Advisory Board “Transport Safety and Mobility in the Alpine Region” within the framework of the Common Declaration of Zurich

EFFINALP

ANALYSIS OF ECONOMIC EFFECTS OF ESTABLISHING TRAFFIC MANAGEMENT INSTRUMENTS IN ALPINE CORRIDORS

Final Report
Zurich, 13th January 2012

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‘The analysis of economic effects of establishing the traffic management instruments ACE, AETS, and/or TOLL+ on the national and regional levels of the Zurich Process member states including economic, logistical, social and occupational impacts on the transport sector in general and the road transport sector in particular’

Client:
Advisory Board “Transport Safety and Mobility in the Alpine Region” within the framework of the Common Declaration of Zurich

Final Report, Zurich, 13th January 2012

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CONTENT

SUMMARY

1. AIM AND APPROACH

ALBATRAS study designs different transalpine traffic management instruments

The 'Declaration of Zurich' (adopted 30th Nov 2001) concerning the improvement of road safety has successfully introduced framework conditions to reduce the risk of serious accidents in the alpine tunnels. As a consequence, the transport ministers of the alpine countries have decided to continue collaborating towards an improved coordination of traffic management systems. Three different managements systems (Alpine Crossing Exchange (ACE), Alpine Emission Trading System (AETS) and a surcharge on existing tolls covering external costs (TOLL+)) were chosen for further in-depth analysis. The 'ALBATRAS' study (Ecoplan, Rapp Trans et.al. 2011) developed the design and analysed the impacts on traffic flows. The analysis has shown that traffic impacts depend on the thresholds chosen for the different instruments (in one or all alpine countries simultaneously) and the ability of the rail systems to take over a substantial part of future traffic flows. Thereby it has to be considered that the points of departure (aims, focus, infrastructure capacities, and instruments) in the alpine countries (and corridors) are different.

Economic analysis with differentiated methodology

Based on this analysis, the EFFINALP study at hand evaluates the economic impacts of these instruments for different economic sectors and different regions.

In order to analyse this complex topic in a comprehensive manner, the analysis distinguishes between three methodological steps:

1. Quantitative analysis of the maximum burden: Based on selected ALBATRAS scenarios, the effects on gross value added (GVA) and employment for the transport sector and different economic sectors and for different regions are calculated. This part of the analysis considers only the burden, but no possible balancing effects of the use of revenues.
2. Qualitative analysis of looking at the detailed reaction patterns of the transport and the other economic sectors and case studies based on interviews with selected stakeholders.
3. Dynamic model analysis based on the ASTRA model (developed by ISI Fraunhofer Institute) considering adaption patterns and the use of revenues.

2. PRICE EFFECTS AND IMPACT CHAINS

Pricing scenarios

Traffic management instruments for transalpine transport such as an alpine crossing exchange (ACE), an emission trading system (AETS) or a TOLL+ system lead first of all to changes in transport prices and cost respectively. These changes depend on the levels of thresholds and related steering aims. The different scenarios elaborated in the ALBATRAS project (acc. to type of instrument, tolerant and restrictive variants, different time horizons) lead to price changes for road freight transport for 2020 between 27 EUR per passage (scenario AETS tolerant) and 160 EUR (scenario ACE restrictive) and for 2030 between 102 EUR per trip (scenario Mix tolerant) and 354 EUR (Scenario TOLL+). These price increases are the basis for the traffic effect, notably the shift between road and rail and the additional burden for the transport sector and transport-intensive industries.

For the economic analysis, some representative ALBATRAS scenarios have been chosen for two different time horizons (2020, 2030). The scenario 'Tolerant' represents a system with mixed instruments in different countries and lower thresholds[1], the scenario 'Restrictive' represents a TOLL+ scenario with rather high surcharges. The following table shows the related price increases for transalpine road passages.

OVERVIEW OF PRICE INCREASES IN DIFFERENT SCENARIOS				
Alpine corridors	**2020**		**2030**	
	Tolerant	**Restrictive**	**Tolerant**	**Restrictive**
Austria – Italy	33–49	87–130	100–150	240–350
Austria – Slovenia	33	87	100	240
CH – Italy	81	78–110	160	240–300
FR – Italy	40–51	73–92	150– 190	200–250

Table S-1 Additional cost per lorry passage in EUR per trip due to the introduction of transalpine traffic management instruments (based on ALBATRAS).

Economic mechanisms

Due to increased road transport costs, all instruments will lead in the first instance to incentives to improve road transport efficiency and environmental performance, in order to save trips and costs. Each instrument (ACE, AETS, TOLL+) however has slightly different economic mecha-

[1] For CH: ACE with 900'000 lorries per year; for A: 10–20% reduction of CO_2 emissions; for F: lower price of ACE and AETS. Source: Ecoplan, Rapp Trans et.al. 2011.

nisms considering the price increases, the specific incentives and the shifting process between the transport sector and the transport-intensive industries:

- An ACE leads mainly to incentives to shift transport from road to rail, since – besides increasing road transport efficiency – this is the only way to reduce HGV trips. Thus, the incentives for structural changes are evident and will be initiated by freight forwarders and shippers. Resulting prices and allocation mechanisms between road transport actors depend strongly on the design of the instrument. One important design factor is also the procedure to allocate certificates for transalpine passages.[2] In addition, all passages are charged with the same prices and do not depend on trip distance. Thus, short distance transalpine transports are charged relatively higher than long distance transports, if no relief measures are undertaken.
- An AETS focuses mainly on the improvement of fleet performance. Since the potential of decreasing specific fuel consumption of road transport and improving fleet performance however is limited, there will also be a significant shift from road to rail, but less dominant than with an ACE. Differently to an ACE, the burden depends on the distance travelled in the alpine space. Thus, the relative burden for short distance transport is significantly (around 20%) lower compared to ACE.
- A TOLL+ with its straight price effect will lead to the strongest potential of shifting the financial burden from the transport sector to the shippers, since the price signal is much easier to anticipate and to calculate than within an ACE or an AETS scenario. The relative burden depends on the design. If the instrument is designed as an alpine toll, the burden is similar to ACE. If the instrument is designed as a km-charge in the alpine space (as suggested in ALBATRAS), the relative burden is similar to AETS.

All in all, however, considering the freedom of design and the possibility of introducing specific measures to deal with short distance transport, the economic effects are mainly depending on the level of restriction (e.g. the price signal in general) and not that much on the type of instrument.

All traffic management instruments analysed are market-based instruments. That means they generate additional burdens and incentives respectively for the transport actors involved. On the other hand they also generate additional income which can be used for different purposes such as financing transport investment, compensation or general reduction of taxes.

[2] Within the ALBATRAS study, it is foreseen to auction the certificates and to install a broker system. The revenues will be allocated at national level.

3. SECTORAL IMPACTS

Effects in the transport sector

Based on the steering effects modelled in the ALBATRAS report, all instruments lead to considerable shifts from transalpine road to rail transport, since the potentials to increase road transport efficiency (such as reducing empty runs or increasing loading factors) are limited. This was also verified by the interviews with transport stakeholders in different alpine regions. From an economic point of view this leads mainly to a redistribution of gross value added and employment within the transport sector.

In quantitative figures, the loss of value added (GVA) in the road sector accounts for 189 million EUR (scenario Tolerant) to 340 million EUR (scenario Restrictive) in 2020 and 685 to 1'051 million EUR in 2030 respectively, whereas the gains of GVA in the rail sector account only for 87–162 million EUR (2020) and 326–505 million EUR (2030). If however the potential to increase GVA in rail infrastructure (and not only railway services) would be considered as well, the differences would decline considerably.

The transalpine transport market is rather segmented. Bigger freight forwarders and transalpine multimodal logistics provider are located in Germany and France. Most of the freight forwarders located within the alpine regions are small size companies with less than 5 employees. This is especially true for the road freight market south of the Alps (e.g. Northern Italy, Slovenia). The rail market – on the other hand – is organised at national level. Regional facilities are especially relevant for infrastructure services.

The following structural changes due to the new transalpine management instruments are most likely:

› Combined transport services: The biggest chances will be visible in the trailer and container market, since freight forwarders and shippers – facing increasing road transport prices – will push their demand towards these services. They will demand especially high quality services creating incentives for the railways to provide improved capacity and reliability. The level of these services however depends very much on the preconditions for the railways (e.g. quality of infrastructure, level of track prices, availability of rolling stock and terminal capacity, priority for long distance freight transport services).
  If this boost is not possible, the only alternative to shift road to rail is an increase in rolling

motorway transport, which is – however – from an economic view significantly less viable and needs specific state support from the alpine countries (notably France, Switzerland and Austria).

› Concentration and spatial reorganisation of the transport sector: It is assumed that bigger transport enterprises have more possibilities to react and are more familiar with market-based instruments. This is especially true for the cap and trade systems (ACE, AETS), where bigger institutions might have better access to broker facilities. In addition, smaller road transport companies (which are most visible in the alpine space and in Northern Italy) will have more problems to profit from intermodal services.
› New logistics organisation: Bigger logistics providers will try to reorganise their hub and spoke and storage systems and their fleet management. This might lead to efficiency increases in overall transalpine logistics. These processes might also focus on intercontinental logistics chains including harbour organisation.

The shift in traffic flows leads as well to a decreased income for transport infrastructure operators in the magnitude of up to 15% (scenario Restrictive 2030). This is mainly relevant for alpine road operators in Austria, Italy and France which are privately organised. At the same time, traffic reduction leads to less maintenance expenses and a higher attractiveness for passenger cars. The financial losses could be compensated by using parts of the additional income of the traffic management instruments.

Effects in the transport-intensive sectors

It is assumed that – due to a high level of competition – the transport sector will try to shift most of the burden to the freight forwarders and transport-intensive sectors. Most affected are the following transport-intensive sectors: Mineral oil industry, chemistry and synthetic material, metal industry, engine construction, construction materials. Their share of transport cost amounts to around 5% to 10% of their turnover. Transalpine transport is especially relevant for both the purchase and delivery market across the Alps. In addition, the economic sectors for foodstuff and retail trade are affected; though their share of transport cost is somewhat lower, they depend highly on the purchase markets north of the Alps.

The quantitative effect depends mainly on the possibility to shift the additional burden from the transport sector to the freight forwarders and shippers. Assuming that around 100% of the burden (after transport reactions) can be shifted and there is a split between origin and destination

industry of each 50%, a total a loss of GVA between 306–597 million EUR (2020) and 847–1’496 million EUR is estimated for the transport-intensive sectors. Most affected is the sector of energy and manufacturing, where most of the transport-intensive industry (such as food industry, chemistry, construction materials and retail) are included. This sector bears a total of 260–497 million EUR (2020) and 787–1’280 million EUR (2030). Although in absolute terms, the share of total GVA is some 0.04–0.09%, there will be severe differences with a further breakdown of burdens to specific sectors, since the level of cost of transport-intensive sectors is considerably higher. The following figure is summarising GVA changes of different sectors for the two scenarios considered.

ADDITIONAL BURDENS DUE TO TRAFFIC MANAGEMENT INSTRUMENTS WITHIN SELECTED SECTORS

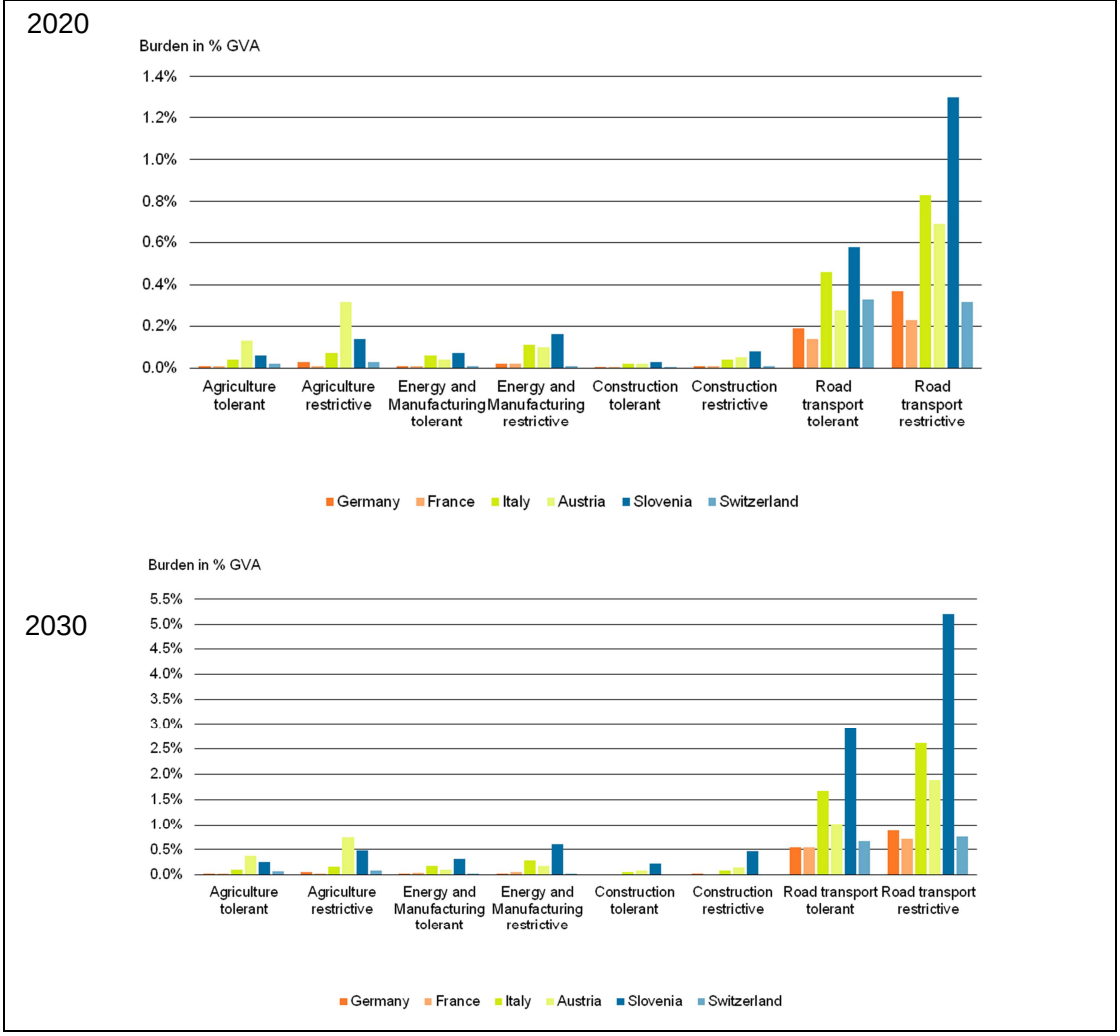


Figure S-1

These burdens represent the cost of shifting transport from road to rail. In general, it is assumed that the additional cost will be borne by and shifted further to the consumers. Within the transport-intensive sectors (namely food industry, chemistry and retail), some changes in the supply chains (e.g. change of suppliers) are expected. These will lead to a slight redistribution of transnational trade. The impacts in the transport sector however (e.g. modal shift) will be considerably more significant than major structural changes in the transport-intensive industries.

4. REGIONAL IMPACTS

Regional burdens

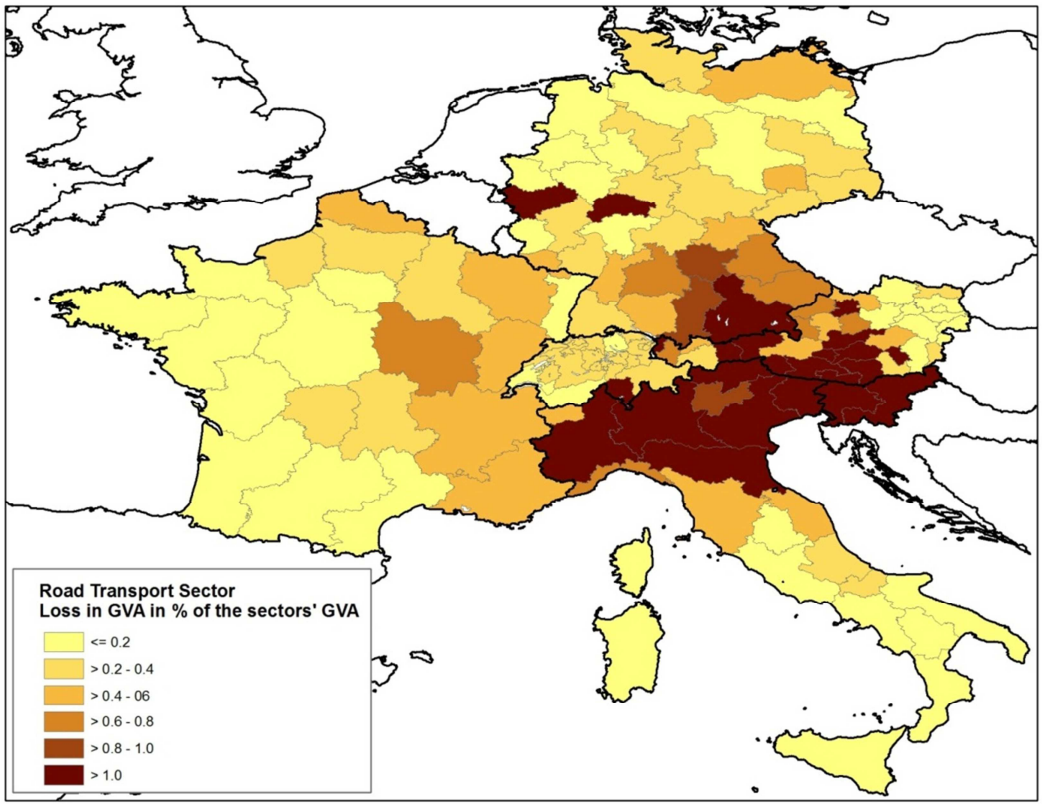
The losses and gains are not equally distributed in Europe. The loss of GVA in road transport in absolute figures is highest in Italy and Germany. In relative terms (compared to the level of GVA of the whole sector), the losses are highest in Slovenia (1.3% of total sector GVA) and Italy (0.83%). Looking at provincial level, the relative burdens can be significantly higher (up to more than 5%), especially in smaller regions directly south of the Alps, such as Southern Tirol, Klagenfurt or Ticino).

The gains within the railway sector have in principal similar regional patterns. However, the regional allocation of rail transport is much more difficult since it depends on the logistics organisation of the national railways. It is obvious that smaller regions have less potential to acquire new railway value added than bigger logistic centres. Thus, the regional distribution depends very much on the location of new hubs/terminals for combined transport.

The following two figures show the regional distribution of burdens for the road transport sector and the transport-intensive industry. In has to be considered that the levels shown are **maximum levels** (based on the scenario Restrictive and without consideration of use of income of the market-based instruments).

Due to the scenario assumption that the cost per passage is not depending on the distances driven, the short distance transports have to carry a higher relative burden than long distance transport (in % of overall transport costs). In addition, their possibilities to shift transport from road to rail is limited. If short distance transport would be given lower charges (e.g. km-dependent), the burden of alpine regions would decline by some 20% by average.

ROAD TRANSPORT SECTOR – MAXIMUM RELATIVE BURDEN 2020

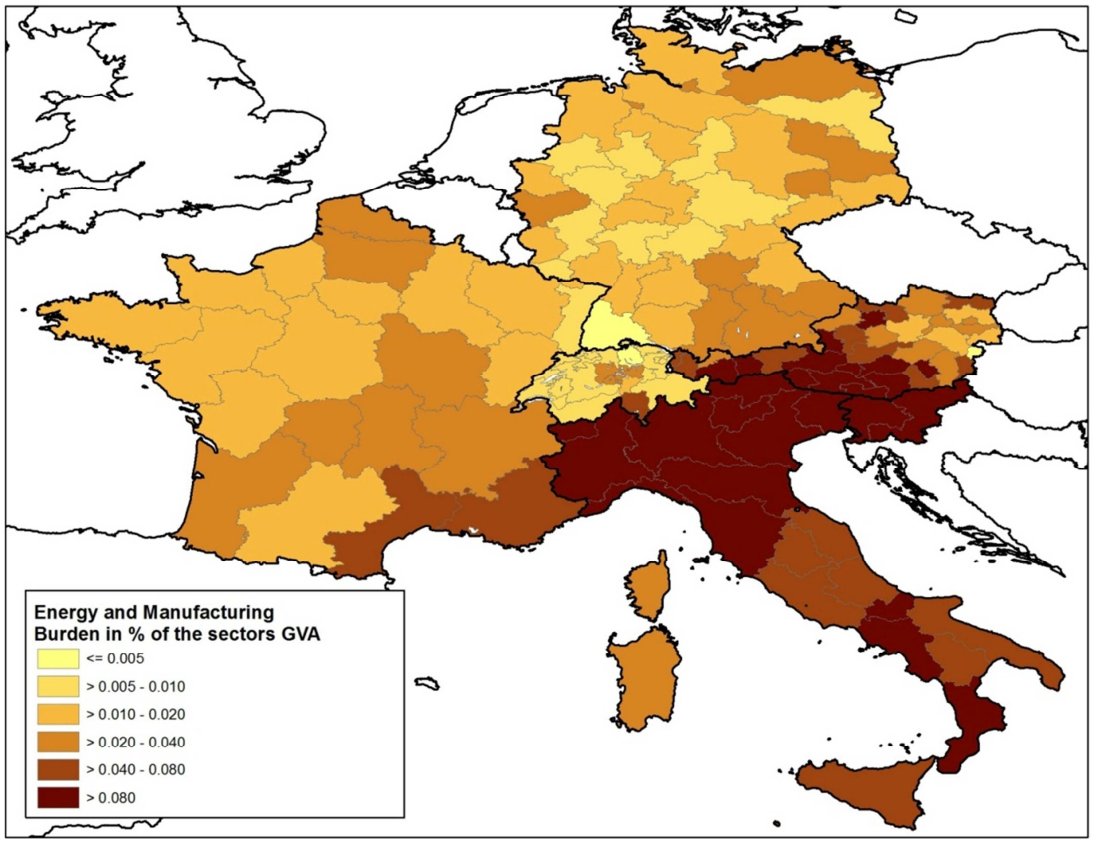


Road Freight Transport

	DE	FR	IT	AT	SI	
Minimal burden in % GVA	0.05%	0.00%	0.00%	0.01%	1.19%	
Highest burden in % GVA	1.34%	0.66%	1.98%	5.57%	1.38%	
Region with highest burden	Gießen	Bourgogne	Bolzano-Bozen	Klagenfurt-Villach	Zahodna Slovenija	Tic

Figure S-2

ENERGY AND MANUFACTURING SECTOR – MAXIMUM RELATIVE BURDEN 2020



	DE	FR	IT	AT	SI	
Minimal burden in % GVA	0.00%	0.00%	0.01%	0.00%	0.09%	
Highest burden in % GVA	0.04%	0.06%	0.40%	0.84%	0.26%	
Region with highest burden	Mecklenburg-Vorpommern	Provence-Alpes-Côte d'Azur	Friuli-Venezia Giulia	Klagenfurt-Villach	Zahodna Slovenija	Ti

Figure S-3

Hardship cases

Although the absolute level of additional burden is at maximum some percentages of regional GVA, several hardship cases have to be expected if the relative burden might lead to critical prospects or changes in locations. The most important criteria for hardship cases are the level of transalpine goods transported: supply and delivery market, the distance of these trips and the potential for modal shift, the ubiquity and competitiveness of the industry and their value added chain, the size of the enterprise and the importance of transport time. Examples show that the cost increase for such hardship cases might be in the magnitude of up to 5%.

This excess burden would be especially relevant for regional transalpine transport within short distances and with no possibility for modal shift. An Alpine Crossing Exchange for exam-

ple might lead to increases of transport costs up to 30–40% for such regional transports. In order to avoid such unjustified increases, specific relief measures have to be considered.

Positive effects and balance for alpine regions

Alpine regions will profit from the reduction of HGV traffic and the relief in environmental terms and related improvement of living conditions. In addition, an improvement of regional accessibility especially for road passenger transport can be expected. It is however difficult to measure such gains in economic terms. Most obvious is the improvement of the touristic image of alpine regions.

The balance for alpine regions (economic losses and economic benefits) is only positive if regional transport is treated separately with specific exemptions and relief measures. In addition, it has to be considered that there might be a trade-off between prioritisation of rail freight transport and regional rail accessibility in passenger transport.

5. LONG TERM ECONOMIC IMPACTS

Welfare considerations

From a welfare economic point of view, one can state that the welfare effects would be negative if the related prices of the traffic management instruments are above external costs. The price changes (esp. of restrictive scenarios) are significantly above the chargeable external costs according to the revised Eurovignette Directive. Compared to the cost rates of the full external cost calculation (according to the handbook and the Swiss HGV fee), the price signals are of a similar magnitude. However, it has to be considered that in Switzerland the prices would be on top of the existing HGV fee (which already internalises the external costs for the distance driven in Switzerland).

Dynamic modelling results

The figures computed within the quantitative sectoral and regional analysis shown above only consider the additional burden, but no specific costs of adjustment processes or compensatory effects due to use of revenues. The ASTRA model is a system-dynamic model, considers such effects and is completing the picture of economic impacts including all effects. It is applied for the scenarios Tolerant 2020 and Restrictive 2030 with different variants of revenue use (general budget, reduction of direct and indirect taxes).

The following figure shows the impact modeled for GDP and employment. The largest absolute decrease in 2030 is in Italy and France, though for France the refunding strategy compensates part of the reduction, while the relative decrease is similar in France and Austria in the order of 0.04% for the scenario Tolerant and 0.16% for the scenario Restrictive. The largest relative decreases can be observed for Slovenia (0.33%) and Italy (0.25%). This is also based on the assumption that the revenues have been allocated within the model calculations in France, Austria and Switzerland. If Italy would receive parts of the revenues created by the instruments according to the length of its infrastructure, the negative impact would be reduced by 25%. It has to be considered that positive effects caused by the infrastructure investments, i.e. the investment stimulus itself (such as the construction of new base tunnels at Brenner and Mont Cenis) have been eliminated. Thus, the reductions can be assigned directly to the increased road prices.

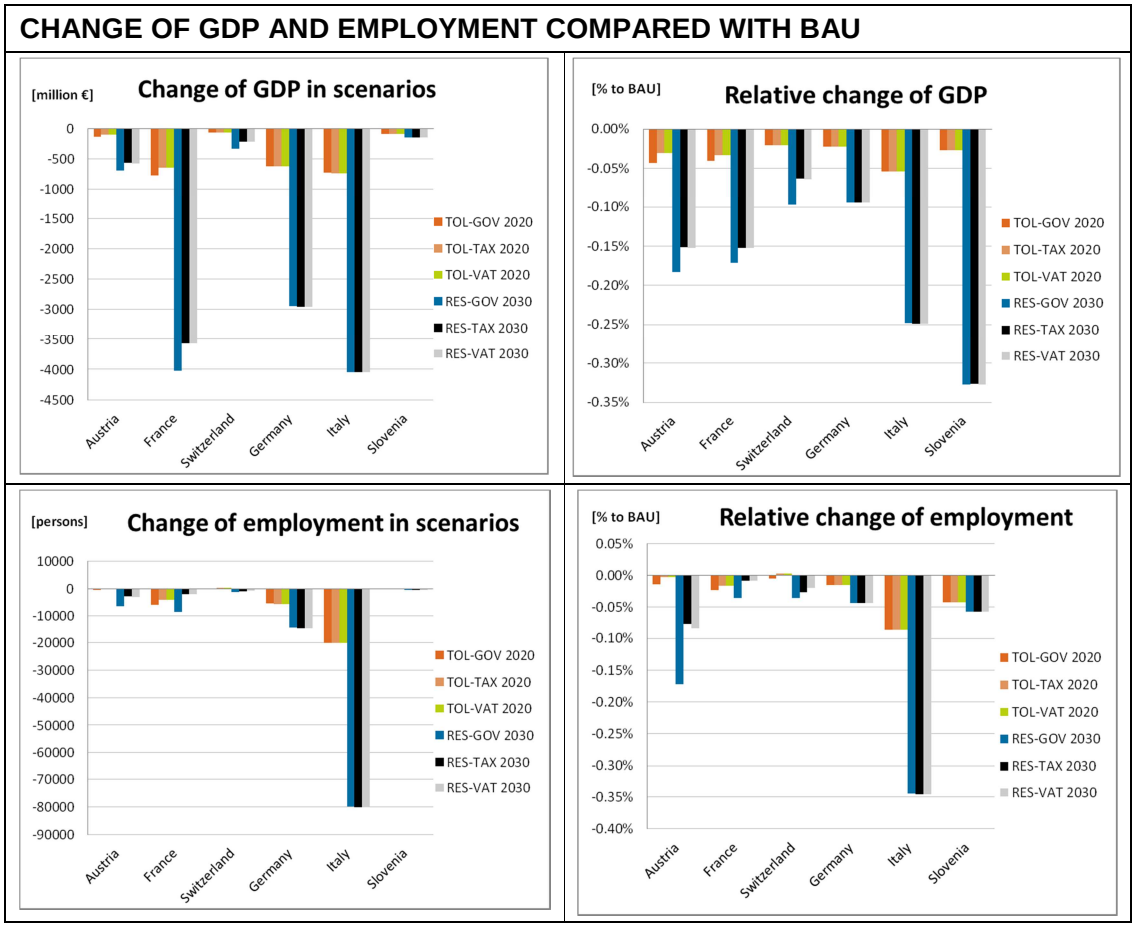


Figure S-4 Impact of transalpine management instruments on GDP and employment in the Alpine countries compared with business as usual (BAU) (Source: ASTRA-model)
- for two scenarios Tolerant (TOL) 2020 and Restrictive (RES) 2030 and
- three types of revenue use general budget (GOV), reduction of income taxes (TAX) and reduction of VAT (VAT).

The negative impact on GDP develops through the reductions of trade volumes into the economic system. The countries stronger affected are Austria and Italy, for which exports are reduced by about 0.6% and 0.5%, respectively. The reductions of exports are then translated into reductions of sectoral output and GDP. However, the slight reduction in GDP does neither in all countries nor in all scenarios lead to a potential reduction in employment, since - on a sectoral level - the impacts vary. Some countries winning sectors compensate for employment losses in other sectors. In the end, Italy might be most affected in terms of employment losing about 0.35% of employment in the scenario Restrictive 2030 due to its reduced exports affecting more labour-intense sectors than in other countries. All other countries remain at levels of losses of 0.06% after refunding the revenues in the scenario Restrictive 2030. Without refunding, also in Austria the employment loss would be more significant and reach about 0.17% in the scenario Restrictive 2030.

