Alpine Convention

Working Group "TRANSPORT"

Sub-Group "COSTS of Transport"

THE TRUE COSTS OF TRANSPORT ON THE TRANSALPINE CORRIDORS

Final Report

July 2007

ACT OF TRANSMISSION

FINAL REPORT "THE TRUE COSTS OF TRANSPORT ON THE TRANSALPINE CORRIDORS"

Rome, 10 July 2007

The Sub – Group "Costs of Transport", in the meeting in Rome of the 4th of July 2007, has agreed the final text of the document "The true costs of transport on the trans Alpine corridors", on the basis of the mandate given in the Working Group "Transport" since the meeting of the 15 of September 2003.

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The Sub-Group thanks Luca Cetara and Giacomo Luciani of the European Academy of Bolzano, and Elisa Boscherini of CSST Rome, who have given their important contribution in the drafting of the Report.

The Document is made up of an introductory part stating the criteria and methodologies adopted and an attachment discussing the technical aspects.

The Sub-Group, on the basis of its activities and the acquired know-how, recommends the development of the work to completely evaluate the costs and the receipts on some large alpine corridors, in accordance with article 14 of the Protocol "Transport" of the Alpine Convention. However it would currently be advisable to adjust the Sub-Group work with the ongoing work of the European Commission. After the presentation of the study, announced for September 2007, and on the basis of its findings, the Sub-Group shall start to continue the work and further steps shall follow with special regards to the various specific situations in the transalpine corridors.

THE TRUE COSTS OF TRANSPORT ON THE TRANSALPINE CORRIDORS

Introduction

The present document represents the final report of the work developed in the framework of the Sub-Group "Costs of Transport" of the Working Group on Transport of the Alpine Convention.

This report synthesizes the experience of the paper presented during the 9th Alpine Conference in Alpbach and enclosed in the following attachment,. The document presents the transport costs issue and includes the contributions provided by the participants in the Sub-Group.

The paper submitted to the Alpbach Conference has been prepared by the Italian Presidency of the Sub-Group "Costs of transport". That paper contributed to set up a proposal for a methodological approach to a quantitative assessment of external costs in three transAlpine corridors (Fréjus, Gotthard and Brenner) and was accepted as a first step in the methodological approach dealing with the delicate issue of external costs assessment and coverage.

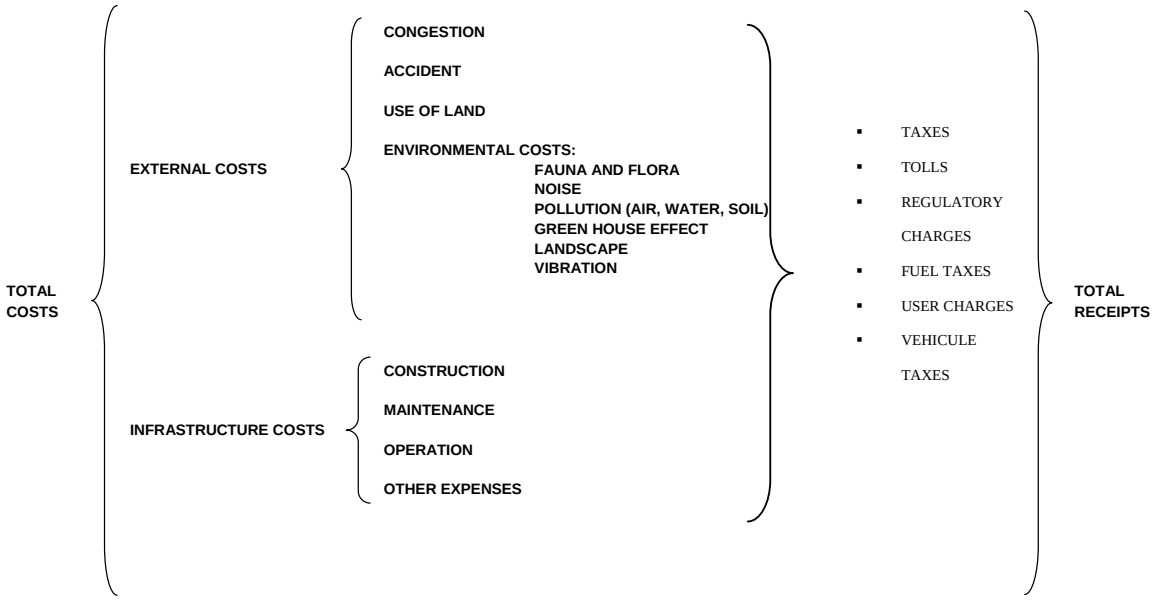
The countries participating in the Sub-Group (France, Switzerland, Austria and Germany) presented their remarks to the papers, making possible, in this way, to find an agreement on a few *"points of reference"*, that the Sub-Group "Costs of Transport" recommends to consider when dealing with transport costs in Alpine countries.

Definition of cost of transport

Detailed information on transport costs is essential both for microeconomic and private decisions and macroeconomic policy choices.

Different types of costs are usually considered to make up the structure of transport costs. The main cost categories considered are external and infrastructure costs, where the first

include environmental and social costs and costs related to congestion, accidents and land use and the second infrastructure costs.



