Indicator fact sheet

TERM 2005 25 — External costs and charges per vehicle type

Indicator code / ID	
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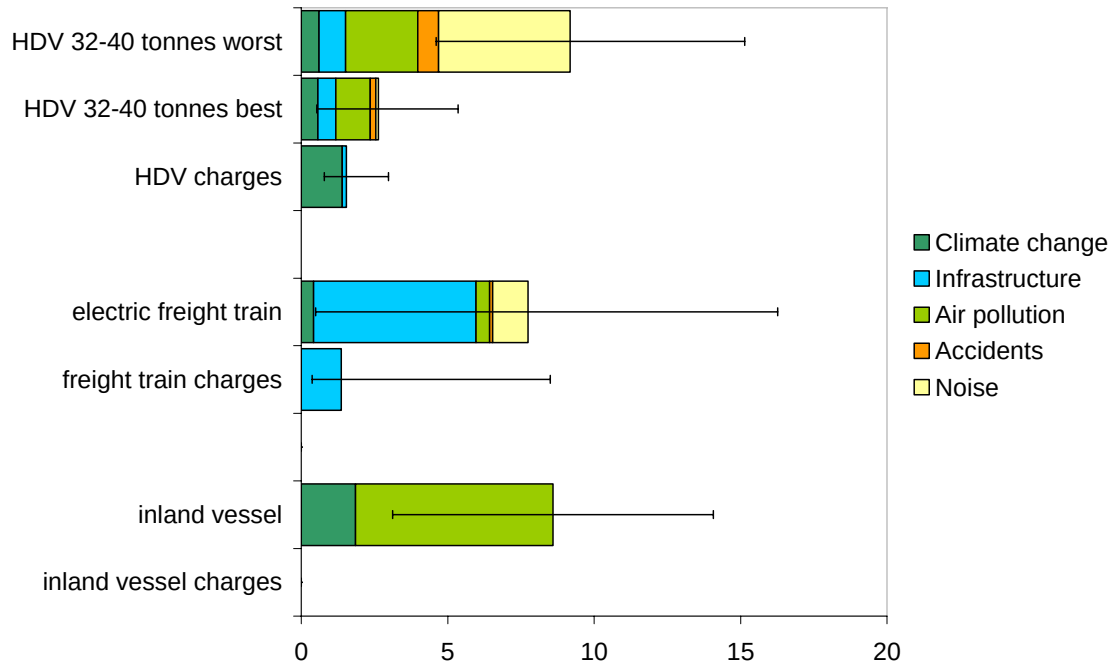
i **External costs of transport are an important issue; they are estimated at about 7% of the EU-15's GDP in total. The external costs per vehicle km are highly variable between modes and within modes, showing that the level of marginal costs depends heavily on the type of vehicle and the traffic situation considered. Marginal external costs generally exceed charges levied. The most important categories of external cost are accidents, air pollution and climate change. Noise and congestion can play an important role in specific traffic situations.**

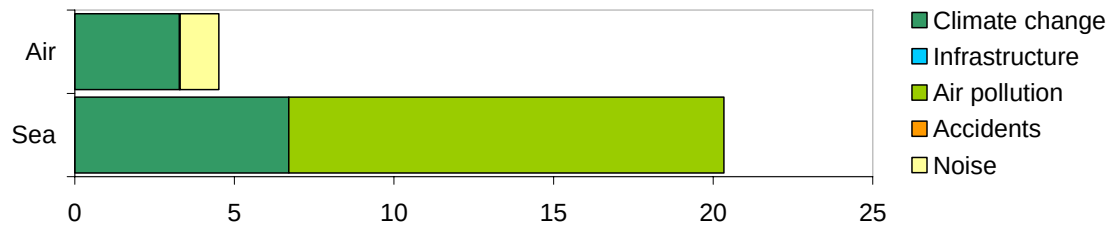
Figure 1a: EU average marginal external costs and variable charges of freight transport (EUR/10 vehicle-km for road freight; EUR/vehicle-km for other modes)