6. CONCLUSIONS

Interpretation of results

Comparing the dynamics of the scenarios Tolerant and Restrictive it is apparent that the changes in the scenario Tolerant 2020 would be close to negligible, regardless whether a refunding strategy is undertaken or not. Obviously, the cost increases remain so limited that transport-using sectors need to adapt only with operational improvements, but not by changing their employment levels. The only exception would be in the transport services sector itself, in which – according to the ASTRA model calculations – also about 1000 to 2000 new jobs could be generated in the larger countries.

However, in the scenario Restrictive 2030 changes of economic variables can be in the order of 0.5% to 1% compared with the BAU scenario in 2030. This would still indicate limited impacts, but for the most affected sectors or regions this should point to observable structural change, e.g. employment gains in transport service sectors or employment losses in labour-intense and export oriented industries. It could also be confirmed that refunding the revenues of the pricing policy to consumers would have a positive impact, though it did not make a difference if the refunding occurred via reductions of direct taxes or via reductions of indirect taxes.

Based on the different analytical steps, the following conclusions can be drawn:

› The lower the possible price increase of the new transalpine management instrument, the better the (rail) alternative and the better the anticipation of the possible mechanisms by the economic actors, the lower are the risks of negative economic impacts. The introduction of a restrictive system without a considerable improvement of rail capacity and quality in freight transport might lead to considerable economic risks.
› The distribution of impacts is more critical than the level of impacts. Notably, small road transport operators in alpine regions and some transport-intensive industries might face excess burdens leading to structural changes and hardship cases.
› The instruments influence economic effects firstly by the level of restriction (e.g. choice of thresholds and price increases respectively). Secondly, however, there are possible design parameters for each instrument which are able to minimise excess burdens and unwanted effects, such as an over proportional burden for short distance transalpine transport and alpine regions.

Preconditions to minimise losses and to maximise benefits

There are the following crucial factors to consider:

› Incentives to increase road transport efficiency: Although at first sight, the potential in the road transport sector to increase efficiency is limited, the instruments should be able to maximise the incentives to improve loading factors and fleet performance without creating detours and unwanted shifts between alpine passages.
› Quality of the rail alternative: The most important challenge is to improve rail quality especially on a transnational scale at the national borders. Until 2020, the realisation of potentials is most significant at Swiss corridors (with the two base tunnels at Lötschberg and Gotthard) and at the Brenner axis (with 4 tracks between Munich and Verona). Between 2020 and 2030, the realisation of the two planned basetunnels at Brenner and Mont Cenis are supposed to create new potentials to improve transnational capacity and interoperability. At the same time, these investments create new potentials for GDP and employment increase.
› Introduction of specific relief and flanking measures: the analysis has shown clearly that the burdens of alpine regions might be above average if short distance transport will not be treated separately and specific relief measures will be introduced. Without such measures, the regional acceptance will be very low. The analysis has also shown that there are different policies available. Possible economic losses might also be reduced by introducing the traffic management instruments smoothly and well-prepared for the stakeholders involved.
  Besides, the most important flanking measures should support a boost for combined transport.

Such measures are related to terminal planning and financing, to support pilot projects and specific supplies in addition to on-going EU and national programmes and efforts.

› Use of revenues: The use of revenues firstly depends on the design of each instrument analysed. In any case, there is potential to equal the different burdens by using parts of the revenues to compensate countries or regions especially south of the Alps.

Further development of instruments

The analysis has shown that there are risks and chances for the alpine regions and the transalpine transport system at the same time. The further elaboration of possible transalpine traffic management systems should further evaluate the following elements especially:

› Definition and development of thresholds: One important advantage of common transalpine traffic management systems is harmonisation. It will create transparency and synergy potentials for the transport system as a whole. The additional analysis should try to focus on the rationale and the definition of common thresholds coordinated between alpine countries and their passages.

› Optimisation of design: According to the proposals made above for relief and flanking measures and use of revenues, the additional analysis should try to concretise the potentials for optimal designs in order to prevent unwanted effects.

› Focus on chances: The economic analysis carried out within this study is not able to focus on all benefits properly, since many effects are not linked with direct economic impacts, such as the increase of quality of life and the reduced risk of environmental costs. In addition, the chances for the rail and combined transport sector and the chances for the alpine regions facing road freight traffic reduction (and better accessibility for passenger transport) and environmental improvements could be analysed (e.g. by case studies) more in-depth.

› Communication: Finally it became clear (especially with the stakeholder interviews) that the knowledge especially on the new cap and trade systems is very limited. Focused communication and information on the design and the functioning of such instruments might help to improve the understanding (and the related chances) of the mechanisms and to improve acceptance for new instruments.

1. INTRODUCTION

1.1. BACKGROUND

The 'Declaration of Zurich' (adopted 30th Nov 2001) concerning the improvement of road safety, in particular in the tunnels of the Alpine zone, has successfully introduced framework conditions to reduce the risk of serious accidents in the Alpine tunnels. Following this, the Transport Ministers of the Alpine countries have decided to continue collaboration towards an improved coordination of traffic management systems. After the first overview study, three different managements systems (Alpine Crossing Exchange (ACE), Alpine Emission Trading System (AETS) and a surcharge on existing tolls covering external costs (TOLL+) have been chosen for further in-depth analysis. The study 'ALBATRAS' (Ecoplan, Rapp Trans et.al. 2011) has looked at the design of these instruments and the impacts on traffic flows (road and rail) for different time horizons (2020, 2030), based on model calculations with the so-called TAMM model.

The design of these three instruments is described in the Glossary. The analysis has shown that the impacts depend on the thresholds chosen for the different instruments (in one or all Alpine countries at the same time) and the ability of the rail systems to take over a substantial part of traffic flows in the future. Thereby it has to be considered that the points of departure (aims, focus, infrastructure capacities, and instruments) in the different countries (and corridors) are different.

Besides this transnational coordination, there are national aims and policies and regional activities to consider. Switzerland for instance has launched several studies to analyse the design and the impacts of an ACE being one of the instruments foreseen to meet the ambitious modal split aims (reduction of transalpine lorries to 650'000 per year). INFRAS (INFRAS/Metron 2011) has analysed the economic impacts for Switzerland in order to evaluate measures to compensate excess economic burdens of Alpine regions.

The Interreg project Monitraf covers all Alpine regions in Austria, Switzerland, Italy and France. This project has evaluated the existing instruments and has also analysed possible coordinated traffic management schemes. The on-going follow up project iMonitraf! is looking at the regional and social impacts and tries to develop a common position and decision basis for the development of coordinated traffic management systems. Hence the regional strategies are in line with the attempts of the Declaration of Zurich process.

Based on previous discussions and study results, the follow-up process of the 'Declaration of Zurich' wants to complete the analysis on possible future traffic management systems. After the conceptual and traffic analysis, it is necessary to study the legal framework and the social and economic impacts, in order to have a common understanding of the advantages and disadvantages of the different approaches and possible approaches to introduce coordinated schemes.

1.2. AIM OF THE STUDY

The TOR of the analysis of the economic impacts (9th Feb. 2011) mentions the following aims:

- Analysis of the economic, logistical, social and occupational impacts
- for the transport sector (road transport sector in particular) and for transport-intensive economic sectors..
- considering especially the impacts on GDP, employment, consumption costs and price levels, industry organisation and supply with goods..
- at regional level (NUTS II) and national level..
- for different types of instruments (ACE, AETS, TOLL+) according to the baselines and traffic impacts analysed in ALBATRAS..
- and different ways of introduction (one instrument for the entire Alpine region, mixed/combined instruments).

In order to be compatible with the previous work done within the ALBATRAS project, the economic impacts have to be evaluated based on selected ALBATRAS scenarios.

2. GENERAL METHODOLOGY

2.1. SCENARIOS OF TRANSALPINE TRAFFIC MANAGEMENT INSTRUMENTS

ALBATRAS scenarios

ALBATRAS has calculated 21 different scenarios. The scenarios differ in the traffic management instruments used (ACE, AETS, TOLL+), the projected year (2020, 2030) and the growth assumptions. The following table summarises the range of price increase per trip of the different scenarios.

ALBATRAS SCENARIOS AND RESULTING TRANSPORT PRICES			
Scenario	**Description**	**Transport price sur charges 2020**	**Transport price surcharges 2030**
BAU	High and low level of transalpine traffic growth; due to minimal differences, the high level scenario has been chosen for the analysis.	Baseline	Baseline
ACE	Cap for lorries in different countries a. Restrictive, based on Swiss modal shift aims (different caps per country) b. Tolerant, one aim for all country	A: 59–94 EUR/trip CH: 93–160 EUR/trip F: 79–126 EUR/trip	A: 128–280 EUR/trip CH: 126–280 EUR/trip F: 166–345 EUR/trip
AETS	Reduction of CO_2-Emissions by 20% (2020) c. Tolerant and restrictive d. Applied jointly and per country	A: 27–102 EUR/trip CH: 30–86 EUR/trip F: 28–73 EUR/trip	A: 114–301 EUR/trip CH: 208–263 EUR/trip F: 100–222 EUR/trip
Toll +	Surcharges on existing charges per km based on additional external cost in Alpine regions	A: 87–128 EUR/trip CH: 78–109 EUR/trip F: 73–92 EUR/trip	A: 184–354 EUR/trip CH: 164–300 EUR/trip F: 153–254 EUR/trip
Mix	ACE for CH–I, AETS for A-I and TOLL+ for F-I	A: 33–49 EUR/trip CH: 81 EUR/trip F: 40–51 EUR/trip	A: 102–151 EUR/trip CH: 160 EUR/trip F: 151–190 EUR/trip

Table 1 Source: ALBATRAS (Ecoplan, RappTrans et al 2011).

The compilation shows that for all measures, the price increases for transports are significant and stronger in 2030 than in 2020 compared to the business as usual (BAU) scenario. The more restrictive the instrument the higher the price increase. Sind the price increase is the crucial variable within the economic analysis, and since the price increases of several scenarios are in the

same range, two different scenarios for two different time horizons (2020 and 2030) will be selected for further analysis in this study

Price effects of selected scenarios

In accordance with the steering group, the scenarios "TOLL+ restrictive" and "Mix" (acc. to ALBATRAS definition) were considered as relevant because of the following reasons:

› Scenario "Mix" is one of the scenarios with the lowest price increase and the only one which combines all instruments.

› Scenario "TOLL+ restrictive" has the highest price increase of the scenarios with a single traffic management instrument in the whole Alpine arc.

In the following we will name the ALBATRAS Scenario TOLL+ restrictive as "Scenario Restrictive" and the scenario Mix as "Scenario Tolerant".

The price effects of the scenarios considered are summarized in the following table.

OVERVIEW OF PRICE INCRESASES UNDER DIFFERENT SCENARIOS									
Description	Distance with costs	Cost per km				Cost per Trip			
		2020 Tolerant	2020 Restr.	2030 Tolerant	2030 Restr.	2020 Tolerant	2020 Restr.	2030 Tolerant	2030 Restr.
AT - Reschen	443	0.11	0.29	0.34	0.80	48.7	128.5	150.6	354.4
AT - Brenner	430	0.11	0.29	0.34	0.80	47.3	124.7	146.2	344.0
AT - Felber	387	0.11	0.29	0.34	0.80	42.6	112.2	131.6	309.6
AT - Tauern	301	0.11	0.29	0.34	0.80	33.1	87.3	102.3	240.8
AT - Schober	0	0	0	0	0	0	0	0	0
AT - Semmering	0	0	0	0	0	0	0	0	0
AT - Wechsel	0	0	0	0	0	0	0	0	0
AT - Tarvisio	301	0.11	0.29	0.34	0.80	33.1	87.3	102.3	240.8
CH - G St. Bernard	321	0.25	0.29	0.50	0.80	81.0	93.1	160.0	256.8
CH - Simplon	375	0.22	0.29	0.43	0.80	81.0	108.8	160.0	300.0
CH - Gotthard	269	0.30	0.29	0.59	0.80	81.0	78.0	160.0	215.2
CH - San Bernardino	291	0.28	0.29	0.55	0.80	81.0	84.4	160.0	232.8
FR - Mont Blanc	251	0.16	0.29	0.60	0.80	40.2	72.8	150.6	200.8
FR - Frejus	307	0.16	0.29	0.60	0.80	49.1	89.0	184.2	245.6
FR - Montgenevre	305	0.16	0.29	0.60	0.80	48.8	88.5	183.0	244.0
FR - Ventimiglia	317	0.16	0.29	0.60	0.80	50.7	91.9	190.2	253.6

Table 2 Price increases at the different Alpine corridors under the considered scenarios per km and per trip according to the calculations in ALBATRAS.

2.2. METHODOLOGICAL STEPS

In order to analyse this complex topic in a comprehensive manner, the analysis of regional economic impacts distinguishes three methodological steps:

1. Quantitative analysis of the maximum regional burden (GDP and employment).
   Based on the ALBATRAS results, the effects on GDP and employment for the transport sector and different economic sectors for selected ALBATRAS results are calculated. This part of analysis considers only the burden, but not possible compensatig effects of the use of revenues due to the different traffic managment instruments.
2. Qualitative analysis looking at the detailed reaction patterns of the transport and the other economic sectors and case studies based on interviews with selected stakeholders.
3. Dynamic model analysis based on the ASTRA model considering adaption patterns and the use of revenues.

The following figure shows the procedure of the analysis along the methodological steps.

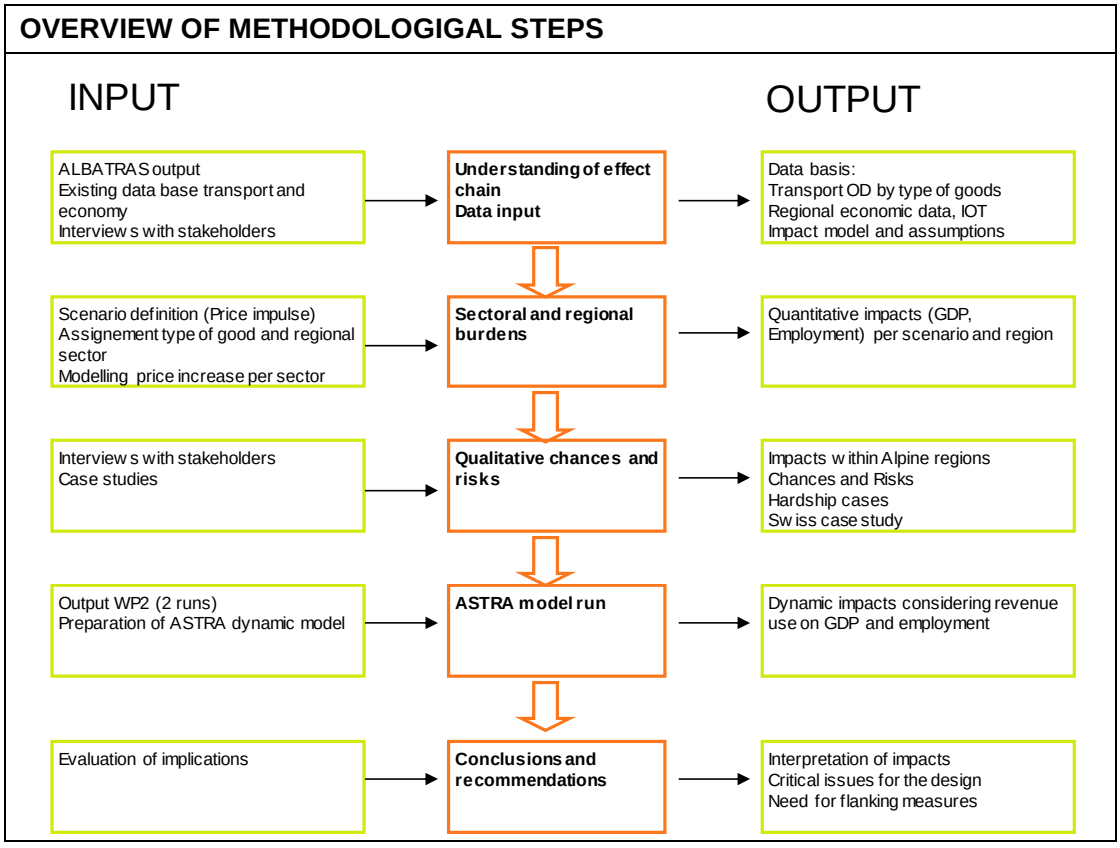


Figure 1

Qualitative interviews

Interviews with selected stakeholders in the transport and industry sectors in different countries aim to provide further in-depth knowledge and expectations on the different effects of traffic management instruments, especially with regard to

› Reaction patterns: How will the transport actors react and how and what incentives do they have to change their behaviour?
› Structural change of the logistics sector,
› Structural change of transport-intensive sectors,
› Chances and risks for different regions,
› Conclusions for hardship cases criteria,
› Preconditions for structural change along chances.

The interviews serve as well as a basis for the understanding of the general economic impact chain and as an input for the qualitative in-depth analysis (see chapter 4).

2.3. SYSTEMS DELIMITATION

The analysis has to consider the following systems and differentiations:

Regional differentiation

› The regional scope for the introduction of the traffic management instruments is the Alpine arc "B+" (region between Ventimiglia and the Tauern-axis). The analysis of the ALBATRAS study considered the impacts on traffic flows on the Alpine arc C, which contains the region between Ventimiglia and Wechsel (see Figure 2).
› The quantitative analysis of regional burdens (chapter 3) considers the impacts on the NUTS 2 regions of France, Germany, Italy and Slovenia and on the NUTS 3 regions of Switzerland and Austria (see Figure 3).
› The ASTRA modeling concentrates at the national level.

REGIONAL SCOPE FOR THE INTRODUCTION OF THE TRAFFIC MANAGEMENT INSTRUMENTS

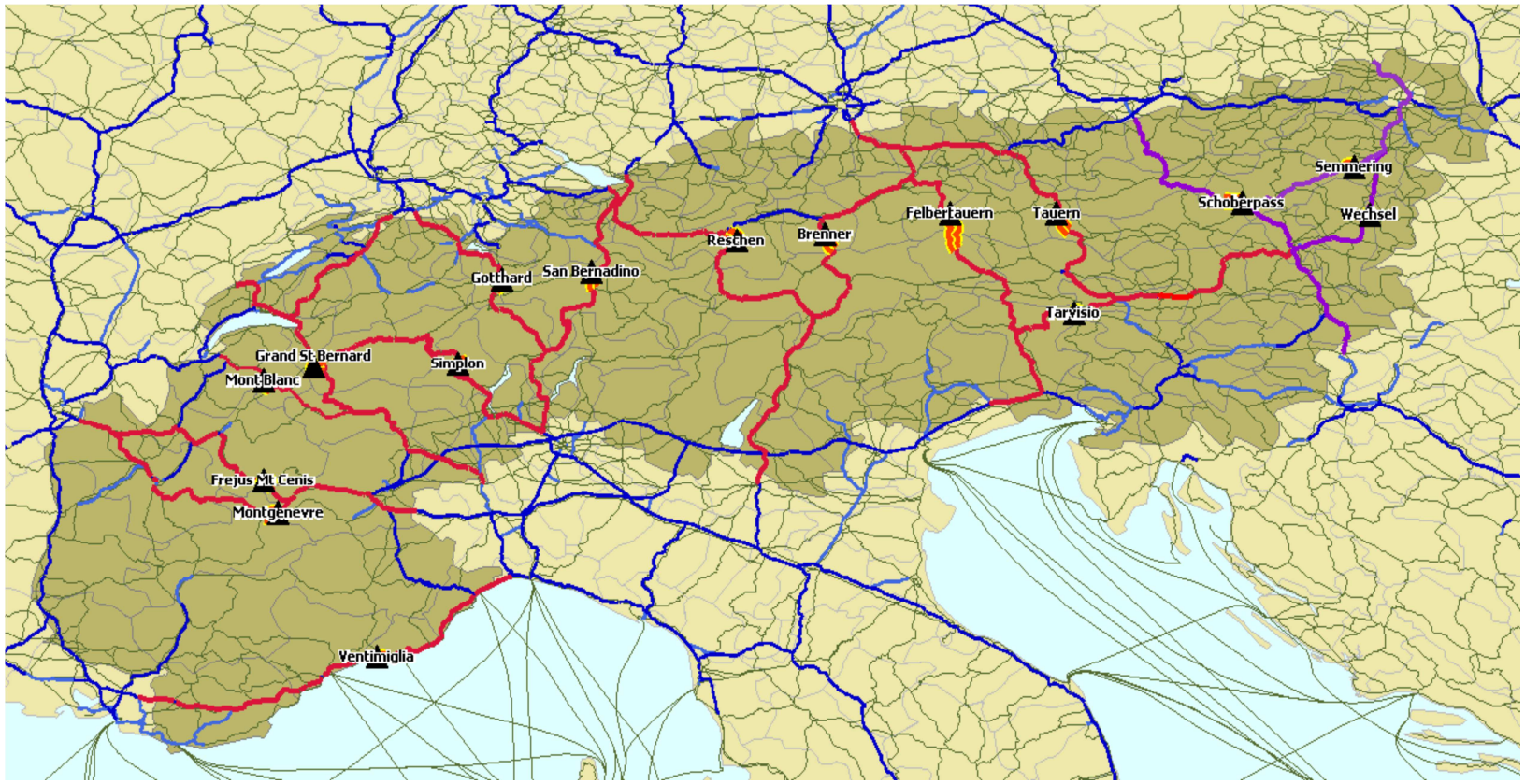


Figure 2 Source: ALBATRAS (Ecoplan, RappTrans et al, 2011)

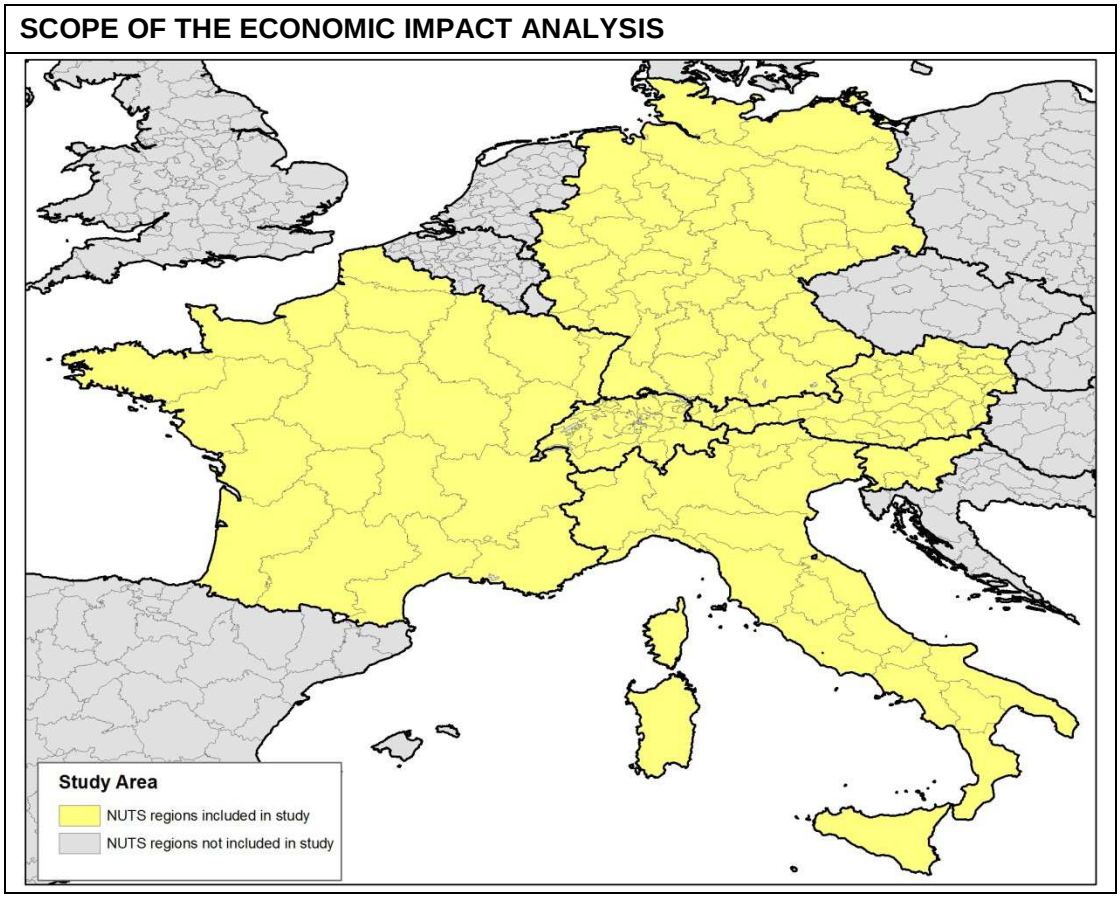


Figure 3 Scope of the analyzed regions.

Sectoral differentiation

For all type of analysis, there is a distinction between the transport sector (road, rail) and transport-intensive sectors.

› Within the quantitative analysis of sectoral burdens (chapter 3) the following sectors are considered: Agriculture, Energy and Manufacturing, Construction, Distribution, Hotel & Restaurants, Transport, Storage and Communications, Marked Services, Non-Marked Services. These sectors have been matched with the type of good transported.

› The ASTRA model considers several economic subsectors. For the purpose of this analysis, a detailed evaluation has not been carried out. The analysis reveals the impact on the general shares of selected sectors (see chapter 5).

2.4. OVERVIEW OF IMPACTS

2.4.1. GENERAL IMPACT CHAIN

Traffic management instruments have different impacts on supply functions/production functions of the different stakeholders along the logistic chain. As a basis for the overall analysis, the reaction model has been differentiated to allow an illustration for the different stakeholders with a main focus on: road transport operators (carriers and logistic service providers), shippers from transport-intensive industries and the rail sector.

On the basis of this stakeholder-specific reaction model and the interviews, the most important elements can be described as follows:

- **Road transport operators (carriers/logistic service providers):** The road transport operators are the first part of the reaction model and will be directly impacted by the traffic management instrument. Road transport operators have to buy allowances from an ACE or AETS or have to pay the toll. Within their "system" they have different possibilities to react and to influence their transport prices. Interviews have provided further information on the different reaction patterns, on differences between big and small operators, "pure" road transport operators and logistic service providers, international and regional/local operators.
- **Shippers from transport-intensive sectors:** The shippers are the second element in the reaction model. They are faced with higher road transport costs and have to decide how to react. Depending on their production characteristics (role of inputs, outsourcing, just-in-time mechanisms, etc.) as well as the geographical market for their goods (international, national, regional, local) these reaction patterns can differ. Firstly the logistics market will be addressed, along the possibility to change logistics structures along the buyers and delivery markets and the possibility to integrate rail transport, secondly – in the longer run – a change of markets and locations. Finally, the possibility to pass higher transport costs to clients on the downstream production chain or to costumers will be different. A special focus is on shippers from transport-intensive sectors.
- **Intermodal services and rail transport:** The rail and intermodal transport sector will profit from the different steering mechanisms as they set direct incentives to switch from road to rail. This however implies further activities to deal with the additional demand. It will be important to analyse the roles of the different rail segments (rolling motorway, unaccompanied combined transports (trailers and containers), wagon load), the potential of innovative approaches (e.g. new trailer systems, improved operating procedures) and the role of cross-financing to ensure these developments.

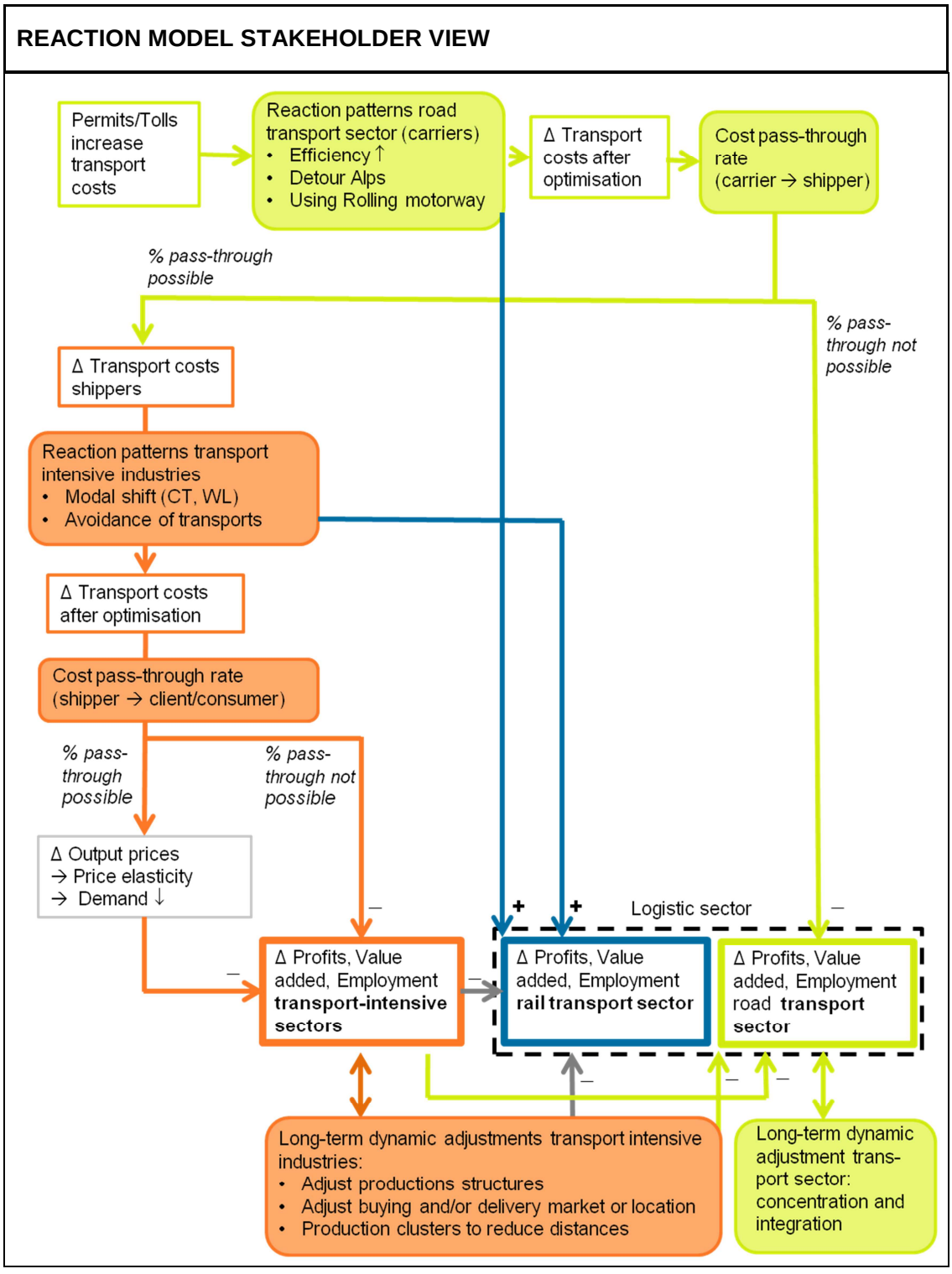


Figure 4 green = transport sector (carriers, logistic service providers), orange = shippers, blue = rail, grey = downstream clients in the production chain/consumers

› **Regional economies in the Alpine Space:** In the Alpine regions, a greater share of goods will be affected from increased transport prices than in other regions. Also, some of them have a higher dependency on provision of goods that are not available in their region. This can include inputs for regional commerce and industry as well as final consumer products (e.g. agricultural products). Especially, it will be necessary to assess if there is a risk of supply interruption due to limited availability of permits or high fluctuations in permit prices.