The left side (TOTAL COSTS) of the figure above refers to cost categories which should be estimated. The right side (TOTAL RECEIPTS) refers to revenue categories which can be met in the Alpine Countries to cover these costs. Therefore it should be checked for each corridor included in the study if revenues levied in the Alpine countries are enough to cover the whole corresponding costs generated by Alpine traffic. In addition, it would be desirable to carry out this check periodically in order to take note of the possible evolutions.

Two different approaches are possible in order to assess the costs generated by road traffic:

- the average costs of infrastructure (investment, maintenance and exploitation)
- the marginal costs of infrastructure (increase in cost of infrastructure generated by an additional unit of traffic)

Adding the external costs (noise, local and regional air pollution, effect of greenhouse, insecurity and congestion) to the marginal cost, it is possible to find the social marginal cost of infrastructure.

Adding external costs (except congestion) to the average (or full) cost, it is possible to find the full social cost of the use of the infrastructure.

For the sub working group on costs, it would have been simpler and easier to evaluate the full social cost for the use of infrastructures. This evaluation was made on three large Alpine corridors. The method adopted is in conformity with the application of article 14 of the Protocol Transport of Alpine Convention.

The way to cover infrastructure and external costs (revenues) is different for each Alpine country. Some countries levy tolls on the use of the motorways; others apply fees for the use of all roads. For example, these royalties are justified by the external costs in Switzerland (RPLP) while in France the TIPP (Excise on the fuels) is taken into account to cover external costs and tolls are justified by the costs of infrastructure (investment, maintenance and exploitation) of the granted road network. For each of the examined cases, it is important to check if total revenues cover the overall costs.

A remarkable sensibility on the undesired effects generated by transport activities can be found, particularly in the Alpine countries which have a very high crossing traffic rate (as for example Switzerland, Austria and Italy). France also bears an important traffic quota (and exchange) through the Alps, even if the growth of traffic at the Fréjus tunnel is lower than at the other Alpine passes.

In order to try an evaluation of the costs of transport system in the Alpine Region, it is necessary at first to find some "macro" costs categories. These categories have to be further organized under sub-categories, in a following phase.

In this context, the following costs have to be taken into account:

- Investment (only in average cost assessment) and management costs of the system, including in this macro-category costs related to labor force employed and financing costs if relevant (cf: Directive 2006-38/EC);
- External costs, including the impact on the environment and human health as well as accident costs;
- Time costs, including also the cost of congestion in terms of longer travel time. This last category of cost is considered only in marginal cost assessment.

The evaluation of these costs is rather a complex and delicate task.

Calculation of the external costs of transport

The cost coefficients that have been developed in order to calculate external costs consider some cost components, such as the average PM_{10} concentration level, the loss in output capacity due to death or disability, the amount of insurance premiums for vehicles, medical expenses, the fleet composition, the frequency and severity of road accidents, the percentage of population exposed to noise, the impact on natural environment and landscape, land use, urban effects and indirect costs.

Switzerland, for example, evaluates regularly the external costs of transports on his territory, in accordance with the Heavy vehicle fee Act.

In France, the reference currently used for the evaluation of harmful effects is the Boiteux Report n°2 developed by the Strategic Council of Analysis (previously called General Commission of the Plan). This report sets standards for the calculation of monetary value of harmful effects. As it often happen for any assessment of costs, the suggested standards are established on often uncertain foundations because of the shortage of unquestionable data in this delicate matter. In particular epidemiologic studies are developed aiming at measuring medium and long term effects of traffic on health.

In the German 'Federal Investment Plan 2003' the external effects of noise, pollution and climate change (CO_2) of each project are evaluated in a cost benefit analysis in monetary terms, some of them as damage costs, some as willingness to pay (noise) and climate change in terms of avoidance cost.

The cost coefficients used in the attached paper have a rather high value compared to other European studies. The values used for calculations in the attached paper are nevertheless realistic.

It should be noted that in June 2008 the European Commission is expected to table a proposal to harmonize the calculation method to internalize the external costs of road freight (revision of the 'Euro vignette' directive).

Calculation of infrastructure costs

With reference to building and maintenance costs of infrastructures it is worth to notice that costs should be calculated for every single corridor, since strong differences in costs exist between different corridors.

Strong differences exist between countries on project financing for infrastructures, too[1].

In addition rather a strong difference exists in construction and maintenance costs (because of tunnels and bridges needed in the alpine area).

In this way, determining the average rate needed to cover infrastructure costs in the main Alpine corridors, looks very complex and requires a specific technical and financial analysis.

The benefits generated from mobility and transport for the Alpine economic system have also to be considered.

Methodological approach: main addresses and perspective

The Sub-group "Costs of transport", coordinated by the Italian Presidency, developed an analysis (described more in detail in the attached document) mainly focused on an estimation of external costs, as those reported in table 21 in the Appendix. The delegations have also evaluated the specific revenues [Heavy Vehicle Fee (HVF), tolls, …] on the three corridors indicated below. It is clear that for a more detailed analysis it would be required also to carry out an evaluation of the infrastructure costs and of the other revenues (for example other taxes and fuel excises). The three major transalpine corridors taken into consideration in the analysis are the following:

- **Lyon-Turin**, through the Fréjus Pass;
- **Basle-Milan**, through the St. Gotthard Pass;
- **Munich-Verona**, through the Brenner Pass.

[1] For instance, in Italy tax revenues are directly used to finance infrastructure development and maintenance.