Note: HDV = heavy-duty vehicle (32–40 tonnes gross vehicle weight). Worst case HDV refers to an urban ride at night time in thin traffic, best case refers to rural ride on a motorway in dense traffic. Both HDVs are of average Euro-class. Charges for the freight train are based on a train with a total gross weight of 1000 tonnes. Cost values presented are averages calculated from ECMT, INFRAS and UNITE, inland vessel costs based on the latter two. All studies are directed at Eu-15. The error bar indicates the range in average values from these studies. Charges include infrastructure charges and excises for 2003. Freight train charges related to EU-15 except LU, ES, GR and IE. HDV charges related to EU-15 plus CZ, HU, PL, SI and SK. Congestion costs are not included; for inland vessel infrastructure charges were neglected. See table 1 for this figure's data. For an analysis of the differences in estimates, see CE, 2003.

Source: Infras, 2000, 2004, ECMT, 1998b and forthcoming, and UNITE, 2002, TERM 21 Fuel prices and taxes and TERM 22 Progress in charge levels.

Figure 1b: EU-15 average marginal external costs and variable charges of freight transport (EUR/vehicle-km)



Note: Air relates to an international flight over 1400 kilometres carrying 12 tonnes. Cost estimates are based on Infras, 2004 and relate to the EU-15. Sea freight estimates come from UNITE, 2002, and relate to the ferry Helsinki - Tallinn. Accident cost (not presented in graph) are estimated to vary from 73 to 10.000 Euros (1998) annually. Since estimates for air and sea are based on different studies, and estimates from both studies for the same mode can differ widely (see Figure 1a) care should be taken with comparisons between modes. See table 1 for this figure's data.

Source: Infras, 2004 and UNITE, 2002.

Results and assessment

Policy relevance

The reduction of external costs of transport is a main policy goal of EU environment and transport policies. There are two sets of policy tools that aim to reduce external costs.

1. 'Command and control' measures that directly reduce emissions (e.g. the Auto-Oil programmes), or other kinds of external impact (e.g. traffic bans in urban neighbourhoods).
2. Pricing mechanisms (e.g. taxes, charges, subsidies) that give incentives to change users' behaviour towards 'cleaner' transport. In most cases, the internalisation of external costs refers to this set of policy tools.

Internalisation policies are dealt with in the fact sheet on internalisation of external costs, which focuses in particular on pricing instruments (TERM 2005 26 EU – Progress in charge structures and internalisation policies).

The main principles for internalising (uncovered) environmental costs are set out in various international agreements (Vancouver, 1996; CEI, 1997; UN, 1997; ECMT, 1998a; UNECE/WHO, 1999):

- Pollution prevention: transport needs must be met without generating emissions that threaten public health, global climate, biological diversity or the integrity of essential ecological processes.
- Health and safety protection: transport systems should be designed and operated in a way that protects the health (physical, mental and social well-being) and safety of all people, and enhances the quality of life in communities.

Policy context

The external costs of transport are those that affect society, but are not directly born by the transport user who has caused them. The structure of the external cost provides information to policy makers as to formulate effective transport policy that reduces costs to society.

External costs may consist of:

- environmental costs (e.g. damage due to air pollution, climate change, noise, electromagnetic fields, and other upstream and downstream environmental effects);
- urban separation;

- non-covered accident costs (such as loss of labour and productivity, but also grief and suffering);
- congestion (time loss inflicted on others);
- non-covered infrastructure costs.

The internal costs, or private costs, are those borne directly by the individual user of transport services. For example, for road transport, these costs include car purchase, fuel, maintenance, taxes, charges and premiums, and the cost of spending time. The total social cost of transport is the sum of the internal and external costs.

As internal costs, external costs may be fixed or variable. Variable costs relate to actual transport (i.e. kilometres travelled), fixed costs do not. Fixed external costs may arise within the upstream and downstream phases of the transport lifecycle (e.g. environmental costs arising when producing the fuels, during production/dismantling or construction of any kind of vehicle.