Existing impact assessments of transport policies (especially market-based instruments) can give a first idea on the mechanisms of the reaction model. Some of the existing studies also worked with stakeholder interviews to gather detailed information on the reaction patterns. Others worked with specific assumptions based on other literature sources. Also, position papers of transport stakeholders give some insights into the market-structure and the reaction to new instruments.

The most important parameter for the quantitative analysis is the question on the potential of passing on of additional costs. The interviews have shown clearly that the transport sector – due to narrow margins and high level of competition – will try to pass on costs to the shippers resp. to the consumer. Facing possible demand reactions, a full pass-through of increased prices however won't be possible.

2.4.2. IMPACTS AND INDICATORS

The following table gives an overview of the indicators which are used by the different methodological steps to evaluate the impacts.

IMPACT ELEMENTS AND INDICATORS		
Indicator	**Level of detail, concretion**	**Methodology**
Prices	Transport prices and consumer prices in a quantitative manner, based on scenario definition	Results from ALBATRAS, ASTRA model, qualitative analysis
GDP/GVA	Quantitative, based on regional forecasts	Analysis of regional and sectoral burdens ASTRA model)
Employment	Quantitative, based on regional forecasts	Analysis of regional and sectoral burdens ASTRA model)
Road traffic management	Qualitative, illustrated quantitatively, considering capacity effects on road and logistic decisions	Qualitative analysis
Trade flows	Selective quantitative for most important trade flows (such as agricultural goods)	ASTRA model
Industrial organisation	Qualitative (impact on labour division and terms of trade) and relative competitiveness, differentiated to transport sector and other sectors	Qualitative analysis
Secured supply with goods	Qualitative analysis (specific focus on captive goods, e.g. agriculture, specific industrial goods); risk of transport interruption due to caps	Qualitative analysis
Additional economic impacts	Positive impacts on tourism and quality of life in Alpine regions due to improved environment	Qualitative analysis

Table 3

2.5. DATABASE

Transport data

To analyse the impact of the introduction of an ACE, an AETS or a TOLL+ strategy, the ALBATRAS consortium used the Transalpine Multimodal Model (TAMM), which produced a forecast of transalpine freight transport for the years 2020 and 2030. The model is calibrated on the CAFT 2004 survey and delivers data differentiated on NUTS3-level and NSTR freight groups by road, and three rail modalities. The most important assumptions were country-specific growth rate according to the EU iTREN 2030 Project, general productivity effects through rail development, introduction of new rail base tunnels and a step-by-step abolishment of rail freight subsidies (Ecoplan, NEA et al 2011). The regional analysis shown in the following chapters is based directly on the OD-matrices of the TAMM-model for the scenarios chosen (direct data transfer from NEA to INFRAS).

Regional and sectoral economic data

The data used for the estimation of the regional and sectoral burdens are based on the following sources[3]: With the exception of Switzerland, we use the data from the output of the E3ME model of Cambridge Econometrics (version 2010). E3ME is a computer-based model of Europe's economic and energy systems and the environment. It was originally developed by the European Commission's research framework programmes and is now widely used in Europe for general policy assessment, forecasting and research purposes. As the forecast of the model ends in the year 2014, we extrapolate the growth rates of the period 2008–2014 to the year 2020 resp. 2030. The E3ME model contains the following sectors:

› Agriculture (NOGA-Code A: Agriculture, Forestry and Fishing)
› Energy and Manufacturing (NOGA-Code B to E: includes the production of construction materials)
› Construction (NOGA-Code F: construction services)
› Distribution, Hotel&Restaurants, Transport and Communications (NOGA-Code G to I)
› Market Services (NOGA-Code K to N and R to S))
› Non-Market Services (NOGA-Code O to Q).

The transport-intensive sectors Agriculture, Energy & Manufacturing and Construction were used straight from the database. As we are especially interested in road and rail freight transport, we had to differentiate the sector “Distribution, Hotel & Restaurants, Transport and Communications” into three parts: Road freight transport sector, rail freight transport sector and the rest.

The Eurostat “structural business statistics” contain detailed information about employees in the different sectors and gross value added per employee in the different countries. On the basis of this data, we were able to calculate the percentage of the land transport (including freight and person transports on rail and road) of the whole sector per region for the year 2008. To isolate road and rail freight transport sectors, employee data differentiated into road freight and rail freight transport is needed. This data is only available at national level. The proportion of rail freight and road freight transport of the aggregate “land transport” is deduced as follows: their proportion of land transport is calculated on a national level and multiplied with the percentage of the land transport of each region (cf. Figure 6). This is the best possible estimation of the regional GVA of those sectors on the basis of the available data. Nevertheless it is important to

3 The ASTRA model has an own data base (see explanation in Chapter 5).

note that the true distribution of road and rail freight transport within a country will not be the same in each region.

ISOLATING ROAD AND RAIL FREIGHT TRANSPORT SECTORS

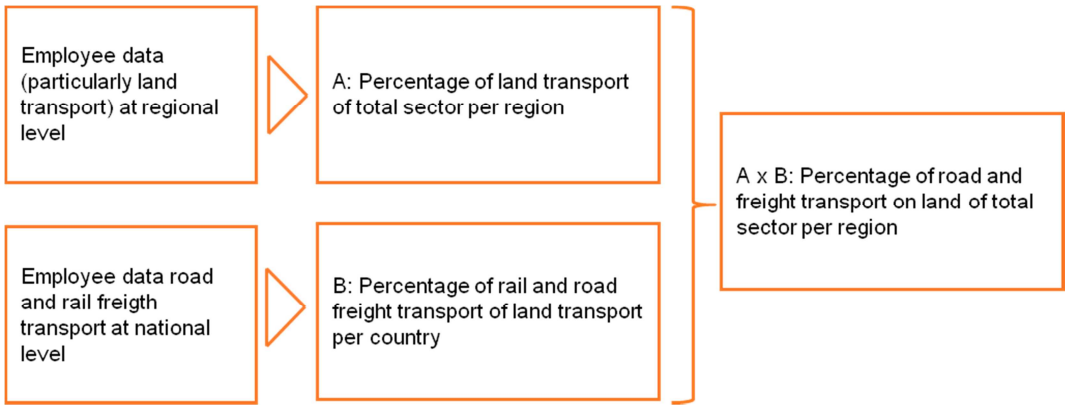


Figure 5 To get the percentages of road freight und rail freight transport sector we derive from regional employee data the part of the aggregate "land transport" at the Distribution, Hotel & Restaurants, Transport, Storage and Communications sector for each region (A). Then we derive the percentage of road freight transport and of rail freight transport at the aggregate "land transport" for each country at national level (B). By multiplying A with B we get the percentage of road respectively rail freight transport at Distribution, Hotel & Restaurants, Transport, Storage and Communications sector at regional level.

A further challenge is that the aggregate 'land transport' contains only professional transports (carried out by third parties) and no transports on own account (internal transport). We corrected the percentage of the road freight transport additionally with the percentage of the transport on own account measured in the hired transports (source: Eurostat, road freight transport statistics, dataset 2008). The remaining part of the sector, which is not rail or road freight transport, is added to the 'Market Services' and 'Non-Market Services' sectors. Together they form the 'Services' sector.

This results in the following sectors:

› Agriculture,

› Energy and Manufacturing,

› Construction,

› Services,

› Road freight transport,

› Rail freight transport.

For Switzerland, the E3ME data is only available at NUTS 2 level. In order to receive data on NUTS 3 level, we segregated the national accounting 2008 with the help of employee data at NUTS-3-level (Source: Bundesamt für Statistik). For the forecast to the year 2020 we extrapolated the growth rate at NUTS 2 level of the E3ME model in the period 2008–2014 to the year 2020 resp. 2030.

The E3ME database is designed in price level 2000 Euros. This means that the results are real term values. Whereas there is no influence on relative values, the nominal values are inflation adjusted. Table 4 and Table 6 summarize the resulting figures on a national level for the year 2020. The data on regional level are shown in Annex 1.

GVA 2020							
in million EUR (price level 2000)	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Services**	**Road Transport**	**Rail Transport**	**Total**
Germany	29'060	602'483	91'071	1'743'306	23'194	1'995	2'491'109
France	40'606	278'456	74'838	1'229'074	22'244	1'407	1'646'625
Italy	29'813	229'902	53'829	844'761	15'254	678	1'174'237
Austria	4'021	77'451	12'388	155'877	7'249	1'032	258'018
Slovenia	586	7'961	1'383	17'893	605	34	28'463
Switzerland	4'126	88'698	22'358	269'926	6'010	620	391'739

Table 4 GVA per country and sector in the year 2020

GVA 2030							
in million EUR (price level 2000)	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Services**	**Road Transport**	**Rail Transport**	**Total**
Germany	34'206	684'587	101'045	2'054'828	26'650	2'292	2'903'608
France	46'299	314'245	74'039	1'376'450	24'214	1'532	1'836'780
Italy	30'775	221'727	48'647	896'828	15'852	705	1'214'533
Austria	4'007	98'083	10'228	175'131	7'409	1'055	295'912
Slovenia	570	8'075	1'011	20'446	632	36	30'769
Switzerland	3'528	104'444	28'388	312'343	7'427	767	456'896

Table 5 GVA per country and sector in the year 2030

EMPLOYMENT 2020							
in 1000	Agriculture	Energy and Manufacturing	Construction	Services	Road Transoprt	Rail Transport	Total
Germany	776	7'915	2'287	32'238	540	33	43'790
France	621	3'332	1'544	20'168	572	36	26'272
Italy	1'315	4'507	2'008	17'652	354	15	25'851
Austria	221	715	292	3'081	152	15	4'476
Slovenia	71	199	84	618	24	1	998
Switzerland	141	751	331	3'089	97	10	4'418

Table 6 Employment per Country and sector in the year 2020

EMPLOYMENT 2030							
in 1000	Agriculture	Energy and Manufacturing	Construction	Services	Road Transport	Rail Transport	Total
Germany	710	7'837	2'383	35'546	576	36	47'088
France	492	3'035	1'499	21'548	617	38	27'231
Italy	1'319	4'054	2'093	18'650	367	16	26'499
Austria	192	716	307	3'352	153	16	4'736
Slovenia	61	164	79	695	26	2	1'026
Switzerland	117	756	344	3'299	102	11	4'629

Table 7 Employment per Country and sector in the year 2030

It is important to note that in this delimitation of the freight transport sectors only transport services are considered. The gross value added of transport infrastructure is not included.

3. REGIONAL AND SECTORAL BURDENS

This chapter contains the analysis of the regional burdens of the traffic management instruments without considering the use of revenues. The assumptions are chosen in order to calculate the **maximal** and not the most likely impacts.

The first passage describes the methodology, the second shows the initial situation with regard to transports and value added of the different regions, the third and fourth part presents the results. Chapter 3.3 gives an overview of the level of the burden under the different scenarios at a national scale. Chapter 3.4 shows the regional distribution of the burdens. Since the regional distribution of the burden is in all scenarios similar, only scenario Restrictive 2020 is presented in detail. The detailed results of the other scenarios are in Annex 1. Chapter 3.5 contains some sensitivity analysis and the last section discusses how the results can be transferred to ALBATRAS scenarios not discussed in this study.

3.1. BURDEN ALLOCATION

Whereas the reaction of the traffic flows is already calculated in ALBATRAS, the aim of this chapter is to calculate the economic costs. On one hand, transport reaction (omitted trips, modal shift, shifts between corridors) causes costs; on the other hand transport costs are higher on the remaining road trips. Both effects are considered. The following passages define the crucial assumptions and explain the calculation of burdens.

3.1.1. ASSUMPTIONS

The two crucial assumptions of the model are the assumptions concerning the passing-on of cost and the assumptions on which products (NSTR-groups) are transported by which sector. We first discuss the passing-on of costs and then the assignment of products to sectors.

Passing-on of costs

Because the reaction of traffic is already contained in the data used (ALBATRAS scenarios), we assume that on the remaining traffic the road freight transport sector can transfer all costs to the shippers. The results of the interviews with stakeholders support this assumption. As a result, the burden of the road transport sector is defined as the loss due to the decrease in demand. As

usually it is assumed that the transport operators have constant marginal costs. [4] Furthermore the home region of the haulier is assumed to be the origin of the transport. The CAFT contains information about the country of registration of the vehicle. Unfortunately this information is not available on NUTS2 respectively NUTS3 level. On a country level the distribution of the origin of the transports does not significantly differ from the distribution of the registration of the vehicles. The only exemption is Italy. Whereas 33% of the transalpine transports have their origin in Italy, only 23% of the vehicles are registered in Italy. On the other hand whereas 17% of all transalpine transports have their origin in a country not considered in this study, 26% of all vehicles are registered in these countries (Datasource: CAFT 2004). The data indicates that the assumption is all-in-all realistic but that the burden of the Italian transport sector might be overestimated.

Comparing the BAU scenario with the scenario Restrictive shows that the decrease in road transport is more or less compensated by an increase in rail freight transport. Due to the increased demand, there is an increase in gross value added of the rail freight transport sector. We assume that the marginal costs in the production of rail freight transport are constant.

The remaining sectors are affected by the traffic management instruments through the transfer of costs by the transport operator. We assume that the shipper is located at the origin of the transport, and the receiver is located at destination. It seems realistic, that even if the shipper pays the whole bill of the transport, he will shift a part of the costs to the recipient (e.g. next step of value added chain, consumer). The share of cost shift depends on the competition position of the shipper and the recipient. The better the competition position of the shipper the higher is the level of passing-on of cost to the recipient. We assume as an average assumption that the shipper pass-on 50% of the additional costs. It is possible, that in some situations the shipper pays the whole additional costs and in other situations the recipient pays all. Furthermore is it probable, that the recipient will as well pass-on a share of the additional costs to his costumers. The increase in consumer prices will influence the consumer and investment behaviour and influence the demand for products. Since the chosen model frame in this chapter is a static one, we do not account for these effects. This means that the burden for the transport-intensive sector will by tend be overestimated. The ASTRA model (Chapter 5) will consider as well dynamic effects and further procedures of cost shifts.

[4] The marginal cost of an additional unit of output is the cost of the additional inputs needed to produce that output. Constant marginal costs mean that the production of a further unit of output has the same costs as the production of the last unit of output. In the given situation the assumption of constant marginal costs seems realistic as the proportion of fixed cost in the production of rail transport is relatively low (the provision of infrastructure is not considered).

In the selected ALBATRAS scenarios, the additional costs of a transalpine transport depend on the distance covered in the Alpine region. This leads to different transport costs for different Alpine passages, because the length travelled within the Alpine area differs. The ALBATRAS-data includes these differences. Another point is that the cost for an Alpine passage for transports with origin or/and destination within the Alpine region using a defined passage is lower, because of the shorter distance covered within the Alpine zone. With the available data, it was not possible to calculate these reduced costs. We assumed that the costs per Alpine passage are always the same, so as if origin and destination were outside the Alpine area. This leads to a slight overestimation of the burdens of the regions within the Alpine area.

Assignment of products to economic sectors

The assignment of products to economic sectors is made on the basis of the national input-output-tables and supply-tables provided by Eurostat. Since the structures of the input-output tables differ between the countries due to technical reasons in the derivation of the statistics the assumptions are an adjusted average of the input-output-tables of the considered countries.

The assignment of products to economic sectors in the transport origin is shown in Table 8. We assume that 100% of the shippers of agricultural products belong to the agricultural sector. For the other products we assume that the shippers belong to the energy and manufacturing sector. According to the supply-tables the construction sector is not relevant as a supplier of the regarded products. The same is true for the service sector.

ASSIGNMENT OF PRODUCTS TO SECTORS IN THE ORIGIN				
	Agriculture	**Energy and Manufacturing**	**Construction**	**Services**
Agricultural products	100%	0%	0%	0%
Foodstuffs	0%	100%	0%	0%
Solid mineral fuels	0%	100%	0%	0%
Crude oil & oil products	0%	100%	0%	0%
Ores, metal waste	0%	100%	0%	0%
Metal products	0%	100%	0%	0%
Building minerals & material	0%	100%	0%	0%
Fertilisers	0%	100%	0%	0%
Chemicals	0%	100%	0%	0%
Machinery & other manufacturing	0%	100%	0%	0%

Table 8 Reading example: The shipper of agricultural products belongs in 100% of the cases to the “Agriculture, hunting, forestry and fishing” sector.

The assignment of products to economic sectors in the destination of a transport is shown in Table 9. The percentage of the assignment to the service sector is mainly caused by the distribution.

ASSIGNMENT OF PRODUCTS TO SECTORS IN THE DESTINATION				
	Agriculture	Energy and Manufacturing	Construction	Services
Agricultural products	10%	70%	0%	20%
Foodstuffs	10%	60%	0%	30%
Solid mineral fuels	5%	80%	5%	10%
Crude oil & oil products	5%	75%	5%	15%
Ores, metal waste	0%	40%	60%	0%
Metal products	0%	60%	40%	0%
Building minerals & material	0%	50%	50%	0%
Fertilisers	70%	20%	0%	10%
Chemicals	0%	80%	5%	15%
Machinery & other manufacturing	5%	70%	5%	20%

Table 9 Reading example: The receiver of agricultural products belongs in 10% of the cases to the agricultural sector, in 70% to the sector energy and manufacturing (food industry) and in 20% to the service sector (distribution, hotel).

3.1.2. BURDEN CALCULATION

Burdens are calculated based on the database used and the assumption mentioned. The burden is always calculated as the difference between the BAU scenario and the scenario Restrictive respectively Tolerant in the chosen year (2020/2030).

The traffic management instrument leads to a price increase ($P_0 \rightarrow P_1$ orange arrow in Figure 6). Assuming that the price increase is born by shippers and receivers, this leads to a decrease in demand for road transports and ends in lower transport quantities. There are three different kinds of burdens:

› Additional costs for the remaining transports (A in Figure 5),

› additional costs due to reduced demand for road transport – also named ‘excess burden’ - (B in Figure 5) and

› losses in the road transport sectors GVA due to the decrease in demand for road transports (C in Figure 5).

The decrease in road freight transport is partly compensated by an increase in demand of rail freight transport, which results in an increase of the rail freight transports GVA. From a welfare

economic point of view - due to the road freight transports constant marginal production cost - only the shippers' excess burden (B) is relevant. The additional cost for the remaining trips leads to higher government income. The loss of GVA in road transport is compensated by GVA increases of rail transport due to modal shift effects.

BURDEN OF SHIPPERS IN SUPPLY-DEMAND-DIAGRAMM OF ROAD FREIGHT TRANSPORT

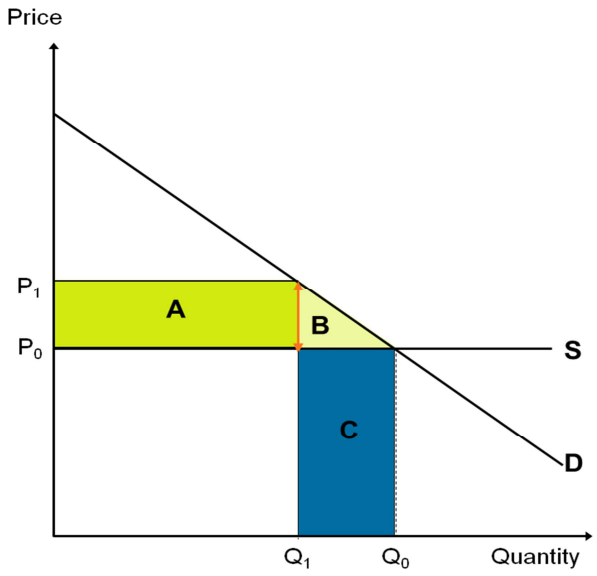


Figure 6 The traffic management instrument leads to a price increase (orange arrow). This leads to a decrease in demand for road transports and ends in lower transport quantities. Assuming that the price increase is born by shippers and receivers, the shippers (respectively receivers) bear two different kinds of burdens: Additional costs for the remaining transports (A) and additional costs of the shipper due to reduced demand for road transport (B). The burden of road freight transporter is measured in lost GVA due to reduced demand (C).

The different burdens are borne as follows:

› It is assumed that road transport is shifting additional cost to the shippers. Thus the shippers (respectively receivers) burden contains A and B. The cost of A are calculated as the number of trips multiplied with the additional cost of the corresponding Alpine passage. The decrease in demand for road freight transport (B) by shippers and receivers might be caused by a shift to rail or omitted Alpine crossing trips. This burden is calculated as the difference in trips per Alpine crossing multiplied by the additional cost of the corresponding Alpine passage divided by two. The intention behind this is that additional costs are at the maximum marginally lower than the additional cost for road transport. Otherwise, the shipper might still be on the road. It is likely that additional costs of the shift to rail or of omitted trips are in many cases significantly lower than the costs for an Alpine passing by road. It is assumed that the marginal utili-

ty of road transport is constantly decreasing for the shipper. As a result of this assumption we divide the cost by two.

› The third part of the burden is the loss in road freight transports' GVA due to the decrease in demand (C). It is important to note, that whereas the burdens of shippers and receivers is expressed in additional costs, the burden for road freight transport is measured in loss in GVA. We calculate the burden as the numbers of omitted road trips multiplied with the average GVA per trip. Due to lack of additional data, the average GVA is estimated based on Swiss input data. The total GVA of the Swiss road freight transport sector is divided by the number of transported tonnes with in Switzerland registered vehicles and multiplies with the average load (11.4 t) of a vehicle (data source: Bundesamt für Statistik, 2008). We assume that the increase in trips from 2008 to 2020 and the increase in productivity outweigh one another. The outcome is an average GVA of EUR 238 per trip (EUR 21/ton) for Switzerland. We assume that the average GVA per trip in Germany, France and Austria is 90% of the Swiss value, the value in Italy equates 85% and the value in Slovenia 75% of the Swiss GVA/trip. This assumption is based on information of the structural business statistic of Eurostat and the expert knowledge of the authors. The higher the GVA/trip is assumed, the higher is the loss in GVA for the road transport sector. According to the structural business statistic 2008 of Eurostat the GVA/ Employee is in Slovenia about one third lower than in western European countries. It is assumed that over the coming years, this difference will decrease. So we estimate that the GVA/trip is in Slovenia only about 75% lower than in Switzerland. The GVA/trip for the other countries lies between the value of Switzerland and Slovenia.

› ALBATRAS shows that omitted road trips have mostly shifted to rail. As a counterpart to the losses in GVA of the road transport sector, the GVA of rail freight transports increases. It is assumed that the transporter is located at the place of origin of transport. To calculate this gain, the additional tonnes transported by rail are multiplied by the average GVA per transported tonne. As in the road transport sector, the estimation is based on Swiss input data. The total GVA of the Swiss rail freight transport sector is divided by the tonnes transported on Swiss railways in the year 2008 (data source: Bundesamt für Statistik, Verkehrsleistungen 2008). This leads to an average GVA per transported ton of EUR 8.9.[5] Again it is assumed that the increase in transported tonnes and the increased productivity outweigh one another. Again we assume that the average GVA per trip in Germany, France and Austria is 90% of the Swiss

5 The difference between the GVA/t for road transports and for rail transports is based mainly on the fact, that only the transport by itself is regarded and SLA are not considered (compare following passages).

value, the value in Italy corresponds to 85% and the value in Slovenia os 75% of the Swiss GVA/ton.

It is important to note that the considered GVA in the transport sector contains only the transport service itself. Particularly the induced GVA of infrastructure use is not included. Moreover government payments to the rail freight transport on the basis of service level agreements are not considered in the value added. To analyse the overall economic impact these aspects have to be considered as well. Whereas the induced value added of running the infrastructure according to the Swiss energy input-output table 2005 corresponds in the rail sector to 59% of the value added of the transport services, the induced value added in the road sector it is only 10% of the transports value added (Nathani et al 2011). The consideration of the Swiss government payments on the basis of service level agreements to rail freight transports increases the value added about further 44%. Unfortunately these data are not available for the other countries. Nevertheless it seems realistic, that the cost structure does not change significantly between countries.

In order to consider – besides GVA of transport services – also the GVA impacts on transport infrastructure, the following factors will be used:

› Increase of GVA rail by 103%

› Increase of GVA road by 10%.

3.2. BAU SCENARIO

In a first step we analyse the traffic flows and the economic situation in the BAU scenario. First, we look at the transport situation according to the ALBATRAS BAU scenarios (2020, 2030). Afterwards we look at the regional economic situation according to the according to the database described in section 2.5 for the year 2020 and 2030.

3.2.1. TRANSPORT SITUATION

As a basis for the economic impact analysed in EFFINALP, a forecast of the transport situation in 2020 and 2030 is necessary. This forecast was produced by the ALBATRAS consortium with the self-developed Transalpine Multimodal Model (TAMM), which differentiates transport situations on NUTS3-level for different NSTR freight groups and road and rail modalities. The transport traffic management instrument is established within the “Alpine Arch B+”, which contains all Alpine crossings from Ventimiglia to the Tauern-Tarvisio corridor. The impacts of the introduced instruments were analysed on Alpine Arch “C”, which additionally contains the

three crossings Schober, Semmering and Wechsel. The CAFT 2004 database served as a basis for the model. For 2020, a business-as-usual (BAU) scenario was produced and two different growth (high and low) scenarios for 2030 (ALBATRAS 2011). The most important assumptions are:

› Country-specific growth rates according to the EU iTREN-2030 project,
› General productivity effects (lower cost factor, Swiss heavy vehicle fee, an increase in average load per HGV etc.),
› Introduction of new rail base tunnels, Lötschberg and Gotthard before 2020 and Brenner and Mt. Cenis before 2030,
› Step-by-step abolishment of rail freight subsidies.

Figure 7 shows the number of transalpine HGV trips per employee as calculated from the TAMM for BAU 2020. This freight transport situation is used as the Baseline 2020. The highest values can be found in Austria around Klagenfurt-Villach, eastern Obersteiermark and Graz. Next to Austria, high values result also in Northern Italy and Slovenia.

NUMBER OF TRANSALPINE HGV TRIPS PER EMPLOYEE

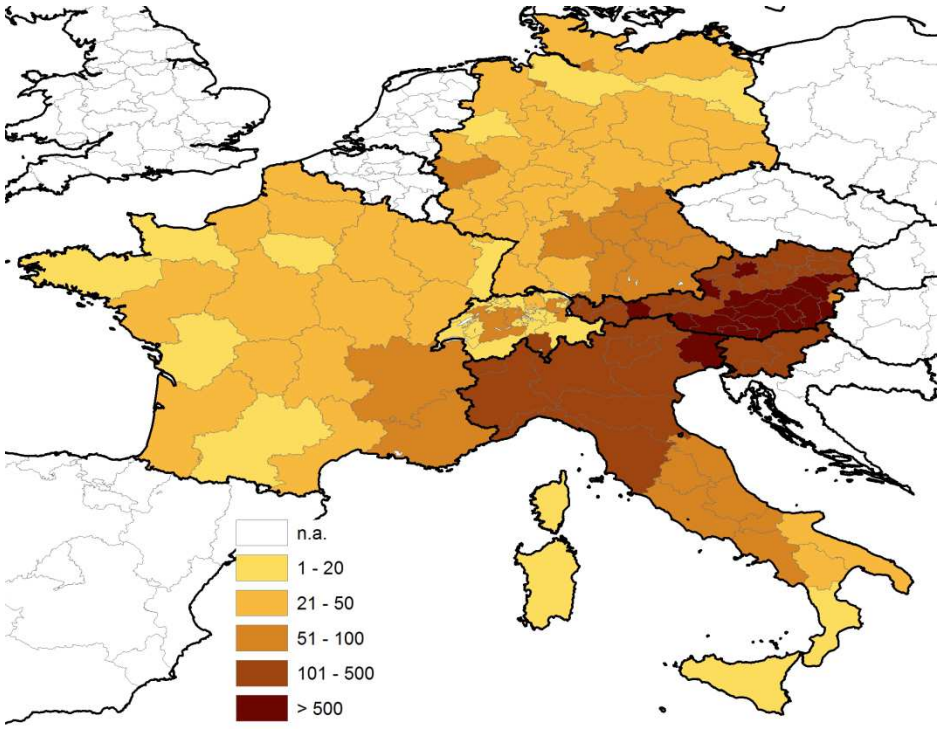


Figure 7 Total number of transalpine HGV trips differentiated on NUTS2-level (excepted Switzerland and Austria NUTS3-level).
Source: ALBATRAS (Ecoplan Rapp Trans et.al. 2011, transport data) and E3ME (regional economic data)

Table 10 shows a summary of the forecast of the transport situation in the three ALBATRAS scenarios. The total number of lorries is expected to increase from 11.4 million/a in 2004 to 12.4 million/a in 2020 and 12.9–15.1 million/a in 2030 depending on the scenario. Due to a general shift of transport relations from the west to the east, a higher growth of number of HGV can be observed in the eastern countries. Overall, for the scenario BAU 2020 an increase of transalpine HGV of 9% is expected. In the year 2030 the expected increase of lies between 13% and 32%. The following calculations are based on the high growth scenario with an increase in transalpine transport of about 32%.

SUMMARY OF THE BAU-SCENARIO FORECAST				
	Base case 2004	**BAU 2020**	**BAU 2030 low**	**BAU 2030 high**
Number of lorries in million/a				
A - I/SLO	7.3	8.4	9.1	10.5
CH - I	1.3	1.4	1.4	1.7
F-I	2.8	2.6	2.4	2.9
Total	*11.4*	*12.4*	*12.9*	*15.1*
In % of base case 2004				
A - I/SLO	100%	116%	124%	144%
CH - I	100%	108%	112%	132%
F-I	100%	92%	86%	103%
Total	*100%*	*109%*	*113%*	*132%*

Table 10: Number of Lorries in transalpine freight transport in Alpine arch C 2004, 2020 and 2030 (low and high), in m/a (ALBATRAS 2011)

The ALBATRAS study applied the three instruments Alpine Crossing Exchange (ACE), the Alpine Emission Trading System (AETS) and TOLL+ for the Alpine passages in the Alpine region "B+".