In order to carry out a proper evaluation, a comparison has been made among overall data related to heavy goods vehicles, which actually cover a certain transalpine route during a certain period of time (a calendar year), in order to take into account the whole variety of vehicles under question (type of vehicle, axle configuration, European emission category) and loads.

Once the "reference route" was identified, an evaluation and a comparison of the heavy goods vehicles transit external and transport charges were carried out in each individual country involved.

As a result, a comparison was made between the overall external costs generated by the heavy goods vehicles that cover a certain distance on a yearly basis and the amount of money paid, which is available to internalize external costs in each individual Country concerned by their transit.

The delegations would like to underline that, even if the calculation of the external costs of heavy freight traffic on the roads in these three transalpine corridors and the costs that have been incurred in by users through the payment of tolls along them give interesting information by themselves, they can't be directly compared.

Indeed, the tolls paid in each country and presented in the attached paper aim at different goals. National differences don't allow to refer to one single mode of how to internalize of external costs of freight transport for each of the involved countries.

Switzerland, for example, introduced on the 1st of January 2001 the so-called heavy vehicle fee on truck weighing more than 3.5 tons. This fee aims at covering not only the external costs of transport, but also the still uncovered costs of infrastructure.

The French delegation specifies that it is advisable to take into account in the assessment of costs borne by users (that become revenues for public authorities), the value of the excises on fuel. Indeed, in France and, for example, in Germany, these excises feed the general receipts of the budget of the State and contribute to the total financing of the infrastructures not in grant. They also take into account the external damage generated by the use of roads. The conveyors are sensitive to the level of these excises. France notes that trucks cross France without fuelling

and therefore they do not pay excises. On the other hand, they use infrastructure placed on the French territory.

Indeed, according to the investigation "Transit 2004" or "CAFT 2004", in consideration of origin/destination data for road traffic from France to Italy, the following results can be observed that only 26 % of HDV drivers say to have bought or to be willing to buy fuel in France.

In order to assess traffic flows on the selected Transalpine Corridors and to identify vehicle classes according to their polluting emissions – that is a necessary task in order to correctly assess the external costs – some stages have to be go through.

In order to evaluate traffic flows, the O/D CAFT 2004 (Cross Alpine Freight Transport) matrix has been used[2], which is characterized by the following features:

- reference period: 2004,
- subject: carriage of goods by road through the Alpine Arc,
- zoning of origins and destinations according to NUTS (*Nomenclature of Statistical Territorial Units*) classification for European States and to ISO Alpha 2 for non-European States,
- transport modes under question: road,
- classification of vehicles according to the weight of vehicles, loads and axle configuration.

For every transit the following elements are known:

- Country in which the vehicle is registered,
- origin,
- destination,
- which pass is crossed,
- which transport mode is adopted,

[2] At the time of the finalization of the present report, the data concerning the Franco-Italian corridor correspond to the early data of April 2006.

- traffic report: import, export, internal traffic, transit,
- type of vehicle: truck, trailer truck, articulated truck, motor unit without trailer,
- axles configuration,
- vehicle mass,
- load mass,
- expansion factor.

Then there are 4 parameters for the vehicle mass that are fundamental for the calculations:

- empty truck or motor unit mass,
- empty trailer mass,
- overall maximum permissible truck or motor unit mass,
- overall maximum permissible trailer mass.

The EURO classification has not been updated with reference to the tariffs introduced in the various routes under question; the division of the used vehicles in emission categories from EURO 0 to EURO IV can be estimated on the basis of local database, considering the vehicle's age reported in the CAFT matrix[3].

Another relevant point necessary for the calculation of the "true cost" of transport in the Alpine space is the analysis of local traffic. This level of analysis is still missing within the current framework of zoning provided by CAFT 2004.

The suggested methodology in order to calculate external costs considers different, specific costs for each of the involved countries and highlights all the differences existing at the national level for each impact category. Anyhow, rather than using distinct values for each country, it has been preferred to use a single value of "average unit's cost" calculated in 7.01

[3] More complete and correct evaluation on vehicle EURO classification using the Alpine road network will be the objective of a specific task of INTERREG IIIB Alp Check Project.

cents €/(ton-km) and to consider a spread between 5.5 and 8.5 cents €/(ton x km) (i.e. ± 22%) in order to include possible differences between countries, and cost actualization[4].

It is eventually important to stress, that the paper that follows only provides a partial analysis of the situation. Nevertheless, the method that the Sub-Group "Cost of Transport" has proposed may serve as a useful starting point to carry out more accurate, thorough and meaningful evaluations, in order to obtain an exhaustive calculation of the true cost of transport on the transalpine corridors.

[4] It is relevant to remark once again that the suggested method provides different values if compared with other European methods: in this respect, it is also possible to consider a study developed by the French Ministry of Transport and Ministry of Ecology (*METLT and MEDD, 'Couverture des couts des infrastructures routières. Analyse par réseaux et par sections types du réseau routier national' – Paris – September 2003*) reporting lower external costs that vary according to the traffic typology and the crossed areas in their country.

Attachment

A methodological approach
for the calculation
of the true cost of transport on the transalpine corridors

This analysis is a methodological proposal developed by the Sub-group "Cost of Transport" delegations from 2004 until 2007 to verify the impact of the different costs on Alpine transport. The document will be submitted to the Transport Working Group by the end of June, 2007.