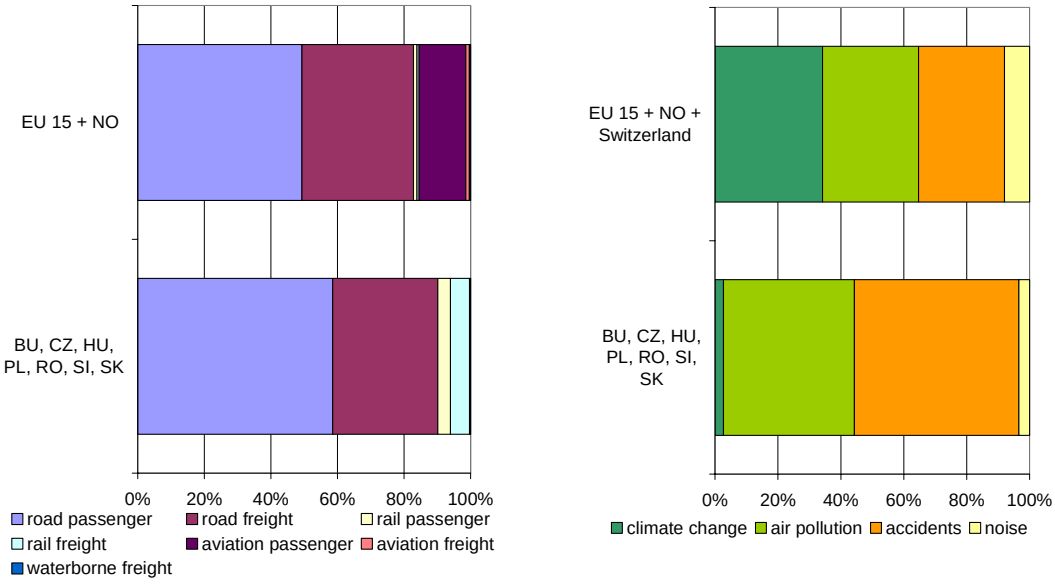
Environmental context

The marginal external costs and distance dependent charge levels tell us how much of the external costs are internalised. The smaller the gap between the external costs and the variable charges, the more efficiently a society is functioning. Efficiency can also be improved by changing the structure of variable charges to better reflect the external costs. The external cost level does not provide direct information on the pressure on the environment, as this depends on local circumstances; the external cost level presents information on the costs to society and depends on population density, time of day and prosperity. Internalisation of external cost provides incentives to internalise external effects that hamper the environment and human health. Internalisation 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 a smaller negative impact of transport.

Assessment

External costs are difficult to estimate and there is currently no unique, commonly accepted methodology for estimating external costs. Results of international studies vary widely due to differences in statistics and normative choices underlying results, see CE, 2003. External cost estimates range from 4 (ECMT, 1998b) to 7% (Infras, 2004) of GDP for the EU-15 countries in 2000 to 14% of GDP for Central and Eastern Europe in 1995 (OECD, 2003). In figure 2 the distribution of marginal external costs over modes and cost components is shown.

Figure 2: a) Contribution of transport modes to external costs (excl. infrastructure) in 2000 b) Composition of external costs (excl. infrastructure) of transport in 2000



Note: The small share of climate change cost for the new member states and the candidate countries is due to lower marginal abatement cost for CO_2 emissions in these countries. Sea transport is not included.

Source: Infras, 2000, 2004; OECD, 2003

As can be seen from these figures, the most important cost categories of transport are accidents, air pollution and climate change. Together, these three cost categories are responsible for more than 80% of total external costs in the EU-15 and even more in the new member states and candidate countries. Road transport as a whole amounts to around 85% of total external costs. The share of aviation in external cost is expected to increase due to the fast growth of the aviation industry and curbing of air pollution cost of road transport due to the Euro-norms. Furthermore, Directive 2004/26/EC is expected to curb the emissions of inland vessels and diesel trains in the future.