3.2.2. REGIONAL ECONOMIC SITUATION

The economic situations of the regions and especially the differences between the regions are in a business as usual scenario in the year 2030 not very different from the year 2020. To avoid repetition, we just have a closer look at the situation in 2020.

Figure 8 shows the gross value added per employee in the year 2020. It is striking that all regions of Switzerland belong to the quantile with the highest GVA per employee. Additionally, there are some city regions (Paris, Bremen) which also belong to the highest quantile. In contrast, the two regions of Slovenia belong to the poorest regions and all regions of Italy belong to the two lowest quantiles.

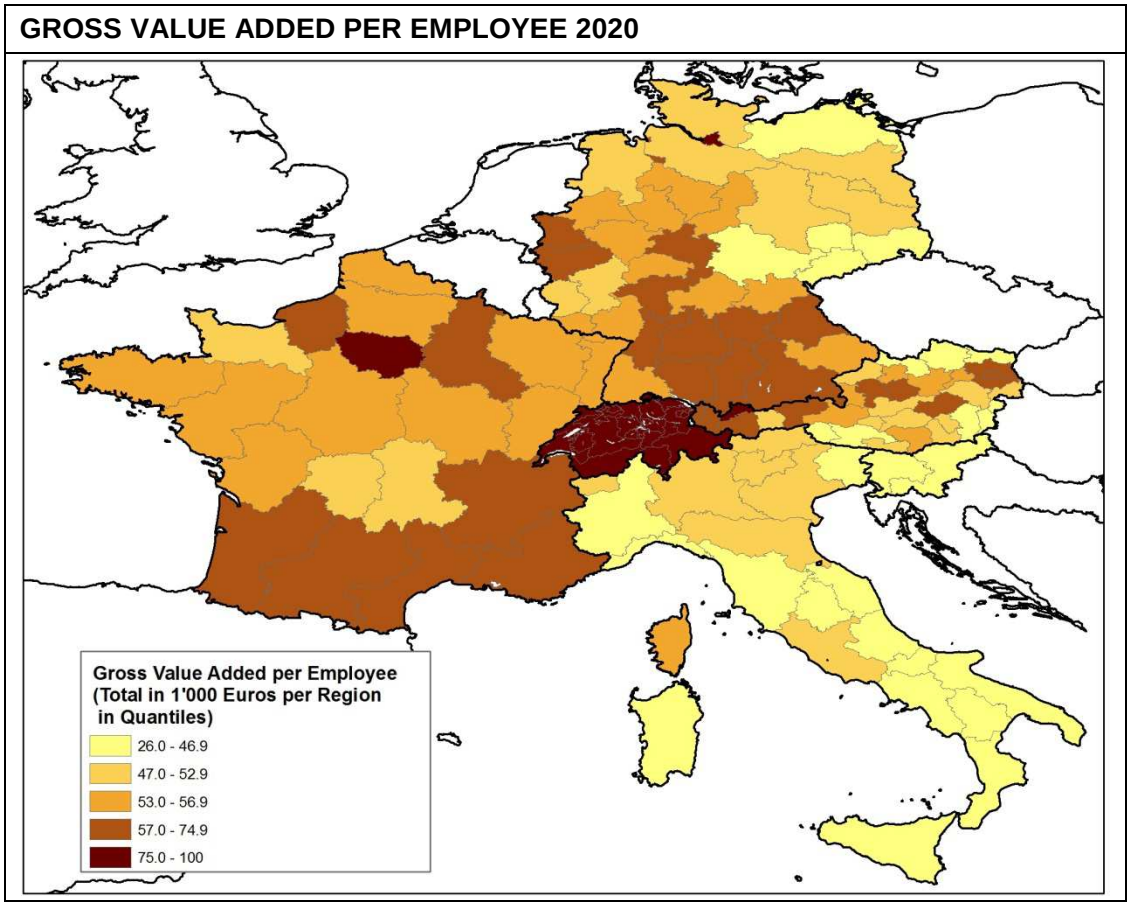


Figure 8 Source: Regional economic data from E3ME version 2010 (Cambridge Econometrics), additionally for Switzerland: Production account by industry and business statistic of the year 2008 (Bundesamt für Statistik)

For our purpose, an important characteristic of the regions is the importance of the freight transport sector in the different regions. Figure 9 shows, that in Austria the freight transport sectors have a higher weight than in the other countries. This is consistent with the above average weight of the transport sector in the E3ME-sector distribution, hotel & restaurants, transport, storage and communications according to the structural business statistic of Eurostat. Some regions in Switzerland, Slovenia, at the English Channel and at the Mediterranean Sea have a high proportion of value added resulting from the transport sector as well.

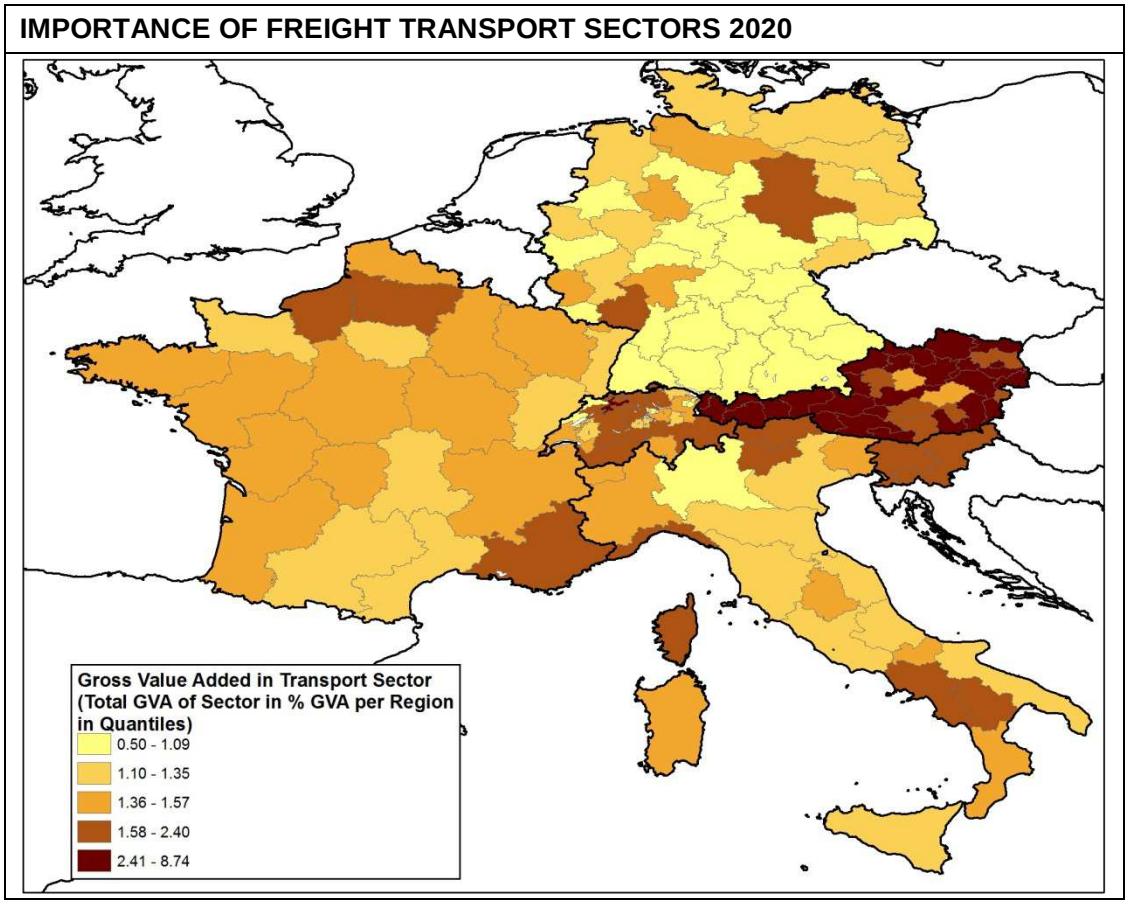


Figure 9 Source: Regional economic data from E3ME version 2010 (Cambridge Econometrics), structural business statistics of the year 2008 (Eurostat), own estimations. Additionally for Switzerland: Production account by industry and business statistic of the year 2008 (Bundesamt für Statistik),

Another important characteristic is the importance of transport-intensive sectors of a region. We define the sectors agriculture, energy and manufacturing and construction as transport-intensive (all sectors except "Services"). Figure 9 shows that regions to which transport-intensive sectors are highly important are dispersed geographically. There is a concentration especially in Austria. Moreover, in the eastern part of Slovenia and in Braunschweig, transport-intensive sectors are important.

IMPORTANCE OF TRANSPORT-INTENSIVE SECTORS 2020

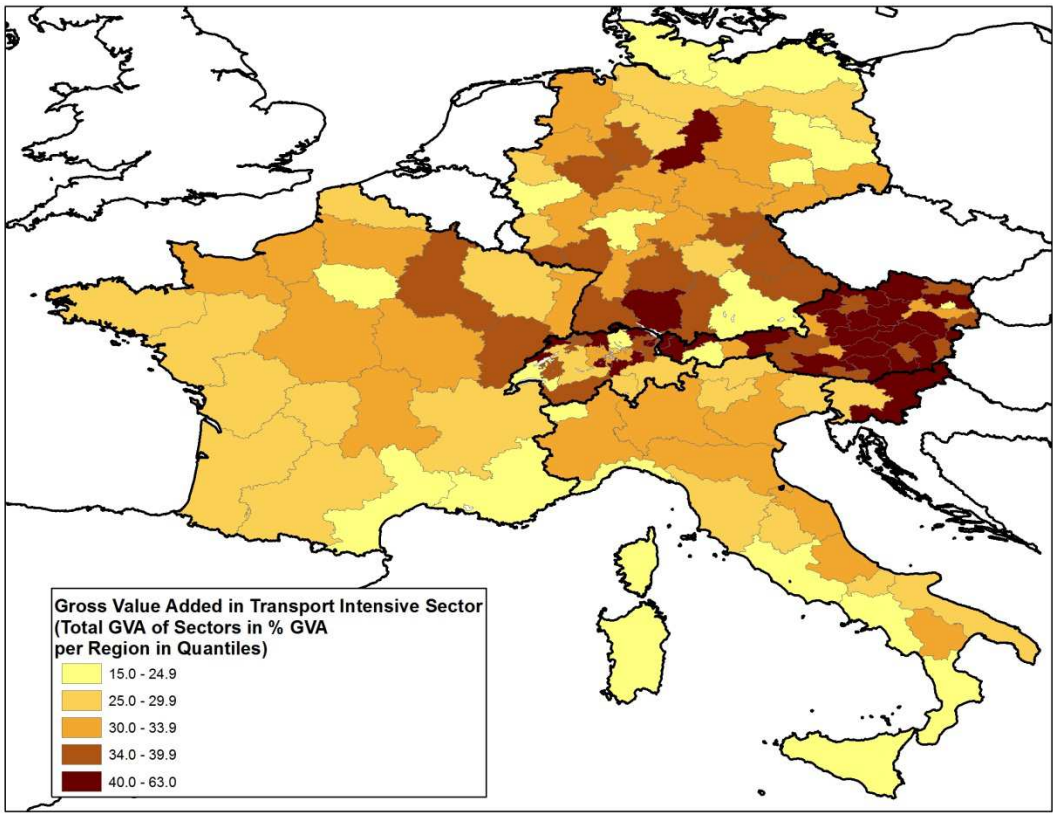


Figure 10 The following sectors are considered: Agriculture, Energy and Manufacturing, Construction. Source: Regional economic data from E3ME version 2010 (Cambridge Econometrics). Additionally for Switzerland: Production account by industry and business statistic of the year 2008 (Bundesamt für Statistik).

3.3. OVERVIEW OF RESULTS PER SCENARIO

In this chapter the results of all scenarios on a national and sector basis are compared. In order to analyse the differences between the scenarios, we look in this chapter only at the average burden on a national level. Because of the big quantity of data an analysis on a regional level would complicate a sound comparison. Thus the regional distribution of the burdens will be analysed in the next chapter. The distribution within the sectors is relevant as well and will be analysed in more detail in the qualitative analysis. In the following we first recapitulate the transport situation under the different scenarios and then summarise the economic impacts.

3.3.1. TRANSPORT SITUATION

The economic burden of the traffic management instruments results – beside the increased transport costs – from a change in the transport situation. The stricter the aim of the traffic management instrument the higher is the burden. The avoided road trips compared to the business as usual scenarios are according to the calculations of ALBATRAS as follows:

› Scenario Tolerant 2020: -1.03 million trips (-8%)
› Scenario Restrictive 2020: -1.85 million trips (-15%)
› Scenario Tolerant 2030: -3.06 million trips (-20%)
› Scenario Restrictive 2030: -4.74 million trips (-31%).

The transports volumes decrease only by about 0.08% (scenario Tolerant 2020) to 0.20% (scenario Restrictive 2030). This means that the avoided road transports shift by nearly 100% to rail.

3.3.2. ECONOMIC IMPACTS

To have an overview of the average magnitude of the economic impacts and the differences between the scenarios we first have a look at the impacts on the different sectors at a national level. We regard the Agriculture, Energy and Manufacturing, Construction, Road freight transport and rail freight transport sectors. The analysis has shown that the impact on the service sector is with an average burden of 0.0016% of its GVA and a maximal regional burden of 0.04% (Scenario Restrictive 2020) more than ten times lower than the impact on the other sectors. Therefor the service sector will not be analysed in detail.

Impact on sectoral GVA on a national level

The following two tables summarise the burdens of the sectors for the different scenarios at a national level.

The first table shows the impact in the year 2020 when scenario Tolerant or scenario Restrictive is implemented. Since the scenario Restrictive is the strictest scenario of all ALBATRAS scenarios and scenario Tolerant is one of the less strict one, the data in the tables shows the range of possible impacts of all ALBATRAS scenarios. On a national basis Slovenia is with one exemption in all sectors the most affected, since all regions lies within or near by the Alpine area. Only in the agricultural sector Austria is more affected. Generally the impacts on Italy and Austria are higher than in France, Germany and Switzerland. The most affected is the road transport sector. Within the transport-intensive sectors the construction sector bears less than the agricultural and energy and manufacturing sector.

With one exemption the burden is in scenario Restrictive always higher than in scenario Tolerant. The exemption is the road transport sector in Switzerland. In scenario Tolerant Switzerland introduces an ACE and in scenario Restrictive a TOLL+ system. Since the most important Alpine corridor in Switzerland (Gotthard) has only a relative short distance within the Alpine area, the price for this specific corridor is in scenario Restrictive higher than in scenario Tolerant. Thus there are less reduced road trips over the Gotthard corridor with scenario Restrictive than with scenario Tolerant.

The results for the year 2030 are summarised in Table 12. Since there are more reduced trips the burdens are somewhat higher but the relations between the countries and sectors do not change.

RESULTS FOR THE YEAR 2020										
in million EUR / in % of the sectors GVA	**Burden Agriculture**		**Burden Energy and Manu-facturing**		**Burden Construction**		**Burden Road transport***		**Gains Rail transport***	
	tolerant	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**
Germany	3.7 / 0.01%	7.7 / 0.03%	46 / 0.01%	94 / 0.02%	3.7 /<0.01%	7.4 / 0.01%	44 / 0.19% 49	86 / 0.37% 94	20 / 1.02% 41	41 / 2.04% 82
France	3.7 / 0.01%	6.1 / 0.01%	37 / 0.01%	61 / 0.02%	2.2 /<0.01%	3.8 / 0.01%	31 / 0.14% 34	51 / 0.23% 56	15 / 1.10% 31	26 / 1.86% 53
Italy	11 / 0.04%	21 / 0.07%	130 / 0.06%	245 / 0.11%	11 / 0.02%	20 / 0.04%	70 / 0.46% 77	126 / 0.83% 139	32 / 4.65% 64	59 / 8.77% 121
Austria	5.4 / 0.13%	12 / 0.32%	32 / 0.04%	74 / 0.10%	2.7 / 0.02%	6.4 / 0.05%	20 / 0.28% 22	50 / 0.69% 55	9.4 / 0.91% 19	23 / 2.26% 47
Slovenia	0.4 / 0.06%	0.8 / 0.14%	5 / 0.07%	13 7 0.16%	0.5 / 0.03%	1.1 / 0.08%	3.5 / 0.58% 3.8	7.9 / 1.30% 8.7	1.6 / 4.65% 3.2	3.6 / 10.6% 7.3
Switzerland	1.0 / 0.02%	1.1 / 0.03%	9 / 0.01%	10 / 0.01%	1.0 /<0.01%	1.2 / 0.01%	20 / 0.33% 22	19 / 0.32% 21	8.8 / 1.43% 17.9	9.0 / 1.46% 18.4
Total	25 / 0.02%	50 / 0.05%	260 / 0.02%	497 / 0.04%	21 / 0.01%	40 / 0.02%	189 / 0.25% 208	340 / 0.46% 374	87 / 1.51% 176	162 / 2.81% 329

Table 11 * The numbers in the second line are rough estimates on the basis of Swiss data about the loss resp. increase in GVA if infrastructure and SLA are considered as well.

RESULTS FOR THE YEAR 2030										
in million EUR / in % of the sectors GVA	**Burden Agriculture**		**Burden Energy and Manu-facturing**		**Burden Construction**		**Burden Road transport***		**Gains Rail transport***	
	tolerant	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**	**tolerant**	**restrictive**
Germany	11 / 0.03% 19	19 / 0.06% 30	135 / 0.02% 240	240 / 0.03% 426	11 / 0.01% 19	19 / 0.02% 34	145 / 0.54% 160	235/ 0.88% 258	68 / 2.96% 138	111 / 4.85% 226
France	10 / 0.02% 16	14 / 0.03% 23	115 / 0.04% 185	155 / 0.05% 249	6.1 / 0.01% 9.8	8.5 / 0.01% 14	133 / 0.55% 146	173 / 0.71% 190	68 / 4.42% 137	89 / 5.81% 181
Italy	32 / 0.10% 51	51 / 0.17% 82	393 / 0.18% 630	626 / 0.28% 1004	28 / 0.06% 45	44 / 0.09% 70	264 / 1.67% 291	415 / 2.62% 457	123 / 17.5% 251	198 / 28.1% 402
Austria	15 / 0.38% 24	30 / 0.74% 48	97 / 0.10% 156	181 / 0.18% 290	8.3 / 0.08% 13	16 / 0.15% 26	75 / 1.01% 82	140 / 1.89% 154	35 / 3.31% 71	66 / 6.24% 134
Slovenia	1.5 / 0.26% 2.4	2.8 / 0.49% 4.5	26 / 0.32% 42	49 / 0.61% 78	2.3 / 0.23% 3.7	4.7 / 0.46% 7.5	18 / 2.92% 20	32 / 5.20 36	8.5 / 23.9% 17.2	15 / 43.1% 31
Switzerland	2.4 / 0.07% 3.8	3.3 / 0.09% 5.3	21 / 0.02% 34	29 / 0.03% 47	2.3 / 0.01% 3.7	3.4 / 0.01% 5.5	50 / 0.67% 55	56 / 0.76% 62	23 / 2.97% 46	26 / 3.43% 53
Total	72 / 0.06% 120	120 / 0.10% 192	787 / 0.05% 1256	1280 / 0.09% 2044	58 / 0.02% 93	96 / 0.04% 153	685 / 0.83% 754 /	1051 / 1.3% 1157	326 / 5.10% 660 7	505 / 7.91% 1027

Table 12 * The numbers in the second line are rough estimates on the basis of Swiss data about the loss resp. increase in GVA if infrastructure and SLA are considered as well.

Figure 11 compares the over-all burdens per sector of different scenarios. It has to be noted that the burden of the transport-intensive sectors is measured in additional costs, whereas the burden of the transport sector are losses in GVA. Because the rail sector has gains in GVA its burden is negative. The figure shows that the order of magnitude of the burdens is in all scenarios the same: The burden is in 2020 always lower than in 2030 and in scenario Tolerant lower than in scenario Restrictive. The order is unsurprisingly the same as the order of the price increases and the order of reduction of trips.

SUMMARY OF THE BURDEN IN THE DIFFERENT SCENARIOS

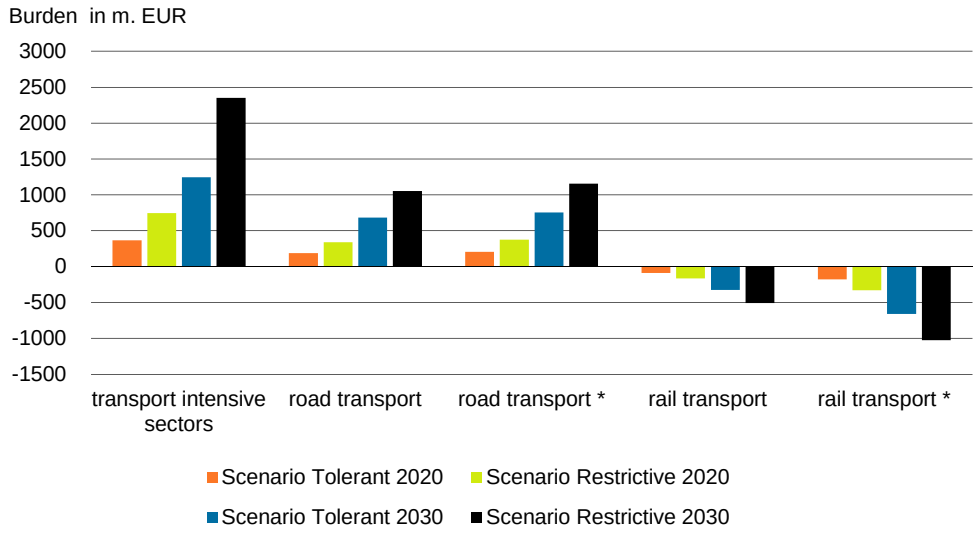


Figure 11 The burdens are in the transport-intensive sectors additional costs and in the transport sectors losses in GVA. Because the rail sector has GVA gains, the burden is negative.
* Rough estimate of the economic impact when transport infrastructure and SLA effects are considered

Differences in the regional distribution of the burdens

The analysis of the results of all scenarios shows, that the scenarios differ in the essence only in the magnitude of the impact (cf. Annex “Regional analysis: Results of the calculation of the scenarios”). The regional allocation of the burdens is in all scenarios similar. In the agricultural and energy & manufacturing sector the three most affected regions are in all scenarios the same regions. In the construction sector the two most affected countries are in all scenarios the same whereas the third region is in the year 2020 in both scenarios Friuli-Venezia Giulia and in the year 2030 its neighbour region Zahodna Slovenija. Also the picture of the 10% most affected

regions is in all scenarios similar. We can conclude that a change of the traffic management instruments leads not to big differences in the regional allocation of the burdens. In section 3.5 the effects of a km-dependent implementation of a TOLL+ or AETS will be discussed.

It can be concluded that the regional allocation of the burden is in all scenarios comparable. To avoid repetitions, only the results of scenario Restrictive 2020 are shown in detail in the following section. The detailed results for the other scenarios are shown in Annex 1.

3.4. DETAILED RESULTS SCENARIO RESTRICTIVE 2020

3.4.1. TRANSPORT SITUATION

The fixed TOLL+ price amounts to 0.29 EUR/km and leads after introduction to a decrease in total transalpine road freight transport volume of around 15% from 161 to 137 million tonnes/a compared to BAU 2020. Although the price per kilometre is the same for all corridors, the shifts of road transport volume vary from 13% on the A–I/SLO corridors to 23% on the CH–I corridors, due to differences in distances charged. Due to the fact that the three eastern Austrian crossings Schober, Semmering and Wechsel are not charged by TOLL+, the number of lorries on these three crossings increases by 14%, while the number of transalpine lorries on the western crossings decreases by 29% (ALBATRAS 2011).

Relocation effects lead on all corridors to an increase in rail transport:

- A – I/SLO: Reduction by 14.2 million tonnes/a (13%) road transport volume. 11.4 million tonnes/a are shifted to rail corridor in this region.
- CH – I: Reduction by 3.9 million tonnes/a (23%) road transport volume. 8.0 million tonnes/a are shifted to rail corridor in this region.
- F – I: Reduction by 5.8 million tonnes/a (16%) road transport volume. 4.2 million tonnes/a are shifted to rail corridor in this region.
- In total, 23.6 million tonnes/a are shifted to rail. The remaining 0.3 million tonnes/a are shifted to other transport modes not considered here (e.g. transport on water between the Iberian Peninsula and Italy) or not transported anymore.

An overall shift of total transalpine freight transport (road and rail) towards Swiss corridors can be observed. A–I/SLO decreases by -1.8%, F–I decreases by -3.4% while CH I increases by +7.7%. This might be due to the fact, that price increases depend on the distance driven within

the Alpine area. Since the distance of the Gotthard corridor is one of the shortest one, the price increase is compared with the other corridors relatively low. Introducing TOLL+ should reduce the modal split of road of total transalpine freight transport from 62% to 53% (ALBATRAS 2011).

3.4.2. IMPACT ON FREIGHT TRANSPORT SECTORS

In freight transport sectors two opposite effects appear. Since the decreased demand in road transports will result in a higher demand on rail transports, the GVA of the road transport sector will decrease the one of the rail transport sector will increase. First, we have to look at road freight transport and then at rail freight transport.

Road Freight Transport

Due to the assumed shift of the financial burden to the transport-intensive sectors, the burden for the transport sector results only in the reduction of GVA due to traffic decrease. Figure 12 shows the respective impacts at regional level. The highest burdens can be found in the south side regions of the Alps and in some Alpine regions itself. Furthermore, in the southern parts of Germany and the eastern parts of France the relative burden lies above average. It is interesting though that many parts of Switzerland are located within the alps the average burdens in Switzerland though are relatively low. The regional differences within the countries are considerable. E.g. the highest burden in Austria is carried in the Klagenfurt-Villach region with 5.6% losses in GVA, whereas the lowest burden in Austria lies with 0.1% in Mittelburgenland.

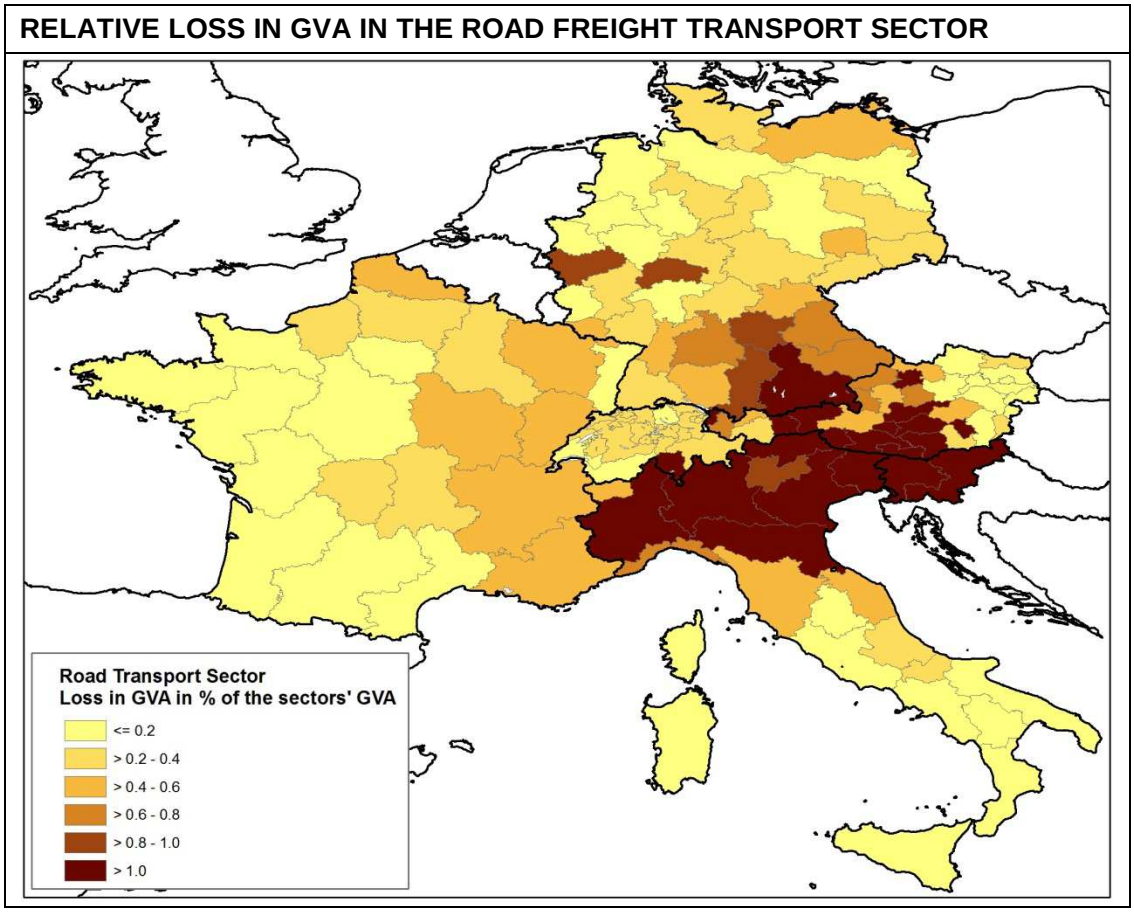


Figure 12 Scenario Restrictive 2020 compared to BAU scenario 2020

Table 13 summarizes the average burden and the minimal and maximal burden of a region per country.

Road Freight Transport						
	DE	FR	IT	AT	SI	CH
Total burden (in m. EUR)	0.1	0.1	0.1	0.1	0.0	0.0
Average burden in %GVA	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Minimal burden in % GVA	0.05%	0.00%	0.00%	0.01%	1.19%	0.00%
Highest burden in % GVA	1.31%	0.45%	1.98%	5.57%	1.38%	2.62%
Region with highest burden	Oberbayern	Rhône-Alpes	P.A. Bolzano-Bozen	Klagenfurt-Villach	Zahodna Slovenija	Ticino

Table 13 Summary of the most important figures per country. Please note, that only the gains of transport by itself without subsidies and payments on the basis of service level agreements is considered. If service level agreements and Infrastructure would be considered as well, the estimated gains in the road sector would be about 10% higher.

This analysis is based on the assumptions that additional costs are passed on fully to the shippers. If this would not be the case, that means the transport sector would have to bear the addi-

tional cost of the traffic management instrument, the additional national burden for the road transport sector would increase by 49% (Switzerland) to 216% (Italy).