The assessment mainly concerns an estimation of external costs deriving from heavy traffic on roads in comparison with the costs that incurred into by users through the payment of tolls along the three major transalpine corridors:

- Lyon-Turin, through the Fréjus Pass,
- Basle-Milan, through the St. Gotthard Pass,
- Munich-Verona, through the Brenner Pass.

The comparison between the amount of the paid costs via tolls and the total external costs arisen along these three major axes might give rise to a few considerations:

- do the charges applied within the different Alpine Arc Countries compensate external costs due to the transit of heavy goods vehicles?
- is the "Eurovignette" Directive effective?
- is the Transport Protocol implemented in order to develop a European policy aimed at the modal rebalancing and the introduction of transparent charges that make users aware of the real goods carriage costs and of the chosen transport mode,?

Methodology

Traffic flow evaluation

The main parameters for quantitative evaluation of annual traffic flows along the routes under analysis and the identification of vehicle classes according to their polluting emissions, which is necessary to estimate external costs, were already described in the main document.

For the calculations freight mass is to be considered as the net mass of transported goods, including packaging.

O/D matrix has allowed to define loads on each individual Pass; the overall result is 9,987,421 vehicles/year.

Table 1 reports the number of road vehicles that have crossed each Alpine Pass in 2004. Hence, the international Passes with the highest traffic rate are: Brenner and Schöberpass in Austria, Fréjus and Ventimille in France and St. Gotthard in Switzerland. This analysis specifically refers to Fréjus, Brenner and St. Gotthard Passes.

Data emerging from the CAFT survey are in line with Alpinfo statistical data published by the Swiss Federal Office for Spatial Development for the same period (2004).

The overall freight quantity transported through the Alpine Passes can be estimated using the total number of heavy goods vehicles crossing all the Alpine Arc Passes every year and the total transported freight (in tons). Taking into account a total of 130,343,715 tons transported by 9,987,421 vehicles, the average load amounts to 13.1 tons/vehic. This amount is higher than the amounts suggested by Cipra, Infras [1] and "Amici della Terra" [3]. This fact could depend on the actual presence of heavy road vehicles that often drive on long international routes.

Countries	**Pass**	**Traffic flows [vehicle]**	**Mass [t]**	**Average load [t/vehicle]**
France/Italy	Ventimille	1,339,960	19,370,992	14.5
France/Italy	Montgenèvre	39,324	430,529	10.9
France/Italy	Fréjus	1,130,963	18,093,272	16.0
France/Italy	Mont Blanc	353,107	5,636,832	16.0
Switzerland/Italy	Gr, St, Bernhard	65,067	610,282	9.4
Switzerland/Italy	Simplon	66,598	670,876	10.1
Switzerland/Italy	Gotthard	969,347	9,884,441	10.2
Switzerland/Italy	San Bernardino	154,352	1,330,670	8.6
Austria/Italy	Reschen	135,143	1,966,093	14.5
Austria/Italy	Brenner	1,995,553	31,138,528	15.6
Austria	Tauern	940,813	12,175,467	12.9
Austria	Schoberpass	1,280,848	14,636,255	11.4
Austria	Semmering	527,934	5,639,756	10.7
Austria	Wechsel (Schäffern)	988,412	8,759,723	8.9
	Total	**9,987,421**	**130,343,715**	**13.1**

Table 1 - Heavy road vehicles crossing the main Alpine Passes in 2004 (source: CAFT data and Alpinfo)[5]

Routes definition

For every Alpine Pass possible routes within the Alpine Arc area were detected. The "Alpine Arc areas" are to be considered as the ones located within the scope of application of the Alpine Convention, in order to make final external costs to fall on that specific area. Complying with this process the chosen routes are the following:

- Montmélian-Turin within the Lyon-Turin corridor (Fréjus tunnel) between France and Italy;
- Altdorf-Bellinzona within the Basle-Milan corridor (St.Gotthard pass) between Switzerland and Italy;
- Rosenheim-Bolzano within the Munich-Verona corridor (Brenner pass) between Germany, Austria and Italy.

The routes mentioned above are the shortest ones and they only include motorways: they represent the routes that a truck driver would most likely prefer while driving through the

[5] The French Delegation points out that the classification "euro" in 2004 of heavy road vehicles to the tunnel of Fréjus communicated by the SFTRF is different.

considered areas.. In this line, urban areas were not considered (and they would anyway be external to the Alpine Arc area).

Emission evaluation

The CAFT survey does not include a classification of vehicles according to European emission classes, a parameter that is instead used for levy systems in force in Germany and in Switzerland.

In order to bridge this gap, a rough evaluation has been tried with reference to the information included in the CAFT matrix concerning French Passes where the year of registration of transiting vehicles is reported.

Then, using the information reported in Table 2, it was possible to tag every vehicle with the corresponding emission category in consideration of its year of registration.

Year of registration	**Emission categories**
Before Dec. 31st 1992	Euro 0
After Jan 1st 1993 or Oct 10th 1996 (by kind of gas emitted)	Euro I
After Jan 1st 1997	Euro II
After Oct 10th 2001	Euro III

Table 2 - Classification of emission categories by vehicle registration year.