Several organisations carried out studies that have estimated the external costs of transport. The studies differ considerably in their scope, the specific transport modes considered, the kind of impacts evaluated, the hypotheses used and, correspondingly, the final quantitative results obtained (OICA, 1995; Friedrich et al, 1997; ECMT, 1998b; Infras, 2000, 2004; UNITE, 2002; CE, 2004). Despite the different approaches, some rather consistent qualitative conclusions can be drawn for the several studies:

- External costs of transport are large in absolute terms and represent a substantial problem for EU countries.
- All transport modes cause external effects by air pollution and climate change. These are the highest cost components.
- Although accident costs only play an important role in road freight transport, they are substantial.
- Among the various atmospheric pollutants considered, fine particles (both emitted directly by tailpipes and generated by photochemical transformation of other pollutants) appear to be particularly damaging because of their threat to human health.
- Road transport — the largest share of both passenger and freight mobility volumes — is also the largest contributor to total external costs (see figure 2a). However, some important improvements have been obtained through the newest technologies (e.g. Euro IV vehicles), reducing the environmental impact per vehicle-km.
- The marginal external cost of road and rail freight transport (i.e. the cost related to the last additional kilometres driven by any transport mode considered) varies considerably according to where and when the trip is taken and what means of traction is used. Urban trips cause a much higher impact than rural trips, mainly because the higher population density in urban areas results in more people being exposed to noise and health effects of air pollution. The valuation can also vary considerably among different urban areas, depending on the population densities and climatic and geographic characteristics.

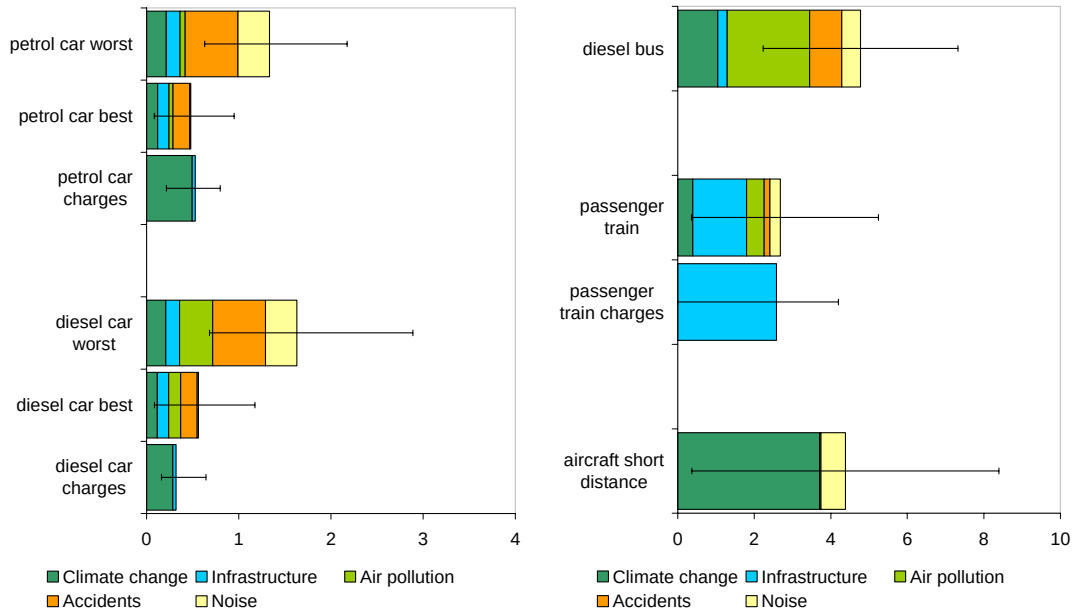
In road transport, the distance dependent charges currently only reflect a part of the marginal external costs (figure 1). Although for the best case situation, variable charges come close to marginal external cost, a differentiated kilometre charging system would be able to better reflect the cost structure and could pose incentives to reduce other than climate change costs.

All studies used were directed at EU-15 countries. OECD 2003 evaluates total and average external cost for 1995 for Central and Eastern Europe. Infrastructure cost were not included in this study. In general, in 1995, for road and rail freight transport cost in the new member states are estimated at about 50 % of cost in EU-15 countries. For aviation costs are estimated at about 14 percent of costs in EU-15 countries. Differences are mainly due to lower valuation of climate change costs and lower accident costs.

Sub-indicator: Marginal external costs of passenger transport

i Passenger cars represent over 50% of all transport externalities. The most important external cost components are accidents, air pollution and climate change. However, this strongly depends on the traffic situation considered. There still remains a gap between the marginal external costs and distance dependent charges of private car transport. Noise and congestion play an important role in specific traffic situations.