BURDEN INCREASE WITHOUT PASSING ON OF COSTS			
in m. EUR	**loss in GVA road freight transport**	**additional costs for transalpine road trips**	**Burden increase by additional costs**
Germany	85.8	95.2	111%
France	51.0	67.5	132%
Italy	126.1	271.9	216%
Austria	50.1	83.5	167%
Slovenia	7.9	12.4	157%
Switzerland	19.5	9.6	49%

Table 14 Reading example: For Germany the calculated loss in GVA of the road freight transport sector is about EUR 86 million. The additional costs, which are assumed to be passed-on to the shipper, are 95 million EUR. If the transport sector cannot pass-on the additional costs, its burden in Germany would increase by 95 million EUR or 111%.

Rail freight transport sector

Figure 13 and Table 15 shows the increases in GVA for the rail freight transport sector in 2020. Given the assumption that the GVA of a transport is generated at the origin of the transport it is not surprising that the picture is more or less the opposite of the one in the road freight transport sector. A reduction of road transports in a region results in additional rail transports in that same region. Especially in the rail sector, which is dominated by - compared to the road transport sector – relatively big companies (e.g. national railway companies and combined transport operators), the place of accomplishment can differ significantly from the place where GVA is generated. Thus the regional distribution shown in Figure 13 has to be interpreted as a rough estimate of the final distribution.

Because the volume of the rail freight transport sector is in the baseline lower than that of the road transport sector, the relative increase in GVA is significantly higher than the decrease in the road sector. The comparison of the absolute loss in GVA in the road sector with the absolute increase in the rail sector shows, that the calculated gains in the rail sector are about 50% of the losses in the road sector. In addition, if payments on the basis of service level agreement and the value added of running the infrastructure would be considered as well, the figures would change significantly. In the case of Switzerland the loss in value added of the road transport has to be increased by 4% and the gains in the rail freight transport by 103% (cf. Chapter 3.1.2). If these aspects are included and the Swiss situation is transferred to the other countries, the loss of GVA in the road sector corresponds to 397 million EUR and the rail sector's GVA gains are 371 million EUR. The losses in the road sector are in this case compensated by 93% by gains in the

rail sector. Unfortunately the corresponding data are for the other countries not available. Nevertheless it seems realistic that the cost structure is in all countries comparable.

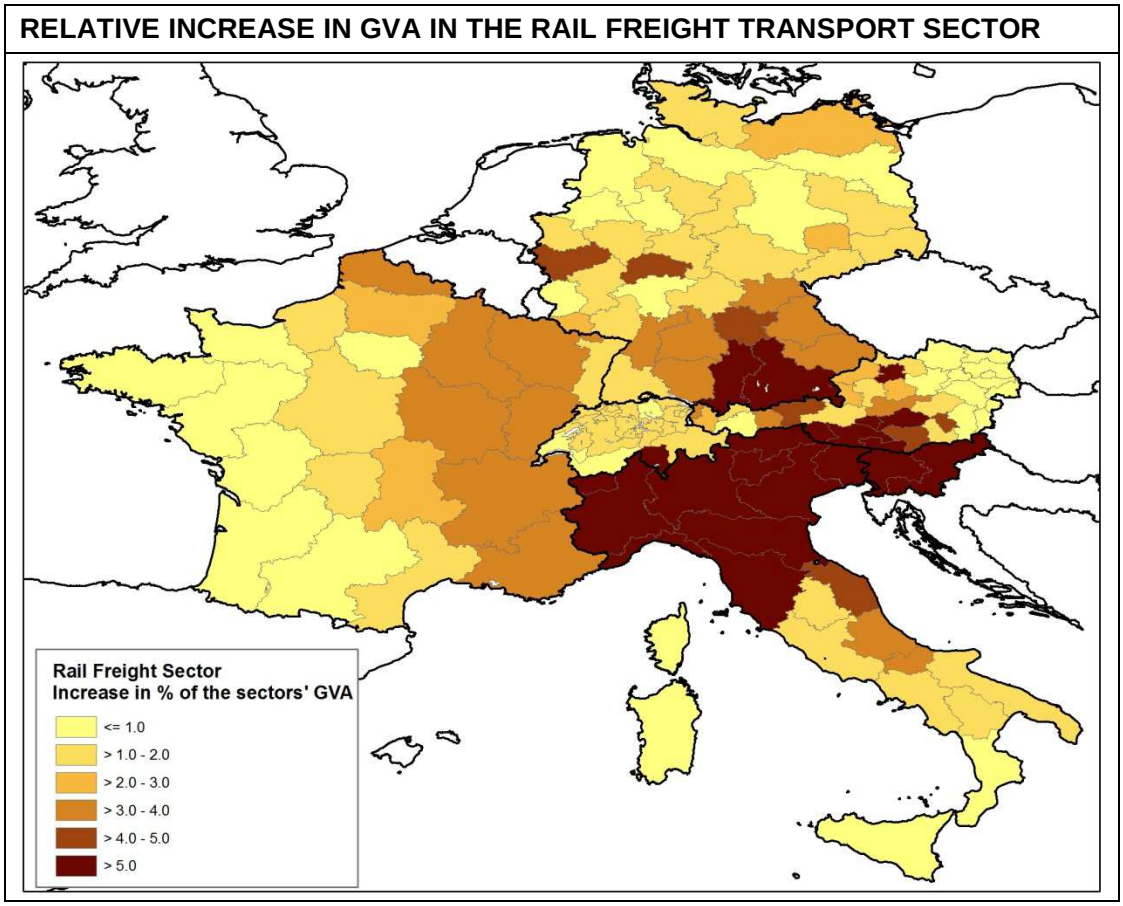


Figure 13 Scenario Restrictive 2020 compared to BAU scenario 2020

Table 15 summarizes the average increase in GVA and the minimal and maximal increase in GVA of a region per country, when only the GVA of the transport by itself is considered.

Rail Freight Transport						
	DE	FR	IT	AT	SI	CH
Total increase (in m. EUR)	0.0	0.0	0.1	0.0	0.0	0.0
Average increase in %GVA	0.00%	0.00%	0.01%	0.00%	0.01%	0.00%
Minimal increase in % GVA	0.28%	0.01%	0.03%	0.03%	9.79%	0.00%
Highest increase in % GVA	7.23%	3.68%	20.65%	17.61%	11.18%	11.77%
Region with highest increas	Oberbayern	Rhône-Alpes	P.A. Bolzano-Bozen	Klagenfurt-Villach	Zahodna Slovenija	Ticino

Table 15 Summary of the most important figures per country. Please note, that only the gains of transport by itself without subsidies and payments on the basis of service level agreements is considered. If service level agreements and Infrastructure would be considered as well, the estimated gains in the rail sector would be about 103% higher.

3.4.3. IMPACTS ON TRANSPORT-INTENSIVE SECTORS

In the transport-intensive sectors the burden contains additional transport cost for the remaining transport on the road and additional costs to avoid transports on the road (excess burden). In the following the results for the agricultural, energy and manufacturing and the construction sector are shown on a regional basis. To see the gravity of the burden, the burden is compared with the sectors' regional GVA.

Agricultural sector

Figure 14 and Table 16 show the impact in the agricultural sector. The level of the relative burden in the agricultural sector is considerably lower than in the road transport sector. The following figure shows that the highest relative burden for the agricultural sector is located in the western parts of Austria and on the south side of the Alps. It is also unsurprising that the other parts of Italy and the southern parts of Germany have a burden above average. Somewhat strange seems that there are high burdens in city regions such as Vienna, Bremen or Hamburg. Checks have shown that the critical assumption for this result is assigning 100% of the origin of agricultural products to agriculture. It seems that HGV trips with these products originate frequently from city regions, whereas the GVA of agriculture in these regions is low. We guess that this results from the pooling of transports from different farmers.

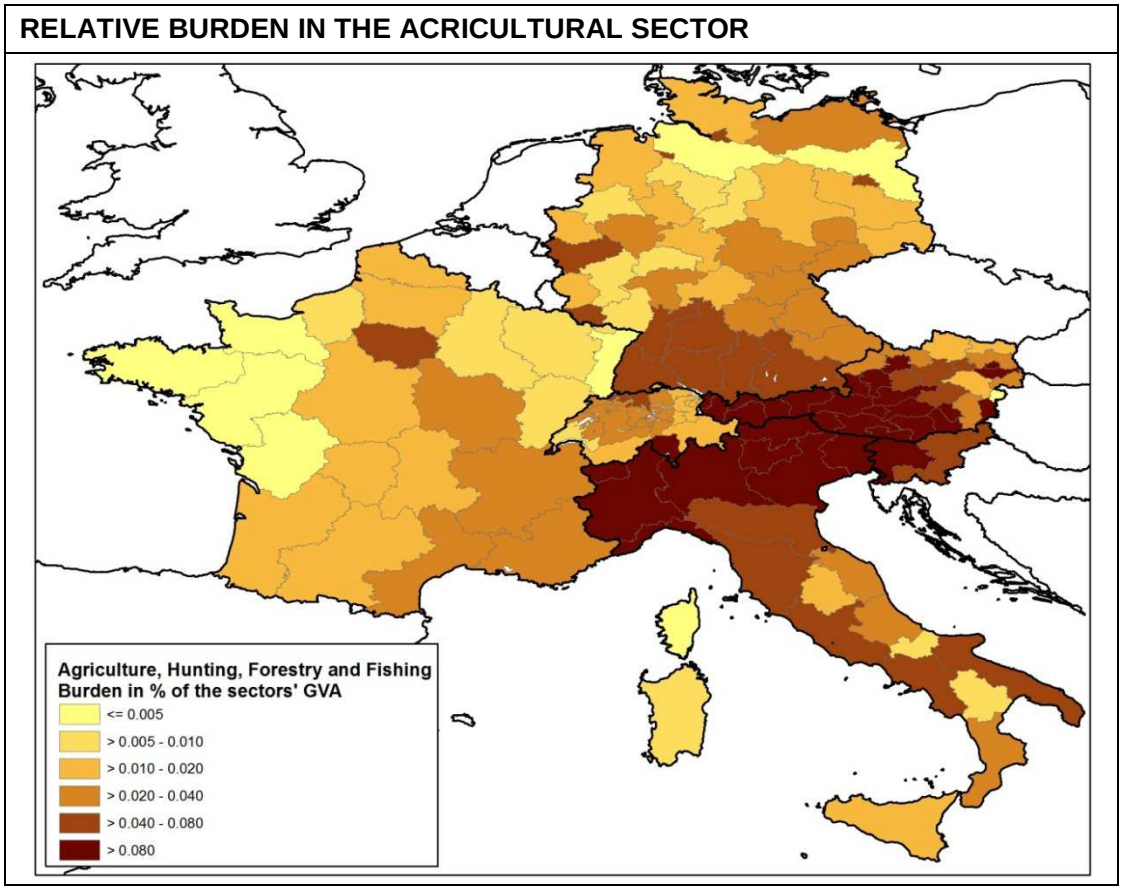


Figure 14 Scenario Restrictive 2020 compared to BAU scenario 2020.

Table 16 summarizes the average burden and the minimal and maximal burden of a region per country.

Agriculture						
	DE	FR	IT	AT	SI	CH
Total burden (in m. EUR)	7.7	6.1	21.0	12.8	0.8	1.1
Average burden in %GVA	0.03%	0.01%	0.07%	0.32%	0.14%	0.03%
Minimal burden in % GVA	0.00%	0.00%	0.01%	0.00%	0.07%	0.00%
Highest burden in % GVA	0.07%	0.35%	0.21%	2.71%	0.30%	0.23%
Region with highest burden	Karlsruhe	Rhône-Alpes	Friuli-Venezia Giulia	Klagenfurt-Villach	Zahodna Slovenija	Ticino

Table 16 Summary of the most important figures per country. In the agricultural sector the burdens are additional cost of transports and the excess burden of avoided road transports.

Energy and manufacturing sector

Figure 15 and Table 17 show the results for the energy and manufacturing sector. As illustrated in Figure 15 the highest relative burden is located in northern Italy and Alpine Austrian regions. Calabria has also a relative high burden. Driving factors are trips with machinery and manufacturing goods with destination Calabria (approx. 40% of burdens). We assume that this results out of transports to the harbour.

The comparison of Table 17 with the same table for the agricultural sector shows, that in absolute values the burden in the energy and manufacturing sector is about ten times higher than in the agricultural sector. Nevertheless besides Italy and Slovenia the average relative burden is in all countries lower than in the agricultural sector. The highest average burden has Slovenia with 0.16% of the sectors GVA, followed by Italy with 0.11%. On a regional basis the maximal relative burden is 0.84% in Klagenfurt-Villach.

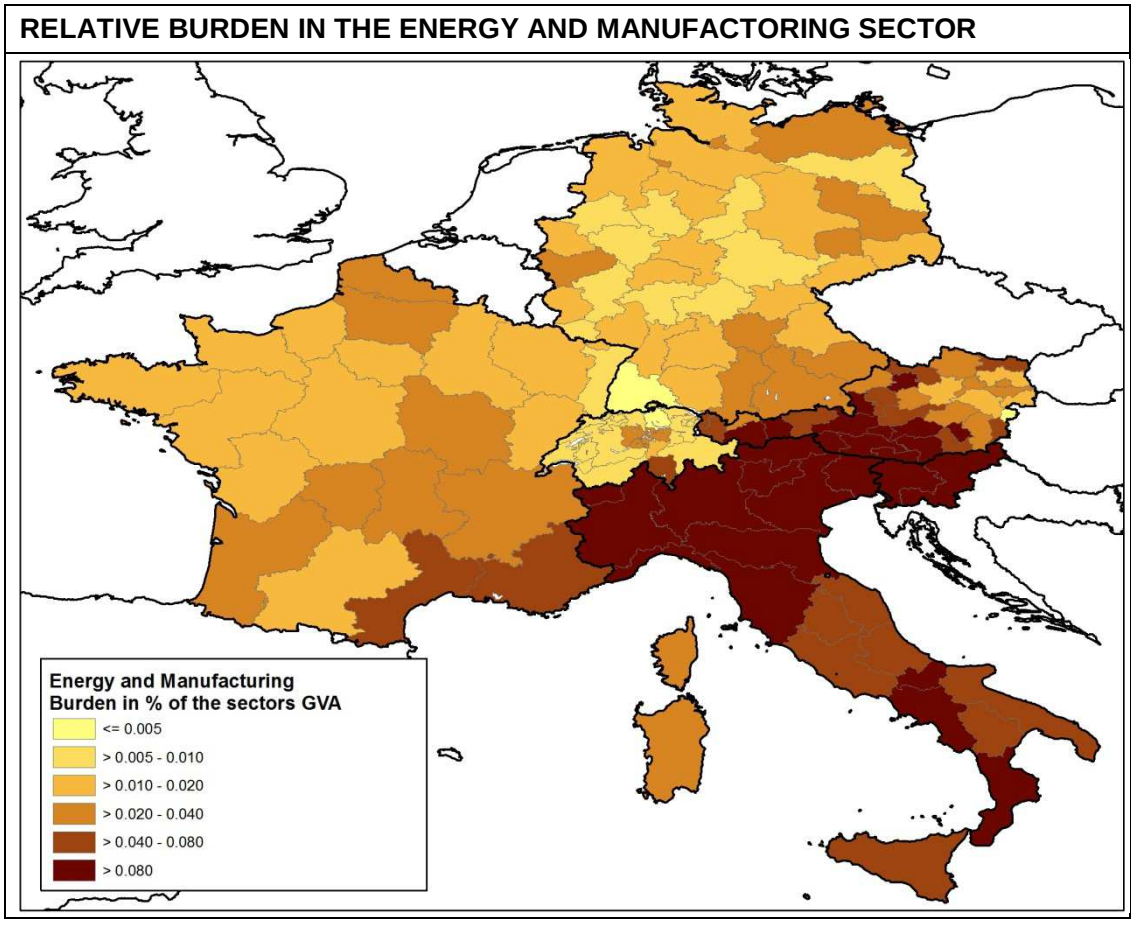


Figure 15 Scenario Restrictive 2020 compared to BAU scenario 2020

Table 17 summarizes the average burden and the minimal and maximal burden of a region per country.

Energy and Manufacturing						
	DE	FR	IT	AT	SI	CH
Total burden (in m. EUR)	93.8	61.4	245.1	74.5	13.1	9.8
Average burden in %GVA	0.02%	0.02%	0.11%	0.10%	0.16%	0.01%
Minimal burden in % GVA	0.00%	0.00%	0.01%	0.00%	0.09%	0.00%
Highest burden in % GVA	0.04%	0.06%	0.40%	0.84%	0.26%	0.08%
Region with highest burden	Mecklenb.-Vorpommern	Provence-Alpes-Côte	Friuli-Venezia Giulia	Klagenfurt-Villach	Zahodna Slovenija	Ticino

Table 17 Summary of the most important figures per country. In the energy and manufacturing sector the burdens are additional cost of transports and the excess burden of avoided road transports.

Construction sector

Figure 16 and Table 18 shows the burden in the construction sector. The lower number of dark pigmented regions in Figure 16 shows, that the relative burden is less than in the other sectors. The highest burdens are seen along the Alpine arc and on the south side of the Alpine arc. On a national level the average burden lies between 0.01% and 0.08% of the sectors GVA and is in Slovenia the highest. On a regional basis the highest relative burden is to be found in Klagenfurt-Villach with 0.64%. In absolute values the burdens are comparable with the ones in the agricultural sector. An exemption is Austria, where the absolute burden in the agricultural sector is twice as high as in the construction sector.

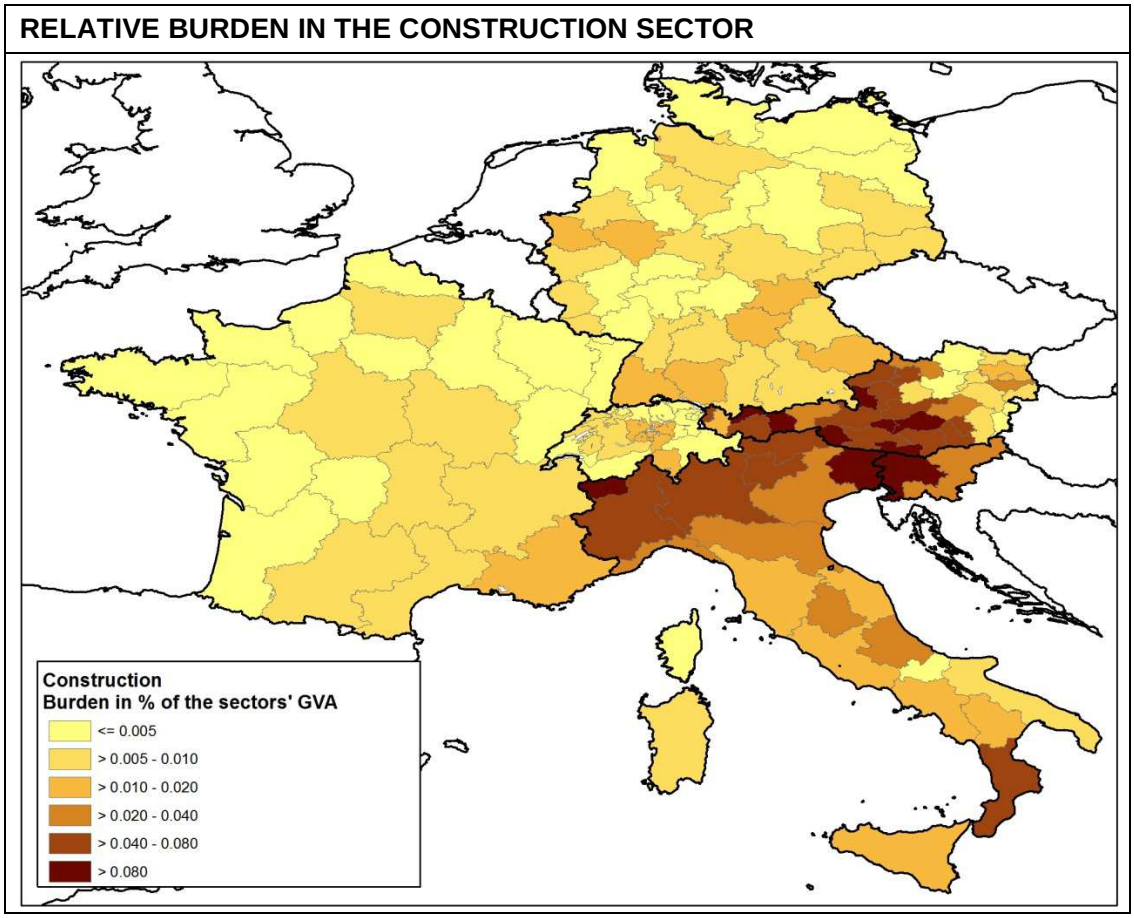


Figure 16 Scenario Restrictive 2020 compared to BAU scenario 2020

Table 18 summarizes the average burden and the minimal and maximal burden of a region per country.

Construction						
	DE	FR	IT	AT	SI	CH
Total burden (in m. EUR)	7.4	3.8	19.8	6.4	1.1	1.2
Average burden in %GVA	0.01%	0.01%	0.04%	0.05%	0.08%	0.01%
Minimal burden in % GVA	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%
Highest burden in % GVA	0.02%	0.01%	0.27%	0.64%	0.13%	0.03%
Region with highest burden	Tübingen	Provence-Alpes-Côte	Friuli-Venezia Giulia	Klagenfurt-Villach	Zahodna Slovenija	Ticino

Table 18 Summary of the most important figures per country. In the construction sector the burdens are additional cost of transports and the excess burden of avoided road transports.

3.4.4. EFFECTS ON EMPLOYMENT

In order to have an idea of the magnitude of the employment effects, the burdens are converted to employment units. The result is a rough estimate of the possible employment effect. Productivity increases and dynamic effects are not considered (the ASTRA model in Chapter 5 will contain these effects).

The calculation is made as follows:

› First, the average GVA per employee is calculated for each region and sector.

› Then the calculated burden of the sectors is divided by their respective GVA/employee. Whereas in the transport sectors the burden resp. gain is calculated in changes in GVA in the transport-intensive sector the burden are additional cost resp. excess burden. We assume that the burden in the transport-intensive sectors leads to an equivalent loss in GVA. This means, that no productivity gains are considered. Because of that assumption the calculated employment effects tends to be overestimated.

Table 19 and Table 20 show the impact of a restrictive traffic management instrument in the year 2020 on the employment of the transport-intensive sectors. All-in-all the burden to the traffic management instrument corresponds to 11'000 employment units. 11'000 employees represent 0.04% of all employees in these sectors. The percentage of jobs at risk varies between the different sectors. In absolute numbers the biggest negative impact can be seen in the energy and manufacturing sector. In relative terms, the agricultural sector is with 0.07% more affected than the energy and manufacturing sector with 0.05%. The lowest impact is seen in the construction sector, where the burden converted in employment units equates to 0.02% of total employment.

BURDEN EXPRESSED IN EMPLOYMENT UNITES IN ABSOLUTE NUMBERS				
in no. employees	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Total**
Germany	213	1'223	181	1'617
France	96	731	79	906
Italy	843	4'810	681	6'334
Austria	878	718	164	1'760
Slovenia	93	316	66	475
Switzerland	38	81	18	137
Total	*2'162*	*7'879*	*1'189*	*11'229*

Table 19 Scenario Restrictive 2020 compared to BAU scenario 2020.

BURDEN EXPRESSED IN EMPLOYMENT UNITS IN RELATIVE NUMBERS				
in % of the sector's employees	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Total**
Germany	0.03%	0.02%	0.01%	0.01%
France	0.02%	0.02%	0.01%	0.02%
Italy	0.06%	0.11%	0.03%	0.08%
Austria	0.40%	0.10%	0.06%	0.14%
Slovenia	0.13%	0.16%	0.08%	0.13%
Switzerland	0.03%	0.01%	0.01%	0.01%
Total	0.07%	0.05%	0.02%	0.04%

Table 20 Scenario Restrictive 2020 compared to BAU scenario 2020.

Table 21 shows the impact of the introduction of a restrictive traffic management instrument on the employment in the transport sectors. There are two kinds of calculations. First the employment effects in the transport sector if only the transport by itself without value added following out of subsidies and service level agreements is considered, are calculated. When only the transport by itself is considered, the burden of the road transports sector expressed in employment unites is double as high as the gains expressed in employment unites in the rail transport sector. Since the rail sector is smaller than the road sector, the employment effect in percentage is in the road sector lower than in the rail sector. The high relative increase of the rail freight transport sector in Italy and Slovenia is caused by its low level starting point. Nevertheless the gain of the rail sector expressed in employment units is as well in absolute numbers in Italy the highest.

If only the transport by itself is considered the burden expressed in employment units is about 4'700 units higher than the gains expressed in employment units.

The picture changes, if infrastructure and service level agreements are considered[6]. The table contains an indicative calculation about the employment effect, if running the infrastructure and service level agreements are considered on the basis of Swiss data. Further it is assumed, that the GVA per employee in the infrastructure sector is the same as in the transport service sector. Under these assumptions the net employment effect declines from 4'700 to 2'200 employment units. In relative figures 75% of the potential lost employment units in the road sector are might be created in the rail sector. Please not that due to rough assumptions (Swiss database transferred to other countries) the figures only reflect rough magnitudes. Nevertheless it can be

[6] In the national accounts service level agreements are treated as subsidies. Since subsidies are financed by tax, subsidies are not included in the value added of the respective sectors. This means, that services based on service level and subsidies to the rail transport sector are not included in the calculations of the value added.

concluded, that the consideration of the transport infrastructure leads to a considerably lower net loss of employment in the transport sector.

TRANSPORT SECTOR: BURDEN AND GAINS EXPRESSED IN EMPLOYMENT UNITS						
in no. employees resp. in % of the sector's employees	Transport only				*Indicative calculation: Transport and infrastructure*	
	Road (absolute)	Rail (absolute)	Road (relative)	Rail (relative)	*Road (absolute)*	*Rail (absolute)*
Germany	-2'017	687	-0.37%	2.06%	*-2'138*	*1'293*
France	-2'421	681	-0.42%	1.91%	*-2'566*	*1'282*
Italy	-1'750	1'272	-0.49%	8.51%	*-1'855*	*2'395*
Austria	-1'165	387	-0.77%	2.50%	*-1'234*	*728*
Slovenia	0	155	0.00%	10.50%	*0*	*292*
Switzerland	-308	144	-0.32%	1.44%	*-326*	*271*
Total	-7'661	3'325	-0.44%	3.00%	*-8'120*	*6'260*

Table 21 The table shows the burden (-) and gains (+) expressed in employment units of the transport sector under scenario Restrictive 2020 The figures for transport and infrastructure are based on an indicative calculation on the basis of Swiss data.

Summing up it can be concluded, that the burden of the transport-intensive sectors corresponds to some 11’000 employment units, which is 0.04% of the total employment. In the transport sector (road and rail) there might even result a small net loss, if infrastructure and SLA are considered. If the estimated burdens and gains are converted in employment units the burdens are about 2’200 employment units higher than the gains.

3.5. SENSITIVITY ANALYSIS

In this section the sensitivity of two specific assumptions will be analysed: First the assumption that the shippers pass on 50% of the additional costs shall be challenged. In addition we analyse the impact of lower costs for short-distance transports.

Shipper passes on 100% of additional costs

Table 22 show the differences in the results, if the shipper (in the origin region) can pass-on all additional costs to the recipient at the destination (sensitivity scenario). The calculations are based on scenario Restrictive 2020. The national average burden of the agriculture sector decreases by 12% to 51%. The burden of the manufacturing and energy sector decreases as well by (8% to 16%). In contrast the construction sector is affected more. Its burden rises by 30% to 118%.

A check of the regional distribution shows, that the regional distribution of the burden does not change significantly due to the change in the assumption about the passing-on of cost. The 10 most affected regions remain in all sectors more or less the same. There is only a change in the construction sector, where the P.A. Bolza-Bolzano belongs not anymore to the ten most affected regions. At its place is Unterkärnten. In the agricultural sector Lungnau belongs not anymore to the ten most affected regions, but Osttirol.

RESULTS OF THE SENSITIVITY SCENARIO 100% PASSING ON OF COSTS						
	DE	**FR**	**IT**	**AT**	**SI**	**CH**
Agriculture						
Burden in % GVA	0.02%	0.01%	0.06%	0.16%	0.12%	0.02%
Difference to burden scenario Restrictive 2020 in %-points	-0.004%	-0.005%	-0.014%	-0.162%	-0.016%	-0.006%
Difference to burden scenario Rrestrictive 2020 in percentage	-13%	-34%	-19%	-51%	-12%	-23%
Energy and Manufacturing						
Burden in % GVA	0.01%	0.02%	0.09%	0.09%	0.14%	0.01%
Difference to burden scenario Restrictive 2020 in %-points	-0.002%	-0.003%	-0.014%	-0.009%	-0.026%	-0.001%
Difference to burden scenario Restrictive 2020 in percentage	-14%	-16%	-13%	-10%	-16%	-8%
Construction						
Burden in % GVA	0.01%	0.01%	0.06%	0.11%	0.15%	0.01%
Difference to burden scenario Restrictive 2020 in %-points	+0.005%	+0.006%	+0.028%	+0.056%	+0.076%	+0.002%
Difference to burden scenario Restrictive 2020 in percentage	+64%	+118%	+76%	+109%	+97%	+30%

Table 22 Changes due to another assumption of passing on of costs between shipper at the origin and recipient at the destination (100% instead of 50%):
Reading example: In Germany the average burden of the agricultural sector equates to 0.02% of the sectors GVA. In comparison to the scenario Restrictive 2020 the burden decreases by 0.004%-points. This equates to a decrease of the burden by 13% compared to the scenario Restrictive 2020.

Lower costs for short distance transport

The treatment of short distance transport might differ for the different instruments considered. The cost for an Alpine passage within an ACE system is for all Alpine corridors the same, not depending on the distance driven. This might be different for the other instruments, depending on their detailed design. The costs for an AETS will depend on the CO_2 emitted in the Alpine area. Thus there is a relation to the km driven. The design for Toll+ can be varied both by a passage toll or a km-charge. If a passage toll would be applied the treatment is similar to ACE, if a km-charge within the Alpine area is applied, the effects are similar to AETS.

This means that the cost increases for a transalpine transport with long distances within the Alpine area are not the same for all type of instruments. Because of data availability this differences could not be considered in the calculations. The calculations made in the previous sections are based on the assumption, that all transport within the Alpine regions are treated the same, without considering their mileage. This raises the question, if the results would be very different, if the impact of lower price increases for regions within the Alpine area would be considered. Thus we consider a sensitivity with a km-dependent charge within the Alpine region. This could be as well a possible measure to reduce the burden for Alpine regions. In the following the impact for three selected regions (Ticino, Friuli-Venezia Giulia, Klagenfurt-Villach) will be estimated. Two effects have to be considered:

› Magnitude of cost reduction for transports with origin and destination within the Alpine area,
› Magnitude of cost reduction for transports with origin / destination outside the Alpine area.