Table 3 summarizes the emission categories of vehicles that crossed the French Alpine Arc passes in 2004. The percent values have been calculated on the basis of data from the above mentioned source, which classifies vehicles according to the fuel they use and to the EU emission category they belong to (91/542 Stage I, 91/542 Stage II, 93/59 Euro I, 96/69 Euro II, 98/69 Euro III, 99/96 Euro III).

Emission Category	Number of vehicles	%
non identified	35,689	1.25%
Euro 0	54,586	1.91%
Euro I	95,042	3.32%
Euro II	1,172,115	40.94%
Euro III	1,505,922	52.59%
Total	**2,863,355**	**100.00%**

Table 3 - Classification of heavy road vehicles transiting the French Alpine Arc passes in 2004 by emission category (source: CAFT matrix).

Results

Traffic

Lyon-Turin Corridor

The Montmélian-Turin route has a total length of 172 km: 83 km lie within the French territory, from Montmélian to Modane (A43 motorway), 76 km lie in Italy, in Piedmont, from Bardonecchia to Turin (A32). A further 13 km long section is covered by the Fréjus Tunnel (T4).

Based on the CAFT data, it can be inferred that 1,130,963 heavy goods vehicles pass through this road in both directions[6].

Traffic [vehic/year]	Mileage [km]	Total gross laden weight [t]	Average freight [t/vehic]
1,130,963	172	18,093,272	16

Table 4 - Annual Traffic along the Montmélian-Turin route (source: CAFT data).

[6] At the time of the finalization of the present report, the data concerning the Franco-Italian corridor correspond to the early data of April 2006.

Basle-Milan Corridor

The Altdorf-Bellinzona route crosses Switzerland for 106 km (A2 motorway) transiting the St. Gotthard Pass.

Based on the CAFT data, 969,347 heavy goods vehicles transit every year along this road in both directions.

Traffic [vehic/year]	**Mileage [km]**	**Total gross laden weight [t]**	**Maximum permissible gross laden weight [t]**	**Average permissible gross laden weight [t]**	**Average gross laden weight [t/vehic]**
969,347	106	9,884,441	33,073,273	34.1	10.2

Table 5 - Annual Traffic along the Altdorf-Bellinzona route (source: CAFT data).

Please note that the average gross laden weight value referred to 2004 for the Altdorf-Bellinzona route is about twice the amount of 1999, having increased from 6.4 to 10.2 tons. This difference is due to the increase in the maximum permissible gross laden weight (28 tons in 1999, 34 tons in 2004) and to the performance-linked tax allowance on heavy traffic in order to optimize the capacity of articulated lorries traveling through Switzerland.

Munich-Verona corridor

The Munich-Verona corridor crosses the Alps on the section between Rosenheim (Germany) and Bolzano and covers a total mileage of 222 km: 27 km in Germany, from Rosenheim to Kiefersfelden along the A93 motorway, 110 km along the Austrian A12 and A13 motorway sections from Kiefersfelden to Brenner Pass, and 85 km on the A22 motorway from the Brenner Pass to Bolzano South.

The CAFT-data reports that every year 1,995,553 vehicles with more than 3.5 t cross the Brenner Pass. However, this value does not correspond to number of vehicles using the entire corridor because the local traffic goes shorter distances, is not constant along the whole corridor and is predominantly centered in two sections: on the Austrian territory between Kiefersfelden and Innsbruck, and in Italy between Vipitano and Bolzano. In order to make a fair comparison of the revenues and the costs generated along the whole corridor, fluctuations resulting from local traffic are excluded in the calculations referring to the corridor. Also excluded are further distinctions on the German territory concerning the toll system, since the Austrian and Italian toll system starts levying tolls on vehicles with more than 3,5t, Germany currently charges only vehicles with 12 t or more. Therefore, to better reflect the traffic moving along the entire section between Rosenheim and Bolzano, since too little numerical detail is available concerning the local traffic, a value is assumed for the traffic crossing the whole corridor, which amounts to approximately 87% of the total traffic passing the Brenner Pass, which corresponds to 1,736,131 vehicles with more than 3.5 t per year[7].

Traffic [vehic/year]	**Mileage [km]**	**Total gross laden weight [t]**	**Average gross laden weight [t/vehic]**
1,736,131	222	27,090,519	15.6

Table 6 - Annual Traffic along the Rosenheim-Bolzano route (source: CAFT data).

Tolls

Lyon-Turin corridor

Toll payment along the corridor linking France to Italy concerns the following motorway tollgates: Chignin barrier, and Saint Michel de Maurienne barrier along the A43 motorway, Salbertrand tollgate, Avigliana tollgate and Bruere tollgates along the A32 motorway. Toll is also due for entering the Tunnel.

[7] Data provided by the Austrian Delegation

Size [N° axles]	**Traffic [vehic/year]**	**Mileage [km]**	**Unit rate [€/vehic]**	**Total Tolls [€]**
2	11,249	83	24.60	276,725
3 or more	1,119,714	83	32.90	36,838,601
TOTAL				37,115,326

Table 7- Total annual costs borne by heavy goods vehicles along the Lyon-Turin Corridor, Montmélian-Modane (A43) section, in France.

Size [No. axles]	**Traffic [vehic./year]**	**Mileage [km]**	**Unit rate [€/vehic.]**	**Total Tolls [€]**
2	11,249	76	10.20	114,739
3	10,413	76	15.50	161,394
4	63,267	76	20.90	1,322,283
5 or more	1,046,035	76	24.20	25,314,038
TOTAL				26,912,455

Table 8 - Total annual costs borne by heavy goods vehicles in Italy along the Lyon-Turin Corridor, Bardonecchia-Turin section (A32).

