and inland waterway transport

No new action (BAU). Congestion in large ports is a problem. It is also a problem in inland waterway for some locks. Here again, leaving the situation as it is would not solve the problem of congestion in maritime transport as there are no measures foreseen in this area.

Differentiated charges. One way of dealing with congestion would be to impose differentiated charges depending on time.

6.2. Policy options: Accident costs

Accidents are mainly a road problem (in 2005, there were 105 killed in rail accidents) even through the number of road fatalities has considerably decreased since 1990.

No new action (BAU). One of the objectives of the White Paper on transport was to decrease fatalities by 50% in 2010. Regulatory measures have contributed to increasing safety on roads and to modify drivers' behaviour. Technological improvements have made cars safer (ex: airbags).

Leaving the situation as it is would mean relying on regulation and enforcement, R&D to generate further technological progress, information and education

measures and car insurance schemes. Regulation has proved successful although cross border enforcement could improve the results. Insurance schemes also contribute to influencing behaviour through the differentiation of premiums. Here, accident costs would remain only partially internalised.

Internalising through the expansion of insurance liabilities. A common principle would be to ensure that insurances cover total costs of accidents and not only partial ones. The Commission could encourage Member States to ensure that insurance companies are able to improve the current pricing system. An option would be to charge the insurance company involved a lump sum amount at the level of estimated external costs for each accident. Insurance companies have information on cost drivers and could then pass through this cost to drivers through differentiated premiums according to their accident risk profile (age, …).

Safety charge: In this case, a safety charge would be levied. It would be based on the difference between the marginal social cost and the marginal private cost. Electronic charging could help differentiate and include an accident charge. In this case, charges may vary according to type of vehicle, type of infrastructure and driver categories.

6.3. Policy options: Dealing with environmental external costs imposed on society

Whereas accident and congestion are highly dependent on the mode of transport (scheduled or not), environmental nuisances are common to all modes of transport. Therefore, policy tools could be the same and used at different level depending on the level of external cost.

6.3.1. Policy options: noise

No new action (BAU). The Commission published a report[24] on existing Community measures relating to sources of noise. As outlined in this report, transport noise is addressed through a wide range of instruments including provisions on assessment and management of environmental noise, noise standards for transport means and products (road vehicles, aircraft, rail rolling stock and tyres) and transport charging. The Commission endeavours to further develop these measures in order to reduce the noise exposure situation in Europe. A communication is in preparation providing suggestions to Member States and stakeholder to retrofit existing freight wagons with low-noise braking systems[25]. A consultation[26] has recently been launched regarding the tyre noise specifications.

Some Member States impose noise charges and the situation is heterogeneous across Europe.

[24] See: http://ec.europa.eu/environment/noise/sources.htm
[25] see http://ec.europa.eu/transport/rail/consultation/2007_rail_noise_en.htm
[26] See: http://ec.europa.eu/enterprise/automotive/pagesbackground/safety/consultation/index.htm

Imposing a tax on noise. Aviation noise charges/taxes are already levied in most Member States. This experience could be generalised through all modes of transport in all Member States.

Imposing a differentiated charge on noise. Here the tax/charge would be levied according to noise class of the vehicle/train/plane and according to location and time (day/night). Member States are due to submit noise mapping by the end of 2007. This could be used as a basis to impose charges in noisy areas. Here again, electronic charging could help differentiate.

6.3.2. Policy options: air pollution cost

No new action (BAU). Several existing taxes contribute to reducing air pollution. In addition, regulatory measures (e.g. standards) have contributed to limiting emissions of pollutants. Annual vehicle circulation taxes are already differentiated according to the vehicle characteristics in some Member States. The Eurovignette directive will after 2010 impose the compulsory differentiation of tolls based on the EURO classification of the engine. As a result, part of air pollution costs are already tackled (through regulation) and internalised (through taxation). Here again, it should be stressed that current Eurovignette tolls are strictly optional and that Member States have no obligation to levy any charges. Furthermore, such charging system only deals with heavy goods vehicles.