On the basis of the CAFT 2009 database the importance of transports with origin and destination within the Alpine area can be analysed. The boarder of the Alpine area does not follow the boarder of the NUTS3 regions. An exact calculation was therefore not possible. The analyses show the following shares of transports with origin and destination within the Alpine area:

› Ticino: 25% - 35%
› Friuli-Venezia Giulia: 15% - 25%
› Klagenfurt-Villach: 40% - 50%.

The cost reduction for transport within the Alpine regions corresponds to 50%, assuming that the average distance is half of the distance between the Alpine borders. The cost reduction for the other transports is depending on their OD-relation. We assume that the distance is in average the following percentage shorter than the full distance through the Alpine area:

› Ticino: 10% (240 km instead of 270 km; distance to Lugano)

› Friuli-Venezia Giulia: 0% (the economic centre Udine lies outside the Alpine area)
› Klagenfurt-Villach: 30% (200 km instead of 300 km, distance till Villach).

This leads to the following reductions of the regional burdens, if short distance transport would be treated differently to long distance transports.
› Ticino: 10% - 20%
› Friuli-Venezia Giulia: 5% -15%
› Klagenfurt-Villach: 35% - 45%

The calculations for the three selected regions show that km-dependent instruments have the following potential to reduce the burden of regions within the Alpine area:
› The burden of regions at the boarder of the Alpine region can be reduced by about 10%.
› The burden of regions in the centre of the Alpine region can be reduced by about 40%.

3.6. TRANSFERABILTY TO OTHER SCENARIOS

In ALBATRAS more than 20 scenarios have been discussed. This raises the question of how the results of scenario Restrictive and scenario Tolerant can be transferred to the other ALBATRAS scenarios. The scenarios considered show the following mechanisms:
› Different levels of price increase: In general the effects are proportional. The higher the price increase of a scenario, the higher are the impacts on GVA and employment. However the level of economic impacts is differing considerably between scenarios. According to the price scenarios of ALBATRAS (see Table 1) the level of economic impacts are varying between max. (Scenario TOLL+ restrictive) and min. (AETS moderate) by a factor 3 to 4.
› Different time horizons: The prices and impacts respectively are higher in 2030 than in 2020. This is due to additional traffic growth and related higher prices of the traffic management instruments. The differences are according to the price increases of different scenarios. The scenarios 2030 however do not consider the positive economic impact of the realization of the two rail base tunnels at the Brenner and Mont Cenis axis. The construction of these rail infrastructures will increase regional welfare considerably.
› Different type of instruments. There are some differences between the three type of instruments with regard to their regional impacts (besides the different price increase):
  › The ACE mechanism leads to similar prices for a transit right for all distances within and outside the Alpine arc, as long there are no specific flanking or regional relief measures to

be considered. Compared to the other scenarios AETS and TOLL+, this leads to an additional burden of short distance transports within the Alpine arch.

› The AETS and TOLL+ instruments are related to the distance driven within the Alpine arch. The shorter the distance the lower the additional burden. Nevertheless long distance transports face a lower burden per km, since the distance driven outside the Alpine arch is not charged.

› These differences might be outweighted with additional measures (socalled relief measures for short distance transport, see chapter 4.4).

› In quantitative terms short distance transports (50km) are charged about 4 times higher within the ACE scenario compared to AETS and TOLL+ as long there are no relief measures considered.

› Overall the burden of Alpine regions with the AETS and TOLL+ scenarios compared to ACE scenario might be around 20% lower if no specific relief measures for short distance transport will be introduced.

4. QUALITATIVE IMPACTS ON ECONOMIC STRUCTURES

The aim of this chapter is to achieve better insight into the details of the reaction patterns of stakeholders and to get a more precise knowledge about the most affected industries in a qualitative way. The analysis is based on interviews with selected stakeholders in different areas and regions (questionnaire and interviewees are in Annex 2) and on existing literature. An overview of the literature and an evaluation of stakeholder position papers are presented in Annex 2.

4.1. REACTION PATTERNS OF STAKEHOLDERS

Based on the reaction chain presented in chapter 2, several general aspects and specific characteristics of the transport sector were mentioned by most of the interview partners:

4.1.1. RESULTS OF INTERVIEWS

Relevance of the different reaction mechanisms of the road transport sector:

Most interview partners stated that the reaction mechanisms will be similar for the three traffic management instruments. All instruments lead to an increase in transport costs and lead to adaptations in the transport sector. Nevertheless, the pressure to change to rail solutions is the lowest in the TOLL+ system. Because of the railway quality, which is regarded as too low, the modal shift to rail will tend to be lower in the TOLL+ system as in the other systems.

› **Efficiency improvements HGV:** All interview partners stated that there is only a very small potential for further efficiency improvements of HGV. Due to the long distances and existing political measures (particularly in Austria), most operators which are involved in transalpine transports already have a modern vehicle mix with Euro 5 HGV. Some potential was localised in the regional transports and transports from southern Italy and Eastern European countries, which frequently use older HGV (lower Euroclasses). Existing measures already set the relevant incentives for modernisation of the vehicle fleet in these countries as well (e.g. in Slovenia).

  However, there are mixed feelings concerning Euro 6 HGV, because they might reduce local air pollutants but at the same time have a higher use of fuel. Thus, it does not make sense for operators purchasing Euro 6 HGV if a future traffic management instrument focuses on CO_2-emissions. This trade-off needs to be considered when designing a traffic management instru-

ment.

→ For this reaction mechanism, there is a **rather high consensus** between interview partners that the potential for improvements of vehicles is limited. Especially at the Brenner corridor, the potential is very limited because of existing political measures. At the other corridors, the possible improvements are somewhat higher. The biggest potential is seen in the regional transports or transports accomplished by Eastern European or South Italian carriers. In the future an air pollutant (not $CO_{2)}$ dependent system might increase the incentive to use Euro 6 HGV. The higher fuel consumption of Euro 6 HGVs is challenged by Mercedes, which presented a model with lower fuel consumption than the previous Euro 5 model due to better motor technology (Deutsche Logistik-Zeitung 27.9.2011).

› **Overall efficiency improvements (capacities):** Concerning this reaction mechanism, the interview partners have different assessments.

1. In Germany especially, the smaller operators have stated that there are no further efficiency improvements – they would already have been realised under existing conditions. Large operators and logistic service providers however stated that the current transport demand has some potential for efficiency improvements. Today, transport costs are very low so that many companies have "outsourced" their stockkeeping to the motorway with just-in-time processes. The trips are focused to point-to-point relations, in order to minimise time. An increase of transport costs might reverse some of this development. From the viewpoint of large operators, there are potentials to increase efficiency if time flexibility is less important than increased costs. These adjustments would however take place in the medium and long-run.
2. The interviewees outside Germany remain sceptical regarding the potential for efficiency improvements. Especially in the transport-intensive sectors, transport costs are substantial. They are already highly optimised.

→ There is a rather low consensus between stakeholders on this reaction mechanism. The different appraisals could also be a result of different km-prices at the different corridors. Where prices are already high (in particular in Switzerland because of the HGV fee and at the Fréjus and Mt-Blanc corridor because of tunnel fees), the optimisation is already higher than at corridors with lower prices. However, due to the fact that the introduction of the HGV fee in Switzerland has led to a higher degree of capacity utilisation, it can be assumed that an increase in transport prices has an effect on the capacity utilisation if at the same time possibilities for larger vehicles will arise (Ecoplan/INFRAS 2007).

› **Reduction of empty runs:** Most interview partners stated that a traffic management instrument would not reduce the share of empty runs. The rates today are already very low. It needs to be considered that there is a 'natural empty run quota' as some products are transported in one direction only with specific vehicles (e.g. mineral oils, chemical products, waste products) and that trade flows are not balanced. Most stakeholders have the feeling that the market is rather close to this natural empty run quota. An Italian transport consortium mentioned that since the start of the consortium at the beginning of the year, the share of empty runs decreased because of the higher economies of scale significantly. At the moment the quota lies between 0% and 5%.

  → There is a rather high consensus that there is low potential to reduce the empty run share under existing market conditions. Nevertheless, the Italian transport consortium indicates that through increase of enterprise sizes efficiency can be improved.

› **Detours:** All interview partners had the feeling that a detouring of the Alps would not be feasible when the traffic management instrument is coordinated within the whole Alpine area due to additional transport costs. However, several interviewees from Germany have stated that, under the existing regulatory framework, there are many detours from the Swiss corridors to the Brenner and that a traffic management instrument will lead to a shifting back to the Swiss corridors if transport prices are increased on all corridors.

› **Use of rolling motorway:** All interviewees stated that the rolling motorway has to be improved in many situations to become attractive (see section below on barriers and accompanying measures). The potential for using the rolling motorway is directly linked with the rail supply and the conditions (price, capacity). If the quality would be raised, a more intense use of the rolling motorway would be an option for several actors.

Reaction mechanisms of the shippers

The shippers and the transport-intensive economic sectors respectively can react by choosing another transport mode or changing their economic relationships in order to avoid transalpine transports.

› **Use of rail modes:** All interview partners stated that a high quality of infrastructure is of high importance to boost the attractiveness of rail modes:

  › Germany: All interviewees see only low potential for other rail modes, especially for wagon load transport. The current supply of wagon load does not match the current needs of the transport market. Only few large shippers or logistic service providers are able to build full train loads. And operators currently offer very few possibilities to transport single

wagons. Innovative approaches are currently tested (e.g. trailer solutions, craneable trailers, etc.) but none of the operators have a knowledge of/interest in these solutions under current conditions.

› Switzerland: The estimated possibilities of shifting transports to rail are dependent on the quality requirements of the transports and the value of the goods. Whereas producers of high-values goods would prefer to pay more for the transport than to shift to rail, producers of goods with low margins see more potential for modal shift subject to the condition that the time requirements of the rail transport decrease. However, there are significant differences of rail quality between national transports and crossborder transports to Italy. Thus, a higher use of rail modes seems more realistic for national transports than for international transports.

› France: In France the interviewed stakeholders are rather sceptical about the use of rail modes. They are widely involved in short distance journeys between south-east France and northern Italy and thus underline that the additional costs due to the additional transhipment induced in rail solutions would make short distance rail transports unattractive. The Study DIFFERENT (Rydzkowski, Hajdul, Bonsall 2008) confirms that intermodal transports are only attractive for a distance of at least 500km.

› Austria: One Austrian carrier pointed out that the unaccompanied combined transport in the last years had a higher growth rate than the rolling motorway and that this trend would continue in the next years. Interviews with firms active in transport-intensive sectors confirm this appraisal provided that the needed infrastructure is disposable. This stands somewhat in contrast to the German interview partners whose tendency is more towards the rolling motorway.

› Italy: The Italian interview partners mentioned that the quality of rail solutions diminished in Italy over the last years. Moreover, interviewees of South Tirol mentioned that the lack of a terminal in the region would make rail solutions unattractive. All-in-all, at the actual quality level rail alternatives for shippers are very limited.

› Slovenia: Overall, it can be stated that in Slovenia the relevance of rail modes is somewhat higher than in Italy but still considerably lower than in the other countries considered. In the last years, several difficulties with rolling motorway services have become clear. Industry associations thus see the need to focus more on unaccompanied combined transport. A considerable increase of rail transport would however require the provision of adequate infrastructures and services.

→ Whereas interviewees in Switzerland, Austria and Slovenia see potential for other rail modes, actors in France, Germany and Italy are rather sceptical. In general, the trailer market seems to be the most dynamic. The potentials depend strongly on the quality of rail markets which is presently not sufficient. Most important are international harmonisations (length of trains, priorities) and increased capacity.

› **Changes in economic relationships:** Some producers of transport-intensive goods stated that higher transalpine transport cost might lead to efforts to boost non-transalpine markets. This is only possible for shippers on the north side of the Alps. Italian international shippers have very limited alternatives in the national market.

4.1.2. BARRIERS TO SHIFT TRANSPORTS TO RAIL

The discussion on reaction mechanisms has made it clear that several barriers are compromising their use. These barriers exist on all levels of the transport sector and relate to the demand side as well as the supply side (road and rail transport). The following table gives an overview on the barriers that have been named during the interviews:

BARRIERS – DEMAND AND SUPPLY SIDE			
	Demand side (shippers, consumers)	**Supply side road**	**Supply side rail and combined transport**
Size of shipments	› Just-in-time processes (shippers) › More custom-made products that are difficult to transport in a big lot or container (e.g. special sizes or colours of tiles)	› Additional transport services from East European countries meet this demand at low cost.	› Wagon load rail services are not available for smaller shipments.
Efficiency improvements (HGV and overall)	› Unbalanced trade flows lead to a “natural quota” of empty runs	› Bad accounting systems make it difficult to identify potentials › Conflicting signals for vehicle mix from different instruments (e.g. night driving ban focusing on Euro-classes, ETS)	-
Choice of transport mode	› In some sectors, the confidence into rail services is very low (fear of intransparency, theft, etc.)	› Combined transport services are less flexible than “pure” road transports (e.g. waiting times).	› Rail operators have a high interest in unit trains/block trains but only little interest in individual waggons.

BARRIERS – DEMAND AND SUPPLY SIDE			
	Demand side (shippers, consumers)	**Supply side road**	**Supply side rail and combined transport**
Rail capacities	› missing priorities	› missing capacities on rolling motorways › Height of profile of 4m not available on all corridors	› Missing capacities on rolling motorways. › Missing capacities of terminals › profile of 4m not available on all corridors
Rail quality	› Often negative attitude towards rail solutions: e.g. bad quality, punctuality, fear of theft. › If there is a disturbance, it mostly affects a whole train. Road transport is more flexible regarding disturbances.	› Waiting times on combined transport terminals are difficult to match with regulatory rest periods of drivers. › Bad sanitary conditions on rolling motorway trains and terminals	› Limited capacity of C.T. terminals especially in Northern Italy

Table 23 Overview of barriers to change transport mode from road to rail according to the interviewees.

4.1.3. COMMONS AND DIFFERENCES BETWEEN INSTRUMENTS

The interviews made clear that the perception of the stakeholder of the different instruments is not consolidated yet. In a perfect economic world, all three traffic management instruments would have similar reaction patterns since the price signals of the instruments are the basis for changing production functions or shifting burdens to the demand side. But because of different designs and economic rigidities, there are some differences between the instruments, which are highlighted in this section. The following table shows the similarities and differences.

COMPARISON OF THE TRAFFIC MANAGEMENT INSTRUMENTS			
	ACE	**AETS**	**TOLL+**
Handling	Difficult (new instrument), especially for small transport companies	Difficult, but some experiences (in A experiences with Ökopunktesystem)	Easy
Knowledge about the price increase	Prices are flexible. In a mature market stable price signals are expected. It is however difficult to anticipate the price signals in detail	Prices are flexible. In a mature market stable price signals are expected. There will be however price fluctuations	Additional costs are fixed.
Possibility to pass costs to shippers	In principal possible, but additional cost can change	In principal possible, but additional cost can change	Easy (additional costs visible)
Efficiency improvements	High pressure (limited flexibility to react)	Medium pressure	Medium pressure
Administrative costs	High (trade mechanism and control systems)	High (trade mechanism and control systems)	Low
Environmental improvements	Low pressure	High pressure	Depending on differentiation
Modal Shift	High potential for structural changes, since transport sector and shippers are urged to seek new solutions	Less important. First the environmental impact of road transport can be reduced.	Less important. If the willingness to pay is high, no modal shift is enforced.
Experience	Low	Medium (EU ETS)	High (different road charge systems)

Table 24

In general, all interview partners stated that the knowledge about design and function of the traffic management instruments ACE and AETS is very limited. The smaller the company, the higher are the needed efforts to get familiar with the new instruments; there is a fear that large operators have a higher potential to deal with the new instrument compared to small actors.

With some exceptions, all interview partners prefer TOLL+ if they have to choose one instrument. The major argument against the other systems is the need of trading the rights. Due to the trading, the price signal will not be stable and passing on of costs is more difficult. Moreover, small road transport actors fear that their large competitors will control the market and increase the prices for transit rights for small actors.

Only two actors would prefer AETS. Unsurprisingly, these actors are from Austria and South Tirol and are familiar with a similar emission-oriented system (Ökopunkte). This shows

that familiar measures are more easily accepted than new, unknown instruments. One actor was motivated in his choice by the environmental benefits. Another actor argued that an emission-oriented system would hurt the Eastern European low-cost carriers (who normally use older HGV) more heavily than the local firms. Thus, the local firms' competition position would be enhanced.

Nevertheless, several actors mentioned that the ACE would give the strongest incentives to boost structural change in the transport sector. Shippers would react differently, if the overall volume of transalpine transports is limited as if there is just a price increase. Limited transalpine transport capacities on the road would force all actors to search for new solutions. Unsurprisingly, it was a rail actor who preferred the ACE.

A subject not addressed by the interviewees is the possibility of grandfathering. In the trading system it would be possible to give transit rights for free to specific vulnerable stakeholders (e.g. carriers in Alpine areas) instead of auctioning all transit rights in order to relieve potential hardship cases.

4.2. EFFECTS IN THE TRANSPORT AND LOGISTICS SECTOR

4.2.1. MARKET ORGANISATION

In order to interpret the results correctly, it is important to know the structure of the freight and logistic markets. Concerning the transalpine freight market, the following aspects are important:

- There are close economic links which induce significant flows of goods between regions in the north and south of the Alps (southern part of France and Germany with northern parts of Italy, Ticino with rest of Switzerland, Austria and Italy/Slovenia). For example, the fact that some German stakeholders are involved in the discussions on the Brenner Corridor Platform is a consequence of these economic links (Bundesamt für Güterverkehr 2009).
- Carriers and logistic service providers alone cannot realise some of the existing potentials for improvements. In most sectors, the production processes have become very complex with 'just-in-time' processes that require high-quality transport services. Thus, transport prices are not the only aspect to determine the transport mode. This is also the case for products that are not perishable, such as paper products, automobiles, ceramics and tiles, etc.
- The just-in-time production processes as well as a growing share of custom-made products have led to ever smaller shipments and a higher need for flexibility of carriers and logistic ser-

vice providers. This often results in peak demands which are difficult to deal with, already under the existing framework.

The road freight transport sector is characterised by small and medium companies. Some companies are highly specialised on specific product groups (e.g. transport of ceramics and tiles from Italy to Germany). Nevertheless, the structure of the logistic markets is not in all countries the same.

In Germany at the beginning of 2011, 57% of the companies operating in the German logistic sector have a business-size of less than five employees, a further 30% have less than 20 employees. Only 4% of the companies have more than 50 employees and can be seen as medium and large logistic service operators (BGL 2011). The average company has 12 employees. This is comparable with the average Austrian company, which has 10 employees (Eurostat, structural business statistic 2008). In Austria, the road freight sector is structured as follows: About one third of all companies have only one HGV, each second company has between two and nine HGV, 20% have more than 10 HGV and about 10% have even more than 20 HGV (Statistik Austria 2012). The Italian market with an average of five employees is even more segmented (Eurostat, structural business statistic 2008). The Slovenian market is also characterised by a large number of small operators. 90% of all operators have a business-size of less than 15 employees, operating a maximum of ten HGV. Due to the insolvency of one of the big players, the market structure became even more segmented. The French and the Swiss markets are comparable to the German market. In Switzerland, the average number of employees per company is as well 12, in France 14 (Bundesamt für Statistik, Betriebszählung 2008; INSEE, Élaboration des Statistiques Annuelles d'Entreprise 2009). The company-size of rail traction companies, combined transport actors and other multimodal transalpine logistics actors (such as national railways, Schenker, Panalpina, Kühne und Nagel, HUPACT, Kombiverkehr) is considerably bigger than in the road transport sector.

In Alpine regions, the share of small companies is even higher than the national average. E.g. in Tirol, 80% of all companies have less than 10 HGV (Amt der Tiroler Landesregierung 2010). In the South Tirol, the company-size is even smaller. 80% of all transport companies have less than 5 employees (WIFO Bozen 2011).

The modal split differs significantly between the considered countries. According to Eurostat in the year 2009, the highest share of rail transports is seen in Switzerland with 38% all ton-km, followed by Austria with 36%. In Germany, 21% of all ton-km are accomplished by rail. In France and Slovenia about 15% of all goods are transported by rail and in Italy 9%. The share of

rail transports is in the transalpine transport market considerably higher than the national average. In 2010, in Germany 45% and in Switzerland 63% of all transalpine transports are accomplished by rail (BGL 2011, Bundesrat 2011). At the Brenner corridor in Austria the modal split is comparable with the national average. In 2010 the share of rail transports at the Brenner axis was 35% (Amt der Tiroler Landesregierung 2010). Whereas the volume and the share of rail increased over the last ten years at the Swiss corridors and the Brenner, the volume of rail transports from and to South Tirol decreased. From 2007 to 2008 rail transports were reduced by 50%. Looking at the years 2004 to 2008, the volume of rail transports decreased even by 75%.

4.2.2. RESULTS OF INTERVIEWS

The interviewees were asked about i) impacts on the transport sector and ii) expected structural changes in the transport sector.

Economic impacts in the transport sector

› Most interview partners shared the view that additional costs from traffic management instruments will be passed on to shippers and finally to consumers. Some interview partners however had doubts about the full passing of costs. There are two kinds of reasons. i) The competition within the transport sector is currently very high due to additional competition from Eastern European operators with low labour costs. Operators from Western Europe are under high pressure for cost savings to remain competitive. ii) For the transport of low-value goods, the cost pass-through is difficult, because their producers have as well low margins. A study of the Bundesamt für Güterverkehr (2008) mentioned the following sectors, in which a full passing on of costs is not possible: Food, construction, automobile and furniture.

› Especially the interview partners representing smaller companies also feared the administrative burden of the traffic management instruments. Above all, the ACE and the AETS with the auctioning of permits and the trading is seen as rather complex. Small companies fear that the big stakeholders will dominate the market, leading to a higher dependency (e.g. if logistic service providers buy the permits and then “dictate” their conditions to their contractors).

In summing up, the following can be concluded:

› The pass-on potential is most transparent and most likely with the TOLL+ scheme.

› If additional costs will be passed on to consumers, the transport sector will still be affected by the traffic management instruments:

› Reduction of transports between Italy and the rest of Europe due to reaction of transport-intensive industries/shippers will have impacts on the transport sector, especially on carriers with a strong and long-lasting focus on Alpine crossing road transports.
› Distributional impacts between road and rail operators and between large and small operators (see further information in next section).
› Hardship cases seem possible and will hit small operators especially. This will especially be the case with the ACE or AETS as this leads to the highest administrative burden and increased risks of unfair treatment of small operators (see below).

Structural changes in the transport sector (short and long term)

› All interview partners share the view that structural changes will only become relevant in the medium to long-term. Some stakeholders made a clear statement that a new traffic management instrument will lead to further consolidation in the road transport market with an increased size of enterprises.
› Several channels that lead to this consolidation were mentioned: i) direct channel due to an increase in the administrative burden which is not feasible for some small operators, ii) indirect channel if trade flows of some specific products are reduced (e.g. ceramics and tiles from Italy or some chemical products) and if operators are highly specialised in this market, iii) indirect channel through a higher dependency on large operators if they dominate auctions and trading of allowances, iv) economies of scale in the supply of multimodal transports.
› Surprisingly, the rail actors interviewed are not expecting big structural changes. Since it is expected that most avoided road transports will shift to combined transport solutions, the structural impact on big logistic providers will be more important than the impact on rail service providers. They will have a higher turnover but still the same products.

4.2.3. RISKS AND CHANCES

Considering the limited possibility of reacting to the steering effects by increasing efficiency, there are according to the above analysis some visible **risks** in the transport sector. Most affected are smaller and specialised transalpine operators with limited alternatives and small fleets. However, the bigger road transport markets with large enterprises and logistical services including rail have more potential in the first place to pass on increased costs and secondly to change their large scale strategy. It has to be considered that there will be southern (Italy, Ticino, Slovenia) and northern operators (Germany, France, Austria, Northern part of Switzerland) affected. Thus, effective steering effects in place, there will be a structural change in the transalpine

transport market leading to higher competition (especially in the Eastern part of Europe) and to an increase of the average size of transport firms.

Due to limited possibilities for optimising the road transport logistics chain, structural change and its respective chances are strongly linked with the combined transport market. Three different directions of impacts have to be considered:

- **Rolling Motorway:** As existing experiences in Switzerland and with the Brenner axis show, road restrictions will lead to an increase of the rolling motorway as a short term alternative. There is no need for a change in logistics since the use of rolling motorway is a decision which will be made by the road transport operator himself. How much rolling motorway will be supplied though will at the end be a political decision since there is very limited potential for economically viable products. Although, rolling motorway has low environmental performance and high intensity of capacity use.
  ►Although rolling motorway can be an alternative for shifting road to rail and can limit unwanted negative effects for the road transport sector, there is no potential for behavioural changes for the transport sector.
- **Combined transport with trailers, containers and swap bodies:** The increase of trailer transport has the highest potential for shifting road to rail with new steering instruments, without major logistical changes. The logistical chain will be organised by large road transport operators and by combined transport operators. Rail transport operators act as traction service providers. Based on the interviews, the highest potential is linked with craneable trailers within distances of 300 to 500 km. Compared to rolling motorway, its economic viability is considerably better. Most important is the availability of terminal capacity and priority tracks.
  ►Especially for large road and C.T. operators there are chances for structural shifts towards new trailer transports. However, related investments are crucial and will be dependent on public support especially in the beginning.
- **Wagon load:** Compared to combined transport, the logistics chain is driven by the collaboration of the transport-intensive industries (shippers) and the rail companies. Based on the interviews, the potential for structural shifts ia linked with the need for additional infrastructure (e.g. marshalling yards and rolling stock) and increased quality services of the railways. A structural shift towards wagon load is limited due to the structure of goods and their just-in-time demand.
  ►Steering instruments will also increase the demand for rail wagon load services, with chanc-

es in particular for the railways. Compared to the potentials for structural changes in combined transport however, the potential will be limited.

The level of risk and the potential for a structural change depends therefore on the need for shifts towards combined transport solutions. Without specific preconditions in the rail sector and terminal capacity, structural shifting will be difficult. This leads to the conclusion that especially the planned base tunnels at the Brenner and at Mont Cenis are important preconditions for increasing capacity and quality.

The impact is not the same for small and big companies or for companies with focus on the transport of low value goods or with a focus on transports of high value goods. Moreover, the distance of transports is important. The following table gives an overview of the variances of the impact on different logistic enterprises:

IMPACT ON DIFFERENT TYPES OF LOGISTIC COMPANIES		
	Possibility to pass-on costs	**Change in demand**
Big/Small companies	The possibility to pass-on costs does not differ between small and big companies, but due to economies of scale, big companies have more potential to increase efficiency (empty runs, capacity utilisation) and thus more possibilities to reduce the additional costs. In addition, it is easier for big companies to handle complex cap and trade instruments.	The change in demand for road transports is the same for big and small companies. But big companies are in general more differentiated and have thus more potential to compensate a reduced demand in transalpine road transports with gains in other business segments. Furthermore, big logistic providers could participate in the rail sector by supplying new combined transport solutions.
High/low value goods	Since the return margin of shipper of low value goods is as well low, it might not be possible to pass on all additional costs to the shipper, whereas in the high value good sector the passing-on of all additional costs should be possible.	The attractiveness of rail solutions is for low value goods higher than for high value goods. Thus, in the low value good sector the shift to rail will probably be higher than in the high value good sector.
Long distance/regional transport	The proportional price increase for regional transports is higher than for long distance transports (esp. for ACE). Thus, passing-on of costs is for regional carriers more difficult than for long distance carriers.	Regional transports have a small potential for modal shift, whereas for long distance transports rail solutions are more attractive.

Table 25

4.2.4. EFFECTS ON TRANSPORT INFRASTRUCTURE PROVIDERS

Beside the carriers the infrastructure providers are as well affected by the traffic management instruments by lower income due to less driven HGV kilometers. In this section the loss of income for the road infrastructure operators under scenario Restrictive 2020 is estimated. Whereas the numbers of reduced trips is known, the exact number of km driven in the different countries is unknown. They were estimated on the basis of the origins of the trips and the Alpine passage used for the trip. The data source of the all-over road fees originate from ALPIFRET 2010. The data of the special road fees are based on an internet research.

The following table gives an overview of the estimated loss of income of the transport infrastructure providers under scenario Restrictive 2020 compared to scenario BAU 2020:

LOSS OF ROAD FEE INCOME RESTRICTIVE 2020 SCENARIO							
	DE	**IT**	**FR**	**AT**	**SI**	**CH**	**Total**
All-over road fees							
Decrease in million HGV-km	307	546	167	128	8	75	1'231
Road Fees in EUR/km	0.183	0.15	0.26	0.39	0.36	0.59	
Loss of Income in million EUR	56	82	43	50	3	44	278
Special Alpine road fees*							
Loss of Income in million EUR	0	0	70	64	0	3	137
Total							
Total Losses of Income in million EUR	56	82	113	114	3	47	415
Net Income Traffic management instrument in million EUR							661

Table 26 * AT: Brenner, Felber, Tauern; CH: G. St. Bernhard; FR: Frejus, Mont Blanc.

The overall loss of income of the road infrastructure providers is about 415 million EUR (+/- 20%). To have an idea of the importance of the loss of income the proportional loss of income is important:

› In Germany for example, in the year 2010 the income of the German HGV road fee was about 3 billion EUR. The estimated loss of income (56 million EUR) amounts to 2% of total income of the year 2010. The demand for transport is rising. Thus total income is expected to grow over the coming years and the loss of income from HGVs will have a lower relative impact than 2%.

› In Switzerland the total income of the heavy vehicle fee was in the year 2010 about 1.25 billion EUR (Eidgenössische Finanzverwaltung 2011). The estimated loss in the year 2020 corresponds to 4% of the income in the year 2010.

› At the Brenner axis the number of HVG-trips reduced by 37%. Assuming that the HGVs contribute to 50% of the total special road fee income[7] the loss of income is about 18%. The HGV-reduction at the Brenner axis is due to a shift of HGV-trips to the Gotthard corridor because of km-dependent additional costs above the average. Thus the proportional loss of income will be lower at the other corridors.[8]

It can be concluded, that the loss of income of the national road fees are significant but only in the one-digit percentage magnitude. The loss of income of the special alpine road fees are of bigger importance. But it is important to note, that the loss of income will not result in an equivalent gain reduction. On the other side of the losses are reduced maintenance expenses and a higher attractiveness for passenger cars, which might reduce congestion and increase the passenger car income. These positive effects will not outweigh the revenue losses due to the reduction of HGV's. Nevertheless it would be possible to compensate the road infrastructure providers with the income of the traffic management instrument, which is estimated to be about 661 million EUR.