In addition to motorway charges, the Fréjus Tunnel toll is also levied. The information on the year of registration of the vehicles transiting along the pass have been used to classify the heavy goods vehicles passing through the Fréjus Tunnel according to the European emission categories.

The total number of heavy goods vehicles passing through the Fréjus and their percentage, rated by emission categories, are reported in Table 9. The overall monetary value of collected tolls in the Fréjus tunnel (in €) is reported in Table 11.

Emissions category	**% vehicles**
Euro 0 – Euro I	3.78%
Euro II	41.77%
Euro III	54.45%
Total	100.00%

Table 9 - Heavy goods vehicles passing through the Fréjus Tunnel in 2004 subdivided by emission category (elaboration on CAFT data in percentage).

		2-axle Vehicles			**Vehicles with 3 or more axles**		
		Traffic [vehicle]	**Rate [€/vehic]**	**Total [€]**	**Traffic [vehicle]**	**Rate [€/vehic]**	**Total [€]**
Euro I	3.87%	425	113.60	48,269	42,294	228.30	9,655,810
Euro II	41.77%	4,699	107.10	503,277	467,748	215.30	100,706,163
Euro III	54.45%	6,125	107.10	655,981	609,672	215.30	131,262,347
Total	100%	11,249		**1,207,526**	1,119,714		**241,624,319**

Table 10 - Tolls paid annually by heavy goods vehicles travelling along the Lyon-Turin corridor passing through the Fréjus Tunnel.

The total amount paid by the 1,130,963 heavy goods vehicles passing through the Fréjus Tunnel corresponds to €242,831,845.

Yet, the result appears to be overestimated since it is possible to obtain a return ticket rather than a one-way ticket for heavy goods vehicles that can be used until the next 24 hours of the 15th day since the day after its issue. Using this return ticket it is possible to save on the average 19.40% of the cost of two one-way tickets. Assuming that all the lorries benefit from this discounted return rate, the total tolls paid would amount to €195,722,467. Hence, this lower value will be taken as reference for the following evaluations.

Total costs Paid in France [€]	**Total costs paid in Italy [€]**	**Total costs paid in the Fréjus Tunnel [€]**	**Total costs paid along the corridor [€]**
37,115,326	26,912,455	195,722,467	259,750,248

Table 11 - Total annual costs paid along the Montmélian-Turin section[8].

[8] The French delegation points out that heavy goods vehicles profits on the motorways and for passing through the Fréjus Tunnel from subscriptions on the public tariffs. These subscription represent average reductions of tolls of about -20% which are not deduced in various calculations.

Basle-Milan corridor

In order to calculate the levy on heavy goods vehicles (LSVA) adopted in Switzerland, the Euro 0 and Euro I vehicle percentage values are grouped together, up to a total of 38.3%.

Lacking any further data related to this specific case, for the classification of lorries in the remaining emission categories, the percentages of traffic within the French Alpine passes are used, supplemented by the results obtained for the Euro 0 category. Please refer to the breakdown reported in the following Table 12.

Emission category	**Percentage**
Euro 0	12.5%
Euro I	25.8%
Euro II	27.0%
Euro III	34.7%

Table 12 - Breakdown according to the European emission categories of heavy goods vehicles that every year travel along the Basle-Milan corridor passing through the St. Gotthard Tunnel.

At this point, the LSVA levied on an annual basis for the transit of heavy goods vehicles can be calculated, by dividing the total maximum permissible gross laden weight (33,073,273 tonnes) by the percentages of emission categories, assuming that the weight is proportionally distributed. The overall distance amounts to 106 km.

	%	**Maximum permissible gross laden weight [t]**	**Rate [CentCHF/t km]**	**Rate [Cent€/t km]**	**Total costs [CHF]**	**Total costs [€]**
Euro 0 – I	38.3	12,667,064	2.88	1.81	38,670,012	24,305,476
Euro II	27.0	8,931,330	2.52	1.58	23,857,370	14,995,204
Euro III	34.7	11,474,879	2.15	1.35	26,151,250	16,436,989
Total	100	33,073,273			88,678,632	55,737,669

Table 13 - Distribution of the maximum permissible gross laden weight among the European emission categories and calculation of the costs incurred into by the heavy goods

vehicles, which every year cover the Altdorf-Bellinzona distance (A2) along the Basle-Milan corridor.

According to this calculation, tolls paid by the 969,347 heavy goods vehicles that cover the Altdorf-Bellinzona section passing through the St. Gotthard amount to €55,737,669.

Munich-Verona corridor

Assuming that the average value of 1,736,131 vehicles passing the Alpine section of the Munich-Verona corridor (between Rosenheim and Bolzano), Table 14 reflects the breakdown of vehicles with more than 3.5 t according to the EURO-classes for the entire corridor and Table 15 estimates these findings proportional to the percentages of vehicles up to 3 axles and those with 4 axles or more passing from Rosenheim to the German/Austrian border (27 km-long section on the German territory).