Figure 3: a) and b) Marginal external costs and variable charges of passenger transport per transport mode (EUR/10 vehicle-km for passenger cars; EUR/vehicle-km for other modes)



Note: Passenger car worst case reflects an urban ride in thin traffic during night time in car of average Euro-class. Best case: interurban ride on a motorway in dense traffic. The average estimate for a bus related to an urban area, with normal traffic and average Euro-class. Charges for the train are the average of a 500 gross tonne intercity and 140 gross tonne suburban passenger train. The estimate for aviation is for a short-range flight. No charges for bus and aircraft were calculated, congestion cost are not included. The error bars for charges represent the countries with the highest and the lowest variable charges. All cost estimates relate to EU-15. See table 2 for the data.

Source: Infras, 2000, 2004; ECMT, 1998b and UNITE, 2002, TERM 21 Fuel prices and taxes and TERM 22 Progress in charge levels.

Assessment

With respect to passenger transport, the conclusions are in line with the conclusions drawn from the main indicator on freight transport, however:

- Every single transport modes is concerned with its owns specific externalities, e.g. accidents for passenger car transport and climate change for aviation, see figure 3;
- Accident costs only play a large role in passenger car transport as stated above, but is one of the highest cost components in total passenger transport, since most passenger transport is done by private car. (see figure 2b);
- The marginal external cost of road and rail passenger transport (i.e. the cost related to the last additional kilometres driven by any transport mode considered) varies considerably according to where and when the trip is taken.

Currently, the level of distance dependent charges for private car transport reflect the marginal external cost for the best case. However, for the worst case there is still a large gap and the charge structure does not reflect the cost structure. A differentiated (e.g. differentiated to place, time and Euro-class) infrastructure charging system is the best means to fill the remaining gap between the MEC and the current charges, since it provides appropriate incentives to reduce external effects, and does not overly burden passengers that cause relatively few external effects.

Infrastructure charges for rail transport appear to be on the marginal cost level. Charges vary however widely across countries, see also TERM 22 EEA 31 - Progress in charge levels. For bus transport, the information available on charges available is rather scarce. Charges on air transport vary from landing rights to noise and LTO emission charges. Fuel is generally not charged. No detailed information on charge levels is yet available, see TERM 22 EEA 31 – Progress in charge levels.

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Data

Table 1: Marginal external costs of freight transport by cost category and transport mode

	HDV worst	HDV best	HDV charges	Freight train	Train charges	Inland vessel	Air	Sea
infra	0,91	0,62	0,14	5,55	1,36			

accidents	0,71	0,19		0,10		0,00	0,00	0,00
noise	4,49	0,09		1,21		0,00	1,21	0,00
air pollution	2,46	1,17		0,46		6,74	0,03	13,63
climate change	0,61	0,57	1,40	0,42		1,85	3,28	6,70
bandwidth plus	5,97	2,72	1,45	8,52	7,14	5,47		
bandwidth minus	4,57	2,11	0,75	7,25	0,99	5,47		

Unit: EUR / 10 vehicle-km for road, EUR / vehicle-km for other modes

Source: Costs: Adapted from Infras, 2000, 2004; ECMT, 1998b; UNITE, 2002, charges: TERM 21 Fuel prices and taxes and TERM 22 Progress in charge levels, ECMT forthcoming .

Table 2a: Marginal external costs and charges of passenger car transport by cost category and transport mode

	Petrol car worst	Petrol car best	Petrol charges	Diesel car worst	Diesel car best	Diesel charges
infra	0,15	0,12	0,03	0,15	0,12	0,03
accidents	0,57	0,18		0,57	0,18	
noise	0,34	0,01		0,34	0,01	
air pollution	0,06	0,04		0,36	0,13	
climate change	0,21	0,12	0,49	0,21	0,12	0,29
bandwidth plus	0,84	0,47	0,27	1,26	0,61	0,33
bandwidth minus	0,70	0,40	0,31	0,95	0,48	0,16

Unit: EUR / 10 vehicle-km

Source: Costs: Adapted from Infras, 2004; ECMT, 1998b; UNITE, 2002, charges: TERM 21 Fuel prices and taxes and TERM 22 Progress in charge levels for charges .