4.3. EFFECTS IN TRANSPORT-INTENSIVE SECTORS

4.3.1. RESULT OF INTERVIEWS

The following statements can be summarised:

› The possibility to pass on additional transports costs to the consumers depends on the produced goods. Whereas producer of high-value goods think rather that passing on of cost is possible producer of low-value goods see more difficulties.

› One producer of transport-intensive low-value goods within the Alpine arc stated that higher transport costs could lead to a review of the location. The Chamber of Commerce in Tirol shares the opinion that some specific producer of capital- and transport-intensive industry goods could in the long term change location but states also that small and middle family enterprises would remain in Austria.

› Several interview partners on the north side of the Alps mentioned that in the case of higher transalpine transport costs they would try to strengthen the markets on the north side of the Alps to avoid the higher Alpine transport prices. This possibility is very limited for Italian enterprises. Thus it is obvious that the transport-intensive sectors in the regions of northern Italy

[7] According to Alpenkonvention 2007 the share of HGV at the Brenner axis was in 2005 15%. Given that HGV pays in average EUR 40 and passenger cars EUR 8, the HGV contribute to 50% to total income.

[8] AT the other taxed corridor the number of HGV-trips is reduced as follows: Felber -30%, Tauern -31%, Grosser St. Bernhard -27%, Mont Blanc -17%, Fréjus -22%.

(which are affected above average as the quantitative analysis in chapter 3 shows) have less adjustment potential in changing their supply or customers markets.

› There is consensus that the availability of high quality rail solutions is of crucial importance.

› Since large enterprises have the possibility to establish full load trains, their competition position will tend to rise. This raises pressure for larger production units.

4.3.2. HIGHLY AFFECTED SUBSECTORS

In the quantitative regional analysis in chapter 3, the following transport-intensive sectors have been considered:

› Agriculture, forestry and fishing

› Energy and manufacturing

› Construction

Notably the sector “Energy and manufacturing” is with respect to transport intensity a rather mixed sector. This chapter, on the basis of existing literature, examines which subsectors are the most affected According to UVEK (2011), in particular the following subsectors have a high transport-intensity:

› Foodstuffs, drinks and tobacco

› Mineral oil industry

› Chemistry and synthetic material processing

› Construction materials

› Metal industry

› Engine construction, electrical and precision engineering

› Retail trade and whole sale

The relevance of these sectors at national level is as follows:

GVA IN % OF NATIONAL GDP OF TRANSPORT-INTENSIVE SUBSECTORS 2008						
Subsector	DE	FR	IT*	AT	SI	CH*
Foodstuffs, drinks and tobacco	1%	2%	1%	2%	1%	2%
Mineral oil industry	0.1%	0.2%	0.2%	n.a.	<0.1%	4%
Chemistry and synthetic material processing	3%	2%	2%	2%	4%	
Construction materials	1%	0.5%	1%	1%	1%	1%
Metal industry	3%	1%	2%	3%	3%	2%
Engine construction, electrical and precision engineering	8%	3%	4%	6%	5%	7%
Retail trade and whole sale	9%	9%	7%	10%	11%	0%
Total	*25%*	*17%*	*17%*	*23%*	*25%*	*16%*

Table 27 Datasource: Structural business statistic, Eurostat.
* Please note that for Italy there is no data for drinks and tobacco. The subsector "Foodstuff, drinks and tobacco" considers in Italy only Foodstuffs. For Switzerland there is no separate information for the subsectors "Chemistry and synthetic material processing" and "Mineral oil industry".

All subsectors have a high share of transport cost at the total logistic costs and a high dependency on road transports in common. But there are significant differences in respect to the following aspects:

› Distances to suppliers and final recipient: There are different distances and spatial distributions of supplying and delivery markets.

› Transport demand: The subsectors have different requests on transport with relation to timeframes, and special transport conditions (refrigerated lorry, dangerous goods, etc.).

› Flexibility in the choice of transport modes: There are different requests on the transport modes.

The following table gives an overview of the commons and differences in different sectors.

CHARACTERISTICS OF TRANSPORT-INTENSIVE SECTORS							
Industry	**Mineral oil industry**	**Chemistry and synthetic material**	**Metal industry**	**Engine construction, electrical and precision engineering**	**Construction materials**	**Foodstuff and tobacco**	**Retail trade and whole sale**
Logistic costs in % of the sectors turnover	5%–7% Thereof transport: 65%	5%–8% Thereof transport: 58%	8% Thereof transport: 48%	5%–11% Thereof transport: 40%	5%–8% Thereof transport: 65%	2% - 8% Thereof transport: 58%	3%–4% Thereof transport: 36%
Modal split road (Swiss data)	84%	90%	67%	82%	97%	83%	79%
Spatial distribution	Refineries central Purchaser distributed	Basic materials: Abroad Production site: central clusters Purchaser distributed	Sector: rather distributed Principal purchaser (engine construction): rather central	Clusters around cities, central	Construction: Large number of small local acting enterprises Materials: bound at the occurrence of raw materials	Beside distribution centres of whole sale is the sector rather distributed, but high interdependencies	Widely distributed purchasers. High interdependencies within the sector
Transport conditions/product characteristics	Disperse purchasers require flexibility in transports (Road transport) High security standards, time requirements are of secondary importance. Supply guarantee	Transport security of high importance (dangerous goods) sensitive goods high-value goods	Raw materials: big, heavy discarded metal	Heavy, sensitive high-value goods customised products Just-in-time, high storage costs	Short distances High transport quantities low-value goods	Time requirements of crucial importance Special quality requirements (temperature, package) High ordering frequencies	Time requirements of crucial importance Low transport quantities High ordering frequencies with low reaction times
Transport modes	Incoming products: rail, pipelines Outgoing products: Road preferred	Pharmacies piece goods: low transport quantities → road preferred	Main mode: Road Rail: only long distance transports (high handling costs)	Road and Rail Transport to purchaser sometimes also by air.	Main mode: Road Big construction projects: Rail Transport frequently done by the sector	Mainly road Big companies: sometimes on rail.	Road, rail, end products sometimes by air

Table 28 Characteristics of transport-intensive industries UVEK (2011).

Identification of hardship cases

Out of the eight analysed transport-intensive subsectors and the interviews, criteria for potential hardship cases can be deduced. The following table gives an overview. Hardship cases have to fulfil several criteria.

CRITERIA TO IDENTIFY HARDSHIP CASES	
Criteria	**Description**
Transalpine road transport intensity	Transport-intensive sectors: Companies for which transalpine road transport costs are a significant share of total costs (transalpine road transport costs have an effect on competitiveness) and with low possibilities to substitute these transports. Transport sector: The main potential hardship cases are transport companies with a focus on transalpine transports.
Time-sensitive goods	E.g. perishable produce and replacement parts are time-sensitive and require short transport times.
Just-in-time production	A just-in-time production requires high ordering and short reaction frequencies. This results in high transport frequencies. E.g. automobile industry, wholesale and retail trade.
Flexibility in transport mode	The possibilities to change transport modes are given by the specific characteristics of the goods (fresh produce, dangerous goods, etc.) and the spatial distribution of conductors and purchasers. The more sensible the goods, the wider the special distribution of purchaser and conductors, the lower are the possibilities for changing transport mode.
Share of regional short distance transalpine transports	The additional costs for regional transports within the Alpine area are above average. Potentially threatened are transport-intensive companies within or near by the Alpine area.
Company size	Because of wider diversification, big companies are less threatened than small companies with less reaction possibilities. This is true for all sectors but is in the transport sector of even higher importance.
Competitiveness	Companies which sell goods with high substitutability are more threatened than companies which supply highly specialised products. E.g. Construction companies or foodstuff producers.

Table 29 Criteria for hardship cases.

Examples of hardship cases

To assess the burden of potential hardship cases, two potential hardship cases are analysed. The examples are imaginary and constructed in order to show a maximal and not most likely burden.

Example 1: Regional carrier

The first example is a regional carrier. We assume the following:

› regional carrier within the Alpine arc
› 50% of all transports are transalpine
› the average length of transport (transalpine and non-transalpine) is 250 km
› costs per km without a traffic management instrument are for short transport relations about 2 EUR (ALPIFRET 2010).
› 20 employees
› cost increase per trip due to the traffic management instrument: 125 (2020) resp. 300 EUR (2030)

In this example, the average cost per transport before the traffic management instrument is introduced is 500 EUR. In the year 2020, the cost increase of 50% of the trips would be 125 EUR. Thus, the average cost increase per trip would be 25% (=125/500). In the year 2030, the additional costs per trip are 300 EUR and thus the average increase 60%.

Let us assume that because of the specialisation on low-value goods he can pass on 80% (and not 100%) of additional cost to the shipper.

In the year 2020, the situation is as follows: Of the additional 125 EUR, the transalpine shippers pay 100 EUR. This leads to a cost increase of 20%. Thus, the demand of transalpine shippers decreases by 10%. The carrier might not find new costumers. The turnover thus decreases by 5% and he lets one employee go. The respective profit rate decreases finally by 2.4%.

In the year 2030, the burden rises. The transalpine shippers pay 240 EUR of additional costs and their demand decreases by 25%. The carrier's turnover decreases by 12.5% and he has to let two to three employees go. For 43% of his transports he has additional costs of EUR 60. The profit rate decreases by 3.5%.

Example 2: Producer of construction materials within the Alps

A producer of high quality construction materials is located within the Alps. He is bound to his location due to the occurrence of raw materials. The customers are mainly located at the other

side of an Alpine passage and the transports are mainly made by road. We assume the following (maximal and not average assumptions):

› The share of road transport cost at total cost is about 7.5%:
  › Share of logistic costs at total costs: 10%, thereof 75% transport costs
  › all transports are made by road
› average distance to the costumers: 300 km
› because of the special requirements to the HGV, the way back is always an empty run
› the cost per km is 2 EUR
› Share of customers on the other side of the Alpine passage: 80%
› cost increase per trip due to the traffic management instrument: 125 (2020) resp. 300 EUR (2030)

Before the traffic management instrument is introduced, the average transport cost per delivery are EUR 1200 (300 km multiplied by EUR 2 multiplied by 2 ways). The cost increase in the year 2020 (2030) is EUR 250 (EUR 600). This is an increase by 21% (50%) for 80% of all transports. If no efficiency increases can be realised, the total costs will rise by 1.3% (3.0%)[9].

The calculated burden is the maximal possible burden for the company. The final burden depends on the possibility to pass on costs to cosumers, possibilities to reduce empty runs or increases capacity utilisation, the change in costumer relations (increase the share of costumers on the same side of the Alps) and the possibilities to shift transports to rail.

4.4. CHANCES AND RISKS FOR DIFFERENT REGIONS

4.4.1. RESULT OF INTERVIEWS

As the quantitative regional analysis shows, most affected are regions which highly depend on transalpine transports. These are regions in southern parts of France (in particular Rhône-Alpes), Southern Germany (first of all Bavaria), the northern region of Italy, the canton of Ticino in Switzerland, Alpine regions in Austria and Slovenia (in particular the western parts). The interviews give the following insights:

› Many interviewees mentioned potential economic impacts for Italian regions that could come along with a new traffic management instrument. If such an instrument reduces the trade flows between Italy and the rest of Europe, this will have direct impact on the Italian economy

[9] 7.5% x 80% x 21% (resp. x 50%).

(which is already faced with economic problems for the time being). Some Italian export products highly depend on high-quality transport services (e.g. high-end ceramics and tiles, other high-quality manufacturing products).

› Some regional actors pointed out the need of exemption for transports within the Alpine arc. If no exemptions are foreseen, the regional economies might suffer strongly, due to augmented proportional transport price increases for short trips than for long distance transports.

› There is no consensus if the traffic management instruments would lead to an interruption in the transalpine transport. Whereas many actors do not think that an interruption would appear, some actors fear that in the case of an ACE or AETS the cap could interrupt transports if the quality of rail services is not high enough. Another stakeholder stated that even in the case of a TOLL+ system with very high additional costs, an interruption of transport could appear, because profitability of transalpine transports would not be given anymore. Thus, in particular the economies in Alpine regions could be hurt, because transport costs which are too high might increase the risk of displacements of firms. The decrease in the regional transport volumes might push aside local carriers. Thus, the local supply of transport services might become very limited.

It can be concluded that in particular the regions on the south side of the Alps and within the Alps will be affected. In these regions higher transalpine transport prices can (in the long run) decrease the trade flows and affect the employment situation in the transport-intensive industry sectors. Two effects must be considered: First the possibility of a change in location of capital-intensive industrial companies, second the reduced attractiveness of the regions for new transport-intensive companies.

To avoid any interruption of transports, high quality rail services are of crucial importance.

4.4.2. FURTHER ECONOMIC BENEFITS FOR ALPINE REGIONS

In the interviews, only business impacts were discussed. With a broader economic perspective, some other economic benefits should be mentioned:

› **Environmental benefits:** As consequence of the traffic management instruments, road transports decrease and rail transports increase. Since the environmental impact of road transports is higher than the environmental impact of rail transports, the environmental quality of Alpine region rises. This is a chance to further develop the regions for tourism.

› **Better accessibility:** Due to new rail infrastructure and less congestion on roads, the accessibility of the Alpine regions increases. This improves the chances for tourism and enlarges the potential labour markets for local firms and inhabitants. The impact of new rail infrastructure can only be developed, if rail stops in the Alpine areas are foreseen.

4.4.3. CASE STUDY SWITZERLAND

In the interviews, the regional actors underlined the need of regional relief measures. A Swiss study analysed the regional impacts of an ACE and elaborated an overview of measures to relief regional actors (INFRAS und Metron 2011). The results of this study are summarised in this chapter.

Price increases for different transport distances and regional burdens

Within an ACE scenario, the price per Alpine passage is fixed. Thus, the price increase per km for short-distance transport is by factors higher than for long distance transport. The following figure shows the differences. The introduction of an ACE would increase the per-km price for a journey of 60 km by 100% to 200%. For the 500 km-distance journey, the price increase would correspond only by about 10%. The calculations assume that the price increase would be about CHF 180 (minimum) and CHF 340 (maximum). In the regarded ALBATRAS scenarios the price increase at the Gotthard corridor varies between 78 EUR (scenario Tolerant 2020) and 215 EUR (scenario Restrictive 2030).

COST INCREASE PER KM DUE TO THE INTRODUCTION OF ACE

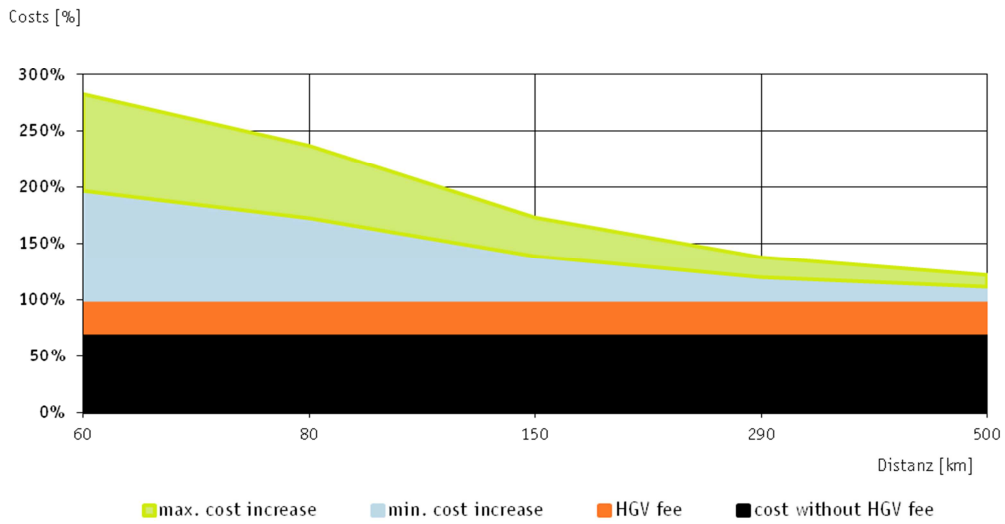
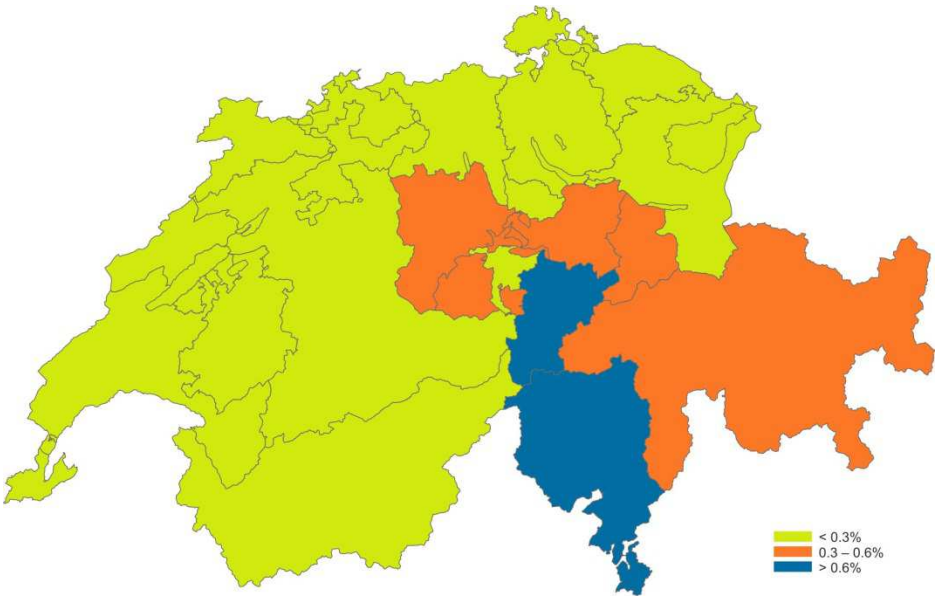


Figure 17 The figure shows the cost increase per km with an ATR-price of CHF 180 (minimum) resp. CHF 340 (maximum) for different transport distances. The calculations are based on a 40t HGV, EURO 4–6. Source: INFRAS and Metron (2011).

When the price of an ACE is about CHF 340, the burdens are distributed within Switzerland as follows:

BURDEN IN % OF THE SECTORS GVA

Transport sector



Transport-intensive sectors

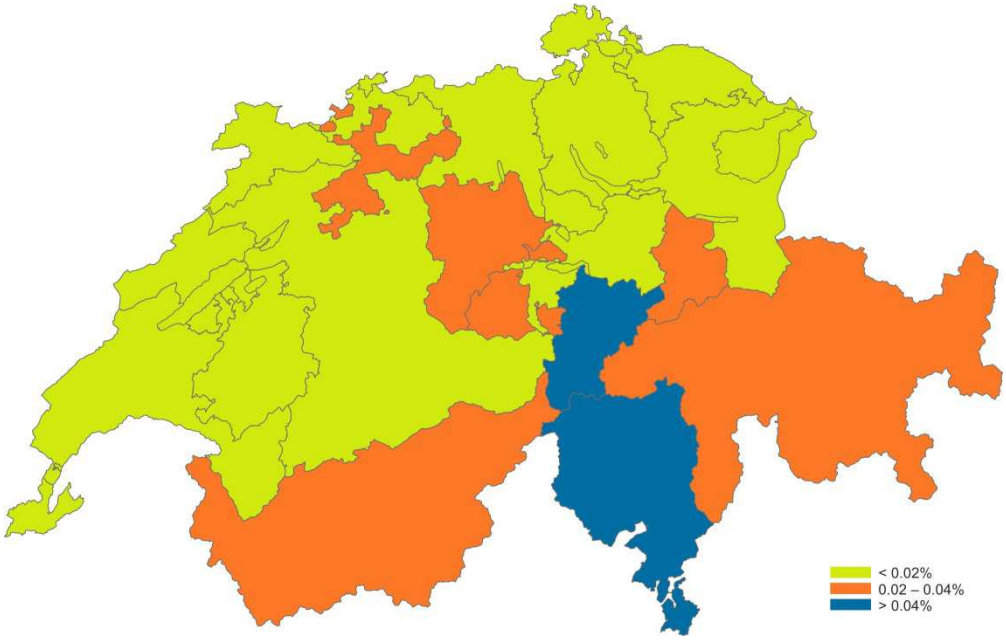


Figure 18 Source: INFRAS and Metron (2011).

Relief measures for regional transport

Mainly three options of relief measures can be discussed i) options within the traffic management instrument ii) options within the transport sector iii) compensation measures.
Within the first measure cluster, three alternatives were studied:

› **Differentiated prices for transit rights:** The approach introduces Alpine transit units (ATU). A defined number of ATU can be transferred into an Alpine transit right (ATR). The number for the regional actors is lower than for transit transports.
› **Free allocation of ATR:** A share of the ATR is not auctioned but allocated for free to the local transport actors.
› **Exemption:** The regional transports are fully exempted of the traffic management instrument.

The second measure cluster addresses the transport sector. In particular, this means the provision of rail transport opportunities for short distance transport. In the study, the introduction of a **short rolling motorway** (RMW) is discussed. Since the rail capacities are not available, these measures are not seen as appropriate.

The third cluster consists of compensation measures:

› **Redistribution to the carriers:** For short distance transports, the cost of the traffic management instrument is reimbursed.
› **Redistribution to the Alpine regions:** The Alpine regions are for each transport with origin or destination within its territory reimbursed with 50% of the cost for the Alpine passage. The regions have to spend this money for transport measures.
› **Redistribution to the regional economies:** The expenditures of enterprises in Alpine regions for ATR are reimbursed via tax reductions.

Relief potential for regional transport

Depending on the measure taken, the relief potential may differ with respect to the impact on road transport and transport-intensive sectors. The following table gives an overview of the relief mechanisms and their relief potentials. It shows that redistributions to the regions or the transport-intensive industries have low relief potential, since the mechanisms relieve all actors in a given area and not just the highly affected ones. Short rolling motorways at all Alpine corridors would request very high investments in rail infrastructure and efficient loading procedures; both would be very costly. Free allocation, exemptions and redistribution to the transport sector have a high potential to relieve the highly affected regional actors. On the other hand, the ad-

ministrative efforts have to be considered. If regional actors are fully exempted, administration might be low. The more differentiated the rules for exemption, the higher the possible administrative efforts.

COMPARISON OF REGIONAL RELIEF MEASURES				
	Relief mechanism	**Regional relief potential road transport sector**	**Regional relief potential transport-intensive sectors**	**Administrative effort for enterprises**
Differentiated prices	lower additional costs per transport	Low	Medium	High
Free allocation of ATR	fixed number of transports without additional costs (basis: historical numbers of transports)	High (given that free allocation is sufficient)	High (given that the carriers do not pass no opportunity costs)	High
Exemption	no additional cost for defined actors	High	High	Low
Short RMW	Provide an alternative to road transports	Medium (depending on quality)	Medium (depending on prices and quality)	depending on the quality of the RMW
Redistribution to carriers	additional costs are paid but reimbursed for defined transports	High	High	High
Redistribution to regions	additional costs are paid but the administrations of the regions are compensated	Low	Low	Medium
Redistribution to economies	additional costs are paid but the economies of the regions are compensated	Low	Low	Medium

Table 30

INFRAS and Metron (2011) have calculated the reduction of the regional burden for the following measures in Switzerland: differentiated prices, free allocation, exemption and redistribution to regions. It is assumed that all transports with lower distances than 150 km profit from this

measure. In the measure free allocation it is assumed that the free allocation corresponds to the number of transports. This leads to the following findings:

› The relief potential of all measures is for many highly affected regions considerable.
› The burden relief is higher the higher the share of transports with less than 150 km at the total number of transports with origin or destination in the region. This is highly dependent on the structure of the regional economies. Whereas in the Canton Uri about 80% of all transports are shorter than 150 km, in the MS region Lugano only 2% of all transports are shorter than 150 km but in both regions the initial burden is of the same magnitude.
› Unsurprisingly, differentiated prices lower the burden less than the other measures. The higher the difference in the number of ATE used for an ATR between regional and long distance transports, the higher the regional relief.
› The relief potential of the other measures equates the share of transports fewer than 150 km.
› Would the distance of regional transports be augmented, the southern parts of the Canton Ticino could also be relieved more.

The second very important question is, whether relief measures reduce the effectiveness of the instrument. Given the fact that regional transports rarely have a modal shift potential, relief measures in favour of regional transports should in general not reduce effectiveness significantly. If rail is no option, regional transports can only pay the additional costs or avoid the transport. Assuming that the potential to avoid transport is small, the reduced effectiveness of the traffic management instrument is with all measures low. Nevertheless, the incentive to avoid transports is the lowest with an exemption or redistribution to carriers, somewhat higher with differentiated prices and the highest with a free allocation of ATR or redistribution to the regions or the regional economies.

The short rolling motorway has another effect. It does not reduce the cost of transalpine road transports, but gives a new rail alternative to regional transports and thus supports modal shift.

Transferability of the relief measures to the other traffic management instruments and other countries

The discussed study is written for the case of an introduction of an ACE in Switzerland. This raises the question if the relief measures can be transferred to the other regarded traffic management instruments and to all countries analysed in this study. The following table gives an

overview of aspects to be considered, when the relief measures are transferred in another context:

TRANSFERABILITY OF RELIEF MEASURES			
	to AETS	**to TOLL+**	**to other countries**
Differentiated prices	The instrument already differentiates the additional cost according to transport distances.	The instrument already differentiates the additional cost according to transport distances.	transferable without conditions
Free allocation of ACP	transferable without conditions	Instead of transferable rights a fixed number of free TOLL+ coupons could be given to the carriers	transferable without conditions
Exemption	transferable without conditions	transferable without conditions	transferable without conditions
Short RMW	transferable without conditions	transferable without conditions	The preconditions with respect to the existing rail infrastructure are very different
Redistribution to carriers	transferable without conditions	transferable without conditions	transferable without conditions
Redistribution to regions	transferable without conditions	transferable without conditions	A federal system is required
Redistribution to economies	transferable without conditions	transferable without conditions	If regional taxes are not important, the implementation is more complex.

Table 31

4.5. PRECONDITIONS FOR STRUCTURAL CHANGES

As discussed in chapter 4.1.2, there are several barriers regarding structural change in the transport sector. Interview partners mentioned many accompanying measures which would help to overcome these barriers. The measures can be clustered in three big groups:

a) Measures on rail supply,

b) organisational measures,

c) measures to assure feasibility/functioning of the traffic management instrument.

Measures on rail supply

Interview partners mentioned the "general aspects" (increase of capacities, equality in the treatment of freight transport, terminals, 4m corridor, quality improvements, harmonising extension

of allowed length of trains, etc.). In addition, some more specific ideas on accompanying measures were named:

› In many interviews the need for international harmonisation of technical aspects is mentioned. Moreover, to increase the quality of rail freight transport, priorities in favour of freight transport are required.

› When developing the accompanying rail measures, the interplay between the different rail transport modes needs to be considered. One interview partner clearly mentioned that the different transport modes should not be played off against each other, especially rolling motorway and unaccompanied combined transport. Another one stated contrary that accompanying measures should focus on unaccompanied combined transport solutions as this is the most efficient solution with the greatest potentials. A further support of rolling motorway services would be counterproductive as it reinforces existing logistic structures and does not set the right incentives.

› Terminals: One interviewee mentioned that the big sea ports could provide best practice examples on how to improve terminals (e.g. logistic processes in terminals, advance reservations for quick handling, disentangling of pre- and post-carriage).

› Two interview partners mentioned the importance of branch line in the transport of individual wagons and the central role of subsidies for branch lines.

Accompanying organisational measures

› Further developed tracking-and-tracing methods are seen as necessary by most stakeholders, especially regarding an improvement of the transport chain and to provide transparency to shippers.

› Freight platforms are seen as less important as they are mostly used for the spot market. The large share of transports is however still conducted with long-time contracts.

› Two interviewees emphasised the need of pooling measures in the rail sector. One of them stated that in particular for an efficient operation of the combined transport a minimal regional economic strength is required. Where the regional economic potential is too low, pooling measures are needed. The other interview partner mentioned the potential of further “pooling solutions” for smaller carriers. These pooling solutions are up to now not very popular which is also due to the existing structures of the transport market. With cost pressure increasing, pooling solutions might become more popular.

Accompanying measures to assure the functioning of the instrument

› Emergency plans for the traffic management instrument, e.g. if one corridor is closed due to an accident. If the permits are allocated per corridor, the emergency plan will have to state how to exchange these permits and which number of permits can be shifted to other corridors.

› Transparency of auctions/trading: Especially the smaller operators and the lobbying groups fear that the auctioning and trading mechanisms of an ACE/AETS would not be transparent for smaller stakeholders and that large actors would dominate the market. One interviewee stated his fear that for example large logistic service providers could dominate the market of allowances and could then "dictate" their conditions for Alpine crossing transports to their contractors. It would thus be necessary to provide transparent information for small carriers and to ensure their involvement in a trading market.

› Actors from areas within the Alpine area emphasised the need of exemptions for import-, export- and internal transports. One of them pointed out that rail is no option for transports below 200km.

5. DYNAMIC ECONOMIC IMPACTS

5.1. METHODOLOGY

The quantitative analysis so far has focussed on the direct burden based on the ALBATRAS model calculation without integrating the effects of revenue use. The ASTRA model completes the analysis. ASTRA is a well-established model elaborated by Fraunhofer-ISI, Karlsruhe, and has been used for several economic analyses in the field of transport, climate policy and renewable energies on the European scale. The architecture of the model is shown in detail in Annex 3.

ASTRA contains passenger and freight transport models. The major transport indicators produced by the models are the transport performances by mode as well as the vehicle-kilometers-travelled (VKT) by mode. Based on these indicators economic indicators are derived (e.g. transport expenditures, fuel tax revenues, road charging revenues) and linked with the economic models. Therefore the model runs are as well a plausibilisation of the ALBTRAS model runs, since ASTRA models the transport flows and instrument related reactions autonomously.

The core of the transport models is a classical four-stage transport model (see Ortuzar/ Willumsen Modelling Transport, 1998/2004) with a very limited assignment component (4^{th} stage). However, the first three stages act in an integrated and dynamic way, i.e. at none of these stages (generation, distribution, mode choice) are any assumptions defined that presuppose structural stability.