Air pollution tax. Vehicle registration taxes could be differentiated in order to promote purchase of less polluting vehicles in all transport modes. The same could be applied to vehicle circulation tax. Fuel excise duties will be examined as a possible means.

Air pollution differentiated charge. Such charges could be differentiated in relation to the environmental performance of vehicles, trains, planes and ships. Sweden and UK (and Switzerland) already impose an element related to NOx emissions in the landing charge at their major airports.

6.3.3. Policy options: climate change

No new action (BAU). One option would be to leave the situation as it is and rely on existing regulations (in this context, part of existing excise duty on fuel can be considered as a first step of internalisation) and foreseen initiatives. These include the proposal to include aviation in the EU emission trading schemes (ETS), the harmonisation of commercial diesel, the passengers' car taxation. According to the proposal on passenger car taxation[27], by 2008, at least 25% of the total revenue from annual circulation taxes and registration taxes shall come from a carbon-dioxide based element in the tax structure. This share should be 50% for 2012. By 2016, it is proposed that all registration taxes should be abolished. The proposal[28] to include aviation in the ETS would allow airlines to purchase allowances for all emissions of aircraft above the historic emission levels of 2004-2006. Finally, the

[27] COM(2005)261
[28] COM(2006) 818

proposal[29] on commercial diesel aims at reducing distortions of competition and environmental damage in the transport haulage by reducing fuel tourism. An initiative will also deal with fuel efficiency target for new passenger cars.

CO2 tax. Here again, a more sophisticated CO2 tax could be imposed on the different modes. Vehicle registration taxes could be differentiated to promote the purchase of vehicles that produce less CO2 emissions. Furthermore, excise duties have to be taken into account[30].

Tradable permits for all transport. The inclusion of all modes of transport in ETS could be envisaged. Depending on the modalities of such inclusion, this might affect the purchase or the use of vehicles. Practical solutions would differ for the different transport modes.

6.4. Integrated charging policy option: electronic, perfectly differentiated charging in road transport

As mentioned, electronic charging would allow differentiation and could lead to the implementation of marginal cost pricing. Furthermore, electronic charging would also allow having an integrated approach of external costs. This integrated charging could include a charge for a number of or all external costs for freight and passenger transport, i.e. perfect information of what can really take place.

Table 9: Summary of policy options (without BAU option)

	Charge	Tax	Tradable permit	Electronic charging
Congestion				
Road	Policy option for freight, passenger, freight + passenger		Policy option	Policy option for freight, passenger, freight + passenger
Rail	Policy options			
Air	Policy option			
Maritime	Policy option			
Inland Navigation	Policy option			
Accident				
Road	Policy option	Policy option		Policy option
Rail				
Air				
Maritime				
Inland Navigation				
Noise				
Road	Policy option	Policy option		Policy option
Rail	Policy option	Policy option		
Air	Policy option	Policy option		
Maritime				
Inland Navigation				
Air pollution				
Road	Policy option	Policy option		Policy option
Rail	Policy option	Policy option		
Air	Policy option	Policy option		
Maritime	Policy option	Policy option		

[29] COM(2007)52

[30] A step further would be to identify a CO2 element in the EU minimum levels of taxation.

Inland Navigation	Policy option	Policy option		
Climate Change				
Road		Policy option	Policy option	
Rail		Policy option	Policy option	
Air		Policy option	Policy option	
Maritime		Policy option	Policy option	
Inland Navigation		Policy option	Policy option	

Annex: Transport and environmental taxes/charges in Member States – transport

	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FIN	F	HU	IE	IT	LT	LV	LU	MA	NL	PO	PT	SL	SK	SW	UK	RO
Infrastructure Charges																											
Road		■			■					■	■											■		■	■		
Rail											■																
Aviation																			■						■	■	
Parking fees	■																		■								
Vehicle charges																											
Vehicle Tax	■	■			■	■	■	■	■	■	■	■	■	■	■				■	■	■				■	■	
Safety levy	■																										
Noise tax													■							■					■		
Fuel tax	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Air pollution tax										■		■	■		■										■		

Adapted from OECD data base.

No data for Slovenia and Latvia. Missing data for Italy.