Emission category	**Percentage**	**Traffic [vehic/year]**
EURO I	2.4%	41,667
EURO II – IV	97.6%	1,694,464
Total	100.0%	1,736,131

Table 14 - Breakdown according to the European emission categories of heavy goods vehicles with more than 3,5 t which every year travel along the Rosenheim-Bolzano corridor.

		Euro I				**Euro II – III**			
	Trucks > 3.5t [vehic/year]	**Traffic Euro I for year (2.4%)**	**Mileage [Km]**	**Rate [€/vehic * Km]**	**Cost [€]**	**Traffic Euro II – III for year (97.6%)**	**Mileage [Km]**	**Rate [€/vehic * Km]**	**Cost [€]**
Up to 3 axles	182482	4380	27	0.13	15,374	178,102	27	0.11	528,963
4 axles or more	1553649	37288	27	0.14	140,949	1,516,361	27	0.12	4,913,010
Total	1736131	41668			156,323	1,694,463			5,441,973

Table 15

Breakdown of vehicles whose weight is > 3.5 tonnes according to European emission categories and calculation of annual costs incurred into along the Rosenheim-Kufstein section of the Munich-Verona corridor.

The total LKW-Maut amount levied for the 27-km-long German section is estimated as € 5,598,296.

On the Austrian section the corridor consists of two different tariffs, that is the standard rate on the 75 km-long section between the German/Austrian border (Kiefersfelden) and Innsbruck and the so-called "special toll rate" between Innsbruck and the Brenner pass, marking the national border to Italy (35 km) (Table 16 and Table 17).

Size [N° axles]	**Traffic > 3,5 t [vehic/year]**	**Mileage [km]**	**Standard km Rate [€/vehic km]**	**Total Costs [€]**
2	133,490	75	0.155	1,551,821
3	48,992	75	0.217	797,345
More than 3	1,553,649	75	0.3255	37,928,456
TOTAL				40,277,622

Table 16 - Annual costs calculated on the basis of the standard charges (toll rates 1.7.2007) applied in Austria for heavy goods vehicles along the Munich-Verona corridor, German/Austrian border-Innsbruck (A12 - A13) section.

Size [N° axles]	Traffic > 3.5 t [vehic/year]	Brenner Special Toll Rate [€/vehic]	Total costs - Brenner [€]
2	133,490	23.50	3,137,015
3	48,992	32.90	1,611,837
More than 3	1,553,649	49.40	76,750,261
Total			81,499,112

Table 17 - Annual costs calculated on the basis of the special toll rate applied in Austria for heavy goods vehicles from Innsbruck to Brenner (A13).

Costs paid according to the standard rate [€]	Costs according to the Brenner special toll rate [€]	Total Costs paid in Austria [€]
40,277,622	81,499,112	121,776,734

Table 18 - Total annual Austrian charges paid by heavy goods vehicles along the Munich-Verona corridor, Kiefersfelden-Brenner (A12 - A13) section (110 Km).

On the Italian territory the same 1,736,131 heavy goods vehicles crossing the Austrian/Italian border per year are required to pay charges between the Brenner tollgate and Bolzano South tollgate on the motorway A22.

Size [N° axles]	Traffic [vehic/year]	Unit rate [€/vehic]	Total Costs [€]
2	133,490	5.20	694,149
3	48,991	6.30	308,646
4	61,782	10.10	624,000
5 or more	1,491,867	12.20	18,200,780
TOTAL			19,827,575

Table 19 - Total annual costs paid by heavy goods vehicles in Italy along the Munich-Verona corridor, Brenner-Bolzano South (A22) section.

The total costs paid along the whole corridor are reported in table 20.

Total paid costs in Germany [€]	**Total paid costs in Austria [€]**	**Total paid costs in Italy [€]**	**Total paid costs along the corridor [€]**
5,598,296	115,626,365	22,790,319	143,668,965

Table 20 - Total annual costs paid along the Rosenheim-Bolzano section.

External costs

In order to calculate external costs, cost coefficients have been defined according to a method [1][7], which takes into account some cost components, such as the average PM_{10} concentration level, the loss of output capacity due to death or disability, the amount of insurance premiums for vehicles, medical expenses, the fleet composition, the frequency and severity of road accidents, the percentage of population exposed to noise, the impact on the natural environment and landscape, land use, urban effects and indirect costs.

The suggested methodology in order to calculate external costs considers different, specific costs for each of the involved countries and highlights all the differences existing at the national level for each impact category. Anyhow, rather than using distinct values for each country, it has been preferred to use a single value of "average unit's cost" calculated in 7.01 cents €/(ton-km) and to consider a spread between 5.5 and 8.5 cents €/(ton x km) (i.e. ± 22%) in order to include possible differences between countries, and cost actualization.

Corridor	**Mileage [km]**	**External costs lower bound [€]**	**External costs upper bound [€]**
A32 – Torino-Fréjus tunnel	76	75.669,067	117.118,365
A43 – Fréjus tunnel-Montmélian	83	82.638,578	127.905,583
A2 – Bellinzona-Gotthard tunnel	27	14.686,001	22.730,562
A2 – Gotthard tunnel-altdorf	57	31.003,780	47.986,742
A22 – Bolzano-Brennero	85	145.648,052	225.429,787
A13 – Brennero-Innsbruck	35	59.972,727	92.824,030
A12 – Innsbruck-Kufstein	75	128.512,987	198.908,636
A93 – Kufstein-Rosenheim	27	46.264,675	71.607,109

Table 21 - External costs of main Alpine Corridors (please, note that infrastructure costs are not considered) [9]

[9] At the time of the finalization of the present report, the data concerning the Franco-Italian corridor correspond to the early data of April 2006.