Table 2b: Marginal external costs and charges of passenger transport by cost category and transport mode

	Diesel bus	Passenger train	Train charges	Aircraft short distance
infra	0,25	1,40	2,58	
accidents	0,84	0,15		
noise	0,49	0,27		0,64
air pollution	2,16	0,46		0,04
climate change	1,05	0,39		3,70
bandwidth plus	2,54	2,56	1,62	4,01
bandwidth minus	2,54	0,32	2,58	4,01

Unit: EUR / 10 vehicle-km for road, EUR / vehicle-km for other modes

Source: Costs: Adapted from Infras, 2004; ECMT, 1998b; UNITE, 2002, charges: TERM 21 Fuel prices and taxes and TERM 22 Progress in charge levels, ECMT forthcoming .

Table 3a: Composition of external costs of transport in 2000 resp. 1995 (excl. infrastructure)

	Climate change	Air pollution	Accidents	Noise
old 15 + NO + Switzerland	0,34	0,31	0,27	0,08
BU, CZ, HU, PL, RO, SI, SK	0,03	0,42	0,52	0,03

Source: Infras, 2004, OECD, 2003

Table 3b: Composition of external costs of transport in 2000 resp. 1995 (excl. infrastructure)

	Road passenger	Road freight	Rail passenger	Rail freight	Aviation passenger	Aviation freight	Waterborne freight
old 15 + NO + Switzerland	0,49	0,34	0,01	0,01	0,14	0,01	0,00
BU, CZ, HU, PL, RO, SI, SK	0,59	0,32	0,04	0,06	0,00	0,00	0,00

Source: Infras, 2004, OECD, 2003

Metadata

Web presentation information

1. Abstract / description / teaser: External costs of transport are an important issue, estimated at 7% of GDP in the EU-15. Actual marginal cost estimates vary widely according to specific circumstances.
2. Policy issue / question: The external costs of transport are those that affect society, but are not directly born by the transport user who has caused them. The structure of the external cost provides information to policy makers as to formulate effective transport policy that reduces costs to society.
3. EEA dissemination themes: Transport
4. DPSIR: P

Technical information

5. Data source: Infras, 2000, 2004; OECD, 2003; ECMT, 2000, forthcoming; UNITE, 2002
6. Description of data:

   Original file name: TERM 2005 25 EEA31 — External costs of Transport.xls

   Original measure units: EUR per passenger-kilometre or tonne-kilometre.

   Conversion factors applied: conversion into vehicle kilometres using load factors given in Infras.
7. Geographical coverage: EU-15 plus Norway, Bulgaria, Czech Republic, Hungary, Poland, Slovenia, Slovak Republic, Romania.
8. Temporal coverage: Infras: 2000, OECD: 1995; ECMT: 2000; UNITE: 1998.
9. Methodology and frequency of data collection: Frequency: Incidentally studies are carried out.
10. Methodology of data manipulation: Conversion from passenger-kilometres and tonne-kilometres to vehicle-kilometres is carried out using load factors given in Infras, 2000.

Quality information

11. Strengths and weaknesses (at data level): There are different European studies that calculate the external costs of transport, with large differences in results. Furthermore, the external costs of OECD relate to 1995, which is not very up to date.
12. Reliability, accuracy, robustness, and uncertainty (at data level): Cost estimates vary widely between studies, as indicated by error bars. See CE, 2003 for an assessment.
13. Overall scoring (give 1 to 3 points: 1 = no major problem, 3 = major reservations): 3

    Relevancy: 1
    Accuracy: 3 (Large differences in cost estimates between studies, and uncertainty within studies can be high — might be around 40 % according to Infras)
    Comparability over time: 3 (No time series available.)
    Comparability over space: 3

Future work

More has to be done to reach consensus — both from the scientific and the stakeholders' point of view — on the methodology that should be used to evaluate external costs.

This fact sheet's value can be strengthened if more reliable and recent data on external cost estimates for the EU-15 and EU-10 (new member states) become available.

Information on tolls and user charges is rather scarce for other modes than road and rail. Therefore, more effort has to be done to extend the view on charges. A methodology will have to be developed to include aircraft charges. Inclusion would require primary data search as well.