The following table represent an example proposed by the French Delegation regarding the kind of activities to be elaborated in order to correctly calculate the external cost.

CORRIDORS	*TRAFFIC*	*COSTS*[1]			*TOTAL COSTS*		*RECEIPTS*[2]		*TOTAL RECEIPTS*	*RESULT Receipts - costs*	
		Infrastructure (total)	*External hyp higt*	*External hyp low*	*Hyp higt*	*Hyp low*	*Tolls*	*Excises on fuel*	*(Tolls, Excise,…)*	*Hyp higt*	*Hyp low*
A43 Montmelian-Frejus											
Tunnel Frejus											
A32 Tunnel Frejus-Torino											
Montmelian Torino											
A2 Bellinzona-Gotthard Tunnel											
Gotthard Tunnel											
A2 Gotthar Tunnel Altdorf											
Basle-Milan											
A93 Rosenheim-Kufstein											
A12 Kufstein-Innsbruck											
A13 Innsbruck-Brennero											
Brennero Tunnel											
A22 Brennero-Bolzano											
Munich-Verona											

1. The infrastructure costs include investments, use and management costs; the external costs include noise, local atmospheric pollution and greenhouse effect

2.The revenues include all the revenues considered in every alpine country on all the sections of the considered corridor (example: Toll + fuel excise in Italy , Austria and France, HVF + excise in Switzerland, Toll collect + excise in Germany)

Infrastructure costs

The share of charges paid by heavy goods vehicles to cover infrastructure costs for each transalpine corridor is now calculated in order to estimate the available amount to cover external costs deriving from their transit through the Alpine area.

This is a very critical step because the infrastructure costs to be taken into account, shared in depreciation and maintenance costs, can vary a lot among the involved Countries as function of age of the infrastructures, taxation norms and other specific factors.

For this reason, in lack of sufficiently precise indications, the estimate of infrastructure costs has not been made. This report is limited to the supply of tentative values, valid for the Italian territory, to be compared to those that might be supplied by other Countries:

- construction costs for a section of highway in Alpine area: 28 ÷ 35 Million €/km (big differences exist at a national level);
- maintenance costs for a section of highway in Alpine area: 350,000 ÷ 600,000 €/km year.

It should also be borne in mind that infrastructure costs can be used to cover maintenance costs in order to reduce external costs, with special reference to noise pollution (building noise barriers or noise-absorbing paving), safety (*guardrails*, drainage paving and facilities, fixed and variable road signs), aesthetics (plant arrangement and grass mowing along the sides of the road). Yet, the relationship between maintenance costs and the internalisation of external costs is not easy to set up.

Taxation

In order to complete this analysis of the internalization of external costs and also the infrastructure costs, it would also be important to consider the problems arising from the different levels of the various fuel taxes.

Also in this case there are harmonization problems among countries: a transport company can pay the fuel tax in a country and to use the vehicle in a corridor crossing another country. Often the country collecting the tax revenue is different from the country that suffers a damage from the external cost of transport.

This evaluation would anyway require precise knowledge about fuel taxation systems adopted in the Alpine countries. For example, in Italy fuel tax represents 52% of the full fuel price, and includes local, regional and national duties.

Conclusive remarks

The data collected in this attachment provide a rough evaluation of the Alpine goods traveling by road system and the coverage of external costs by means of traffic tariffs.

Regardless of numerical values that have emerged, this survey should be intended as an attempt to develop a rough examination method, which starting from the already available data taken from technical literature without any expensive and sophisticated analysis, has allowed the Costs Subgroup and the Transport Workgroup to carry out a few quantitative evaluations.

The progress of this study does not allow to consider it the final one: a few data are still missing in this report. Lack of data can be mainly referred to the following items:

- used traffic data have been updated considering the CAFT 2004 matrix;
- tolls have been calculated according to current tariffs (2006);
- EURO vehicle-classification has not been updated according to the tariffs introduced in the different analyzed routes; the breakdown of vehicles in emission categories from EURO 0 to EURO III has been made considering the vehicle's age expressed in the CAFT matrix for the France-related traffic; updated data would allow a more accurate evaluation for all the examined corridors;
- external costs have been assessed using a method providing higher values if compared with others. In this respect a study developed by the French Ministry of Transports estimating lower external costs that vary according to vehicle type and

crossed areas. This study shows that in France, on toll motorways, on average and in certain circumstances, external costs can be covered by the sum of the revenues on trucks, including fuel excises. It would therefore be necessary to evaluate if these considerations can be extended to the Austrian, French, German, Italian and Swiss corridors too.

In addition it is important to stress, that this report only provides a partial analysis of the situation. Nevertheless, the method that the Sub-Group "Cost of Transport" has proposed may serve as a useful starting point to carry out more accurate, thorough and meaningful evaluations, in order to obtain an exhaustive calculation of the true cost of transport on the transalpine corridors.

Hence, the contribution provided by the delegations taking part in the Costs Subgroup was fundamental for developing this method, finding updated traffic data and proposing this methodological approach that could be hopefully useful to find solutions for a delicate issue, as the calculation of external costs of transport and its coverage.

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