The generation stage of the freight model is divided into two parts:

(1) Domestic transport is generated from the sectoral production estimated by ASTRA. The monetary values are converted into volumes in tonnes that are differentiated into three goods categories (bulk, unitised, general cargo). In the distribution stage, of course, changes may stem from domestic generation, but more important would be the impacts on aggregated generalised transport cost between any origin (O) and destination (D) in each country, where O and D stand for four types of different NUTS-II zones per country (metropolitan, high density, medium density, low density). The distribution assigns the volumes then onto four different distance bands.

(2) International freight transport is derived from the ASTRA trade model converting the monetary trade flows into volume flows. Trade flows depend on the GDP of the importing country, relative sectoral productivity changes between importing and exporting country

and the aggregate generalised cost between the two countries. This means, for international transport generation and distribution are handled by the trade model, which is sensitive to aggregated generalised cost.

The aggregated generalised costs affecting both the domestic freight transport and international freight transport consist of monetary costs and time costs and thus represent an accessibility measure for each European OD-relation. This structure of the freight model is shown in Figure 19.

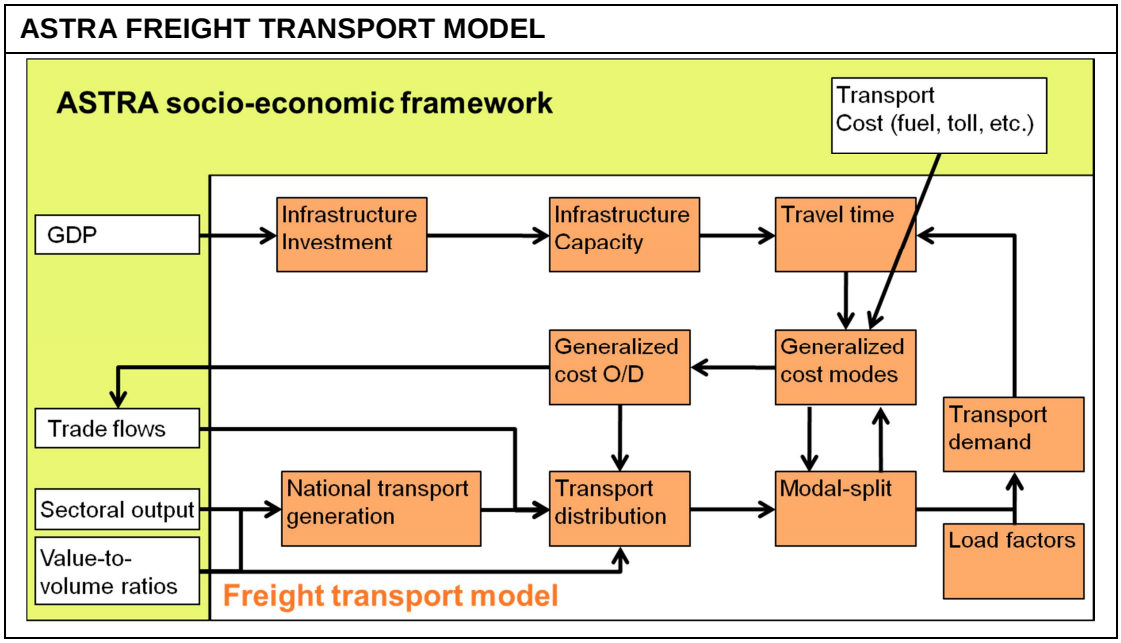


Figure 19 ASTRA freight transport model. Source: Fraunhofer-ISI

Policy implementation for the EFFINALP study in ASTRA has to take place on the OD-matrix structure defined by the ASTRA model. A five step approach was chosen, in which four steps belong to the implementation and one additional step to verification:

1. In the first step the original NUTS zones used in ALBATRAS needed to be assigned to the functional NUTS-II zones of ASTRA. Based on this assignment the data on transport volumes and changes in the scenarios was calculated.
2. In the second step the shares of the different Alpine routes on all European OD-pairs were calculated and a weighted average of the additional costs per ton was used to estimate the cost increase for the ASTRA OD-pairs.

3. In the third step the according cost increase of each OD-pair caused by the policy was added to the total cost of transport between O and D. This will then affect the (aggregate) generalised cost in ASTRA, the modal choice, the distribution, the trade flows and via the economic feedbacks possibly also the generation of transport demand.
4. Further, the additional toll revenues for long distance OD-pairs that are crossing Swiss, French or Austrian territory were calculated and according to the share on the three transit countries distributed between these countries, as ALBATRAS provided toll revenues on a link base, only, where a link could require toll payments in more than one of the countries.
5. In the fifth step the estimated toll revenues were compared with the revenues estimated by ALBATRAS and in previous sections of this report. As the revenues were well-aligned we assumed that the policy implementation in ASTRA is adequate.

5.2. BEHAVIOUR OF THE ASTRA MACROECONOMIC MODEL

By adapting the transport demand and the transport expenditures the pricing policy will stimulate a number of impact chains in ASTRA, as shown in Figure 20. Most relevant for a pricing policy focusing on freight transport should be

(1) the effect that transport inputs as a production factor in non-transport sectors increase changing the structure of their intermediate inputs and consequently also value-added and employment.

(2) the change of generalised cost is causing impacts on trade flows, though a cost increase may be compensated by time savings e.g. if transport is better organised as a response to the cost increase or if revenues from the pricing policy are used to increase the infrastructure capacity.

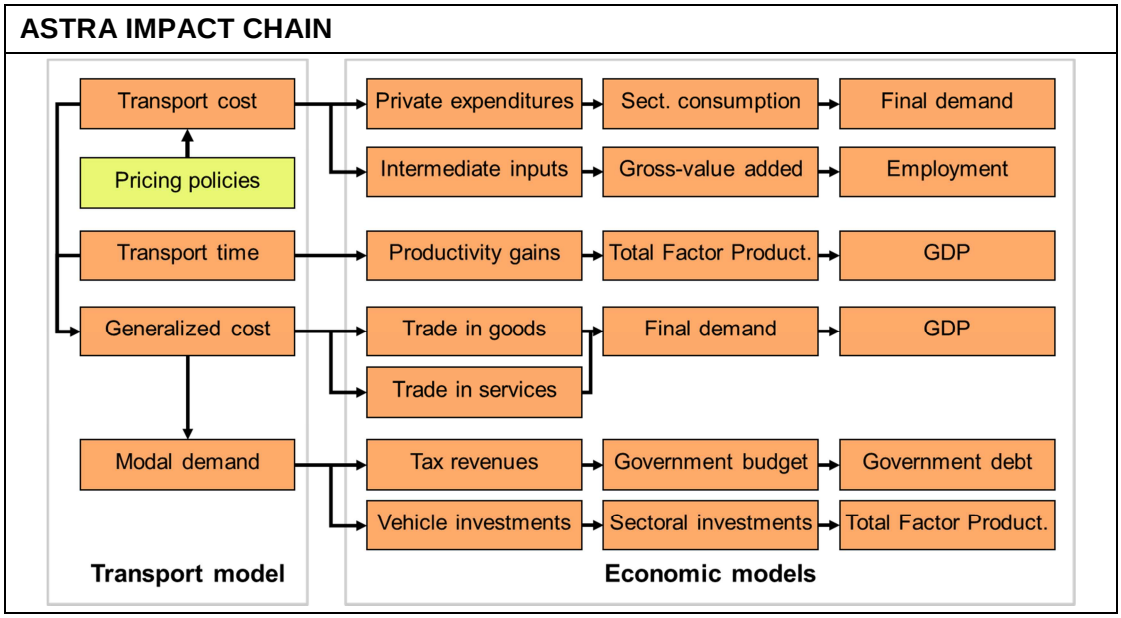


Figure 20 Effects of a pricing policy on economic models in ASTRA (excluding the revenue use)

The previous effects will occur endogenously in the model. However, concerning the use of the revenues generated by the pricing policy a choice has to be made. Options to refund the revenues are:

› Invest in new infrastructure e.g. rail tunnels. Investments could further than be satisfied by domestic sectors (e.g. construction sector, electronics sector) or by imported goods and services from this sector.

› Refund the revenues via a reduction of indirect taxes e.g. VAT.

› Refund the revenues via a reduction of direct taxes providing households with additional income that can be used for consumption..

› Keep the revenues within the government budget e.g. such that government debt can be reduced.

It would also be feasible to mix the usage of revenues between the four options e.g. use 50% for investments and 50% for reduction of direct taxes. From previous experiences reduction of direct taxes was the option that stimulated best the economic development. In all options further indirect economic effects will be kicked off as shown exemplarily by Figure 21.

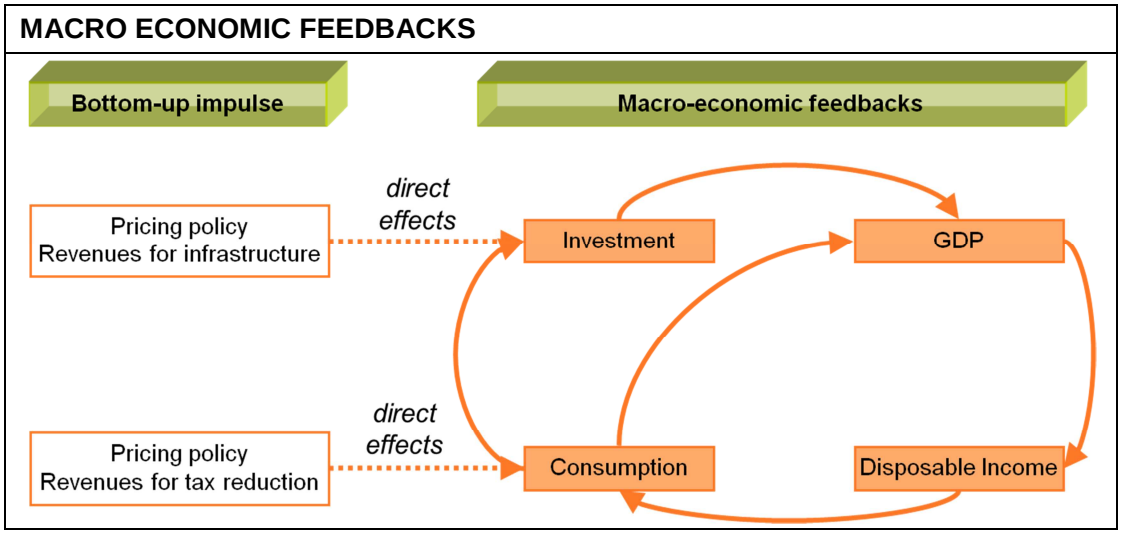


Figure 21 Effects of different uses of revenues in ASTRA

5.3. ASTRA SCENARIO RESULTS

The ASTRA model in EFFINALP applied a scenario BAU for the years 2020 and 2030 that is derived from the iTREN-2030 reference scenario (Fiorello et al. 2009) and thus is comparable to the baseline in this study building on ALBATRAS and iTREN-2030, as well. On top of this BAU scenario the two charging scenarios, tolerant and restrictive were implemented, such that in 2020 the tolerant scenario was achieved (0.29 EUR/km) and in 2030 the restricted scenario (0.80 EUR/km). As the purpose was to isolate the impact of charging and not of infrastructures the tolerant scenario was compared with the BAU scenario with the infrastructure status of 2020 and the restrictive scenario with the BAU scenario of 2030. For each scenario three different variants for refunding were tested: no refund i.e. money goes into the government budget, refund via direct tax reductions, refund via VAT reductions. The following Table 32 presents the **seven scenarios prepared by the ASTRA model.**

IMPLEMENTATION OF SCENARIOS IN ASTRA				
Scenario	**Description**	**Usage of additional revenues**		
		Government budget	Refund via direct tax	Refund via VAT
BAU	High level scenario that has been chosen for the analysis represented by the iTREN-2030 reference scenario	Baseline (2020, 2030)		
Tolerant 2020	Inputs to ASTRA based on: ACE for CH–I, AETS for A-I and TOLL+ for F-I. Infrastructure as implemented until 2020.	TOL-GOV	TOL-TAX	TOL-VAT
Restrictive 2030	Inputs to ASTRA based on: Surcharges on existing charges per km based on additional external cost in Alpine regions. Infrastructure as implemented until 2030.	RES-GOV	RES-TAX	RES-VAT

Table 32 study set-up of scenarios for ASTRA.

The first element to be looked at is the additional revenues through the price increases in the EFFINALP scenarios. These increases have been added on top of the cost per km implemented in ASTRA in the BAU scenario, as explained in section 2. The ALBATRAS study has estimated cost increases for specific corridors and linked these corridors with three Alpine countries (see Table 2). Following the ALBATRAS study the estimation of revenues in ASTRA has been linked with these three countries: Austria, France and Switzerland. Table 33 presents the additional revenues generated on country level by this approach. The assignment to country level is relevant to decide later on, whom of the governments or tax payers will benefit from the additional revenues. In principle, it is possible to take a political decision about the distribution of the additional revenues amongst the Alpine countries. Different options would be:

- to assign the revenues to the countries where they accrue. (1) In ASTRA modeling terms and following the ALBATRAS assignment this would be Austria, France and Switzerland. (2) Depending on the actual implementation of the infrastructure the share of infrastructure on the territory of a country could be applied as criteria for distribution of revenues. (3) the revenue could be distributed according to shares of transport demand on the territory of a country.
- To take a political decision about the distribution of the revenues between countries. Such a decision should take into account in which countries economic benefits or disbenefits accrue as well as where the positive health and environmental impacts occur.

In ASTRA the revenues where used as estimated in modeling terms and following the ALBATRAS cost estimates (see Table 33).

ADDITIONAL REVENUES BY POLICIES				
Scenario	**Additional revenues compared with BAU (annual)**			
[million EUR]	Austria	France	Switzerland	Total
Tolerant 2020	195	236	126	557
Restrictive 2030	535	656	409	1600

Table 33 Additional revenues generated in the scenarios (source : ASTRA).

The total of these revenues is comparable to the ALBATRAS estimates with slightly higher values in ALBATRAS for scenario Tolerant 2020 (661 vs 557 million EUR/a) and slightly higher estimates in ASTRA for scenario Restrictive 2030 (1600 vs. 1271 million EUR/a). On country level the ASTRA levels are lower for Austria, which in ALBATRAS seems to include some revenues occurring in Italy and Slovenia and higher numbers are estimated, for France.

In ASTRA a reduction of GDP is estimated for the scenarios, as shown in Figure 22. The largest absolute decrease in 2030 is in Italy and France, though for France the refunding strategy compensates part of the reduction (see Figure 23), while the relative decrease is similar in France and Austria in the order of 0.04% for the tolerant scenarios and 0.16% for the restrictive scenarios. The largest relative decreases can be observed for Slovenia (0.33%) and Italy (0.25%). Looking at the numbers one should have in mind that positive effects caused by the infrastructure investments, i.e. the investment stimulus itself as well as the time improvements of the new infrastructure, have been eliminated on purpose by the set-up of the scenarios. Thus the reductions can be assigned to the increased road tolls.

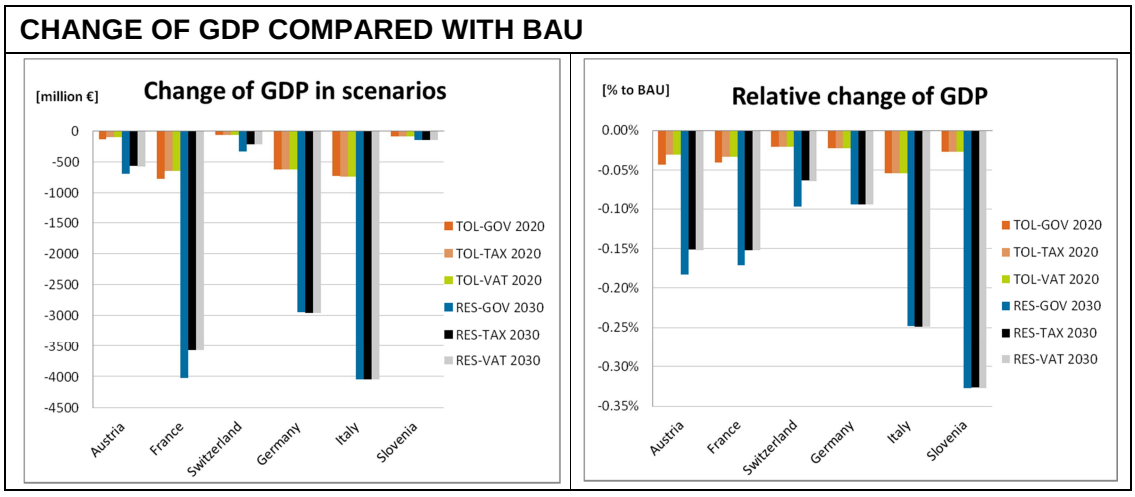


Figure 22 Impact on GDP in the Alpine countries (Source: ASTRA).

Figure 23 presents the impact of the refunding strategy on GDP. Refunding mitigates part of the negative impact on GDP, but does not compensate completely. Between 0.019% (France) to above 0.03% points (Austria, Switzerland) of the GDP loss in scenario Restrictive can be compensated in 2030.

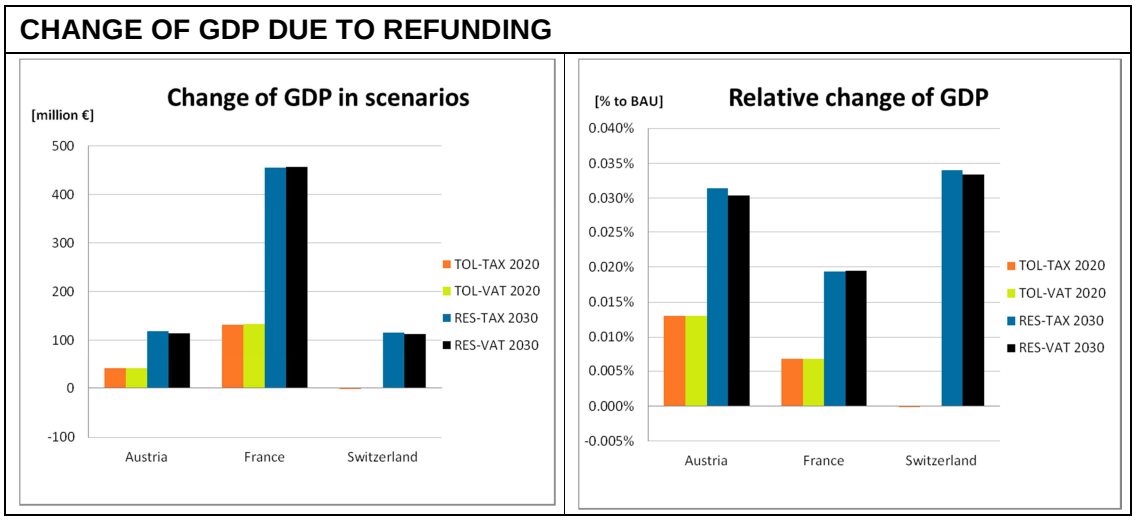


Figure 23 Impact on GDP due to the refunding strategy (Source: ASTRA).

The negative impact on GDP develops through the reductions of trade volumes into the economic system. These are caused by the transport cost increases. The countries stronger affected are Austria and Italy, for which exports are reduced by about 0.6% and 0.5%, respectively. The reductions of exports are then translated into reductions of sectoral output and GDP. Comparing this finding with ALBATRAS the reduction of volumes (exported tonnes) seems similar, but the reduction of value flows would be higher.

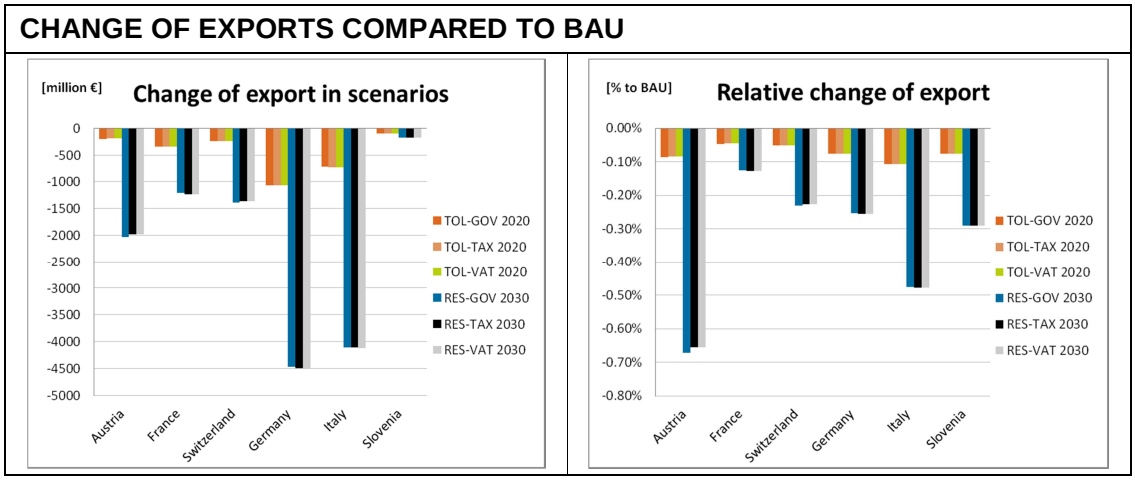


Figure 24 Impact on exports in the Alpine countries (Source: ASTRA).

However, the slight reduction in GDP does neither in all countries nor in all scenarios lead to a potential reduction in employment, as on a sectoral level the impacts vary, such so that in some countries winning sectors compensate for employment losses in other sectors (see Figure 25). In the end Italy could be most affected in terms of employment losing about 0.35% of employment in the restrictive 2030 scenario due to its reduced exports affecting more labour intense sectors than in other countries. All other countries remain at levels of losses of 0.06% after refunding the revenues in the restrictive 2030 scenario. Without refunding also in Austria the employment loss would be more significant reaching about 0.17% in restrictive 2030 scenario.

About 40% of the employment reduction in Italy occurs in service sectors (excluding transport services). Choosing different refunding strategies should also partially mitigate the dampening effect on employment in these sectors. Thus a sensitivity test was carried out to assign 50% of revenues from Austria and France to Italy, i.e. about 200 million € in scenario Tolerant 2020 and about 600 million € in scenario Restrictive 2030. Such a compensation measure would improve the impact on Italy such that about one fourth of the potential employment loss would be avoided. At this point it should be pointed again on the scenario set-up that isolates the impacts of the pricing strategy, but neglects on purpose the positive impacts of the infrastructure implementation. On this side, it can be expected that Italian exports over-proportionally would benefit from these improvements, such that compensation of the pricing strategy for Italy should rather be expected from transport improvements through better infrastructure than from the compensation by additional revenues.

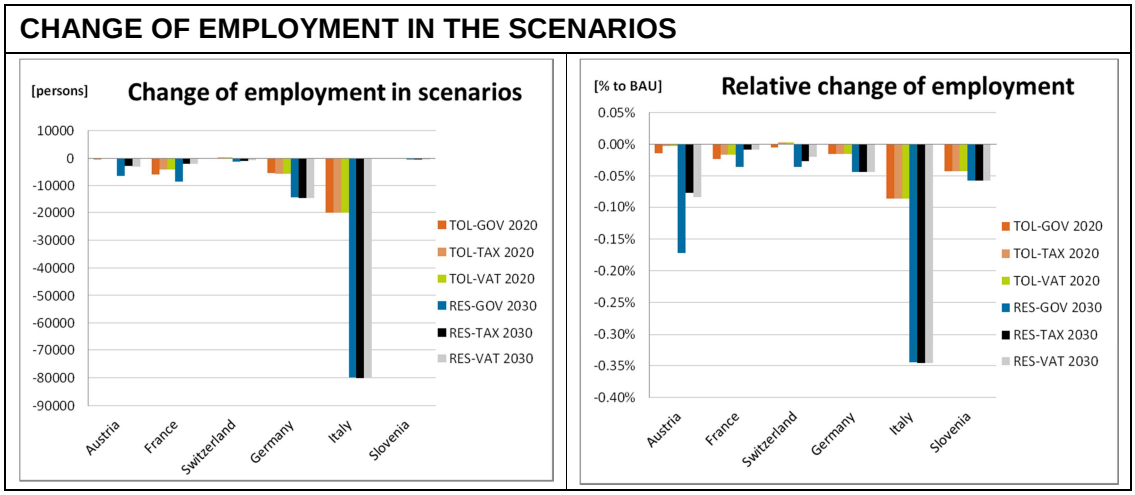


Figure 25 Impact on employment (Source: ASTRA).

Looking at the sectoral level it can be observed that additional employment is generated in the transport services sector, due to increased demand for rail services and logistics services as transport demand shifts from road to rail and intermodal services (see Figure 26). The manufacturing sector and the construction sector are reducing employment in all scenarios and all countries.

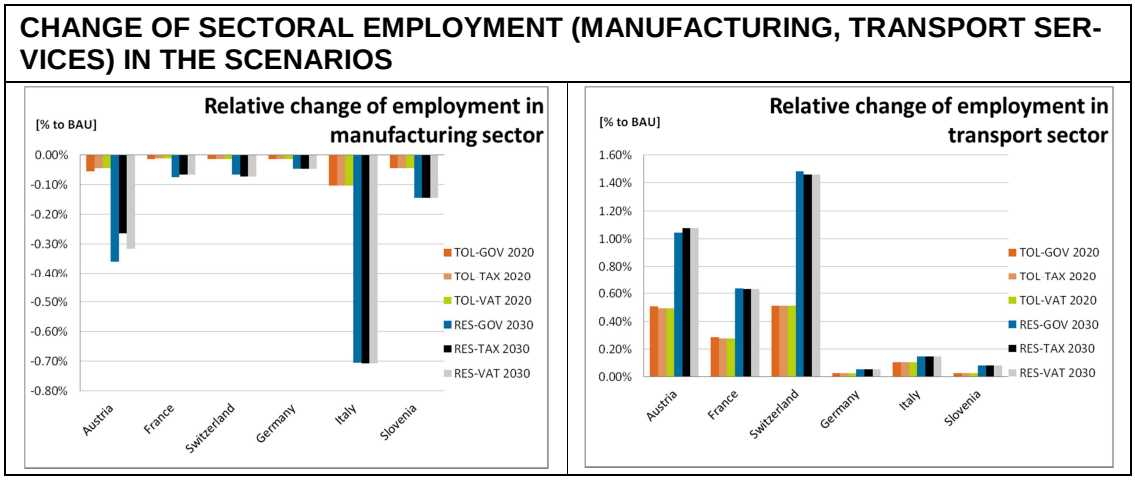


Figure 26 Impact on employment in manufacturing and transport services sector (Source: ASTRA).

The bottom-up analysis presented in the previous sections did not identify an increase of employment in the transport service sectors as estimated by ASTRA (right side of Figure 26). The reason seems to be that the average productivity levels of road and rail mode differ in ASTRA as compared with the bottom-up analysis. In ASTRA the rail sector is about one fifth less productive than the road sector, while in the bottom-up analysis this ratio differs and is country

specific. Looking at the tables of GVA and employment in Chapter 2.5, one can derive the productivity in € per employed person for the different countries. In Switzerland the road sector would be more productive than rail sector, as in ASTRA. In France and Italy the rail sector is slightly more productive, while in Austria rail would be significantly more productive than road sector.

It was also verified if the modal-shift away from road would cause significant losses of fuel tax revenues that would compensate for the additional revenues from the tolls. Losses of fuel tax revenues could be observed in the order of 3 to 50 million EUR annual in 2030 for the different countries, but actually they were one order of magnitude smaller than the additional toll revenues.

Differences between ALBATRAS and ASTRA emerge as ASTRA always estimates the net effects. One example would be sectors that depend largely on consumption expenditures, like trade or other market services. In ALBATRAS the transport cost increases directly lead to increases of product cost assuming forwarding the cost impacts or in reductions of value-added of the affected sectors. However, the consumption budget of households is assumed to be constant. In ASTRA the product cost increases as well, but there would also be a second impact, where the reductions of GDP lead to reduced disposable income and thus to decreasing consumption expenditures. Such an indirect effect would not be part of the ALBATRAS estimations. Also spending behavior of households differs between sectors, such that the sectors are affected to different degrees by consumption changes. Typical sectors in ASTRA that reduce GVA and employment as a consequence of reduced household consumption would be trade, catering and other market-services, which in the case of Italy would bear about half of the employment reduction.

Other sectoral specifics relate to the structure of national economies. The textile sector in all six countries is amongst those whose exports react most sensitive to the cost increase by the policies. In relative terms the reduction is larger in Austria, Switzerland and Slovenia than in Italy. However, Italy by far disposes of the largest employment in the textile sector such that in absolute terms the reduction of textiles exports causes the largest reduction of employment in textile sector in Italy. In Austria, France and Switzerland other sectors in which exports are dampened significantly by the policy in relative terms would be minerals, ores and plastics products, that are all sectors with lower value density and comparably higher weights and thus sensitive to

transport cost increases. Again these are also sectors less important in these economies. However, in Italy the sectors responding more sensitive to the cost increase would be vehicles, semi-finished metal-products and agriculture products. Basically these are more important sectors in terms of value-added and employment than those stronger affected in the other three countries, such that the estimated stronger net reduction of employment in Italy than in the other countries seem to be the sum of the described sectoral impacts: (1) second round effect on consumption affecting specific service sectors, (2) specific importance of textiles sector in Italy, and (3) cost sensitivity of Italian exports of vehicles, semi-finished metal-products and agriculture products.

6. CONCLUSIONS

6.1. INTERPRETATION OF THE RESULTS

Regional and sectoral burdens

The quantitative regional analysis gives the following insights:

› The analysis is based on the assumption that the price increase of the traffic management instruments is leading to additional burdens for different economic sectors. In this analysis the revenue of the market based instruments is not considered. The scenario Restrictive (based on the ALBATRAS scenario TOLL+) leads to the highest impacts and can be seen as a worst case scenario.

› In the average of all regions regarded, the economic impact of the introduction of a traffic management instrument in the alpine region is relatively low but still economically significant.

› The burden differs between the sectors. The highest burden has the road transport sector to bear, followed by the transport-intensive sectors. In the scenario with the highest impact (scenario Restrictive 2030), the burden of the transport-intensive sectors corresponds by average to 0.13% of its GVA of all regions considered. The relative burden of the road transport sector is with 1.28% in scenario Restrictive 2030 about ten times higher than the relative burden of the transport-intensive sectors.

› There are significant regional differences for all sectors. They are more important than the vulnerability of specific sectors (besides the transport sector as a whole). The southern regions and regions within the alpine arc will be more affected than the northern regions.

› Due to the scenario assumption that the cost per passage is not depending on the distances driven, the short distance transports have to carry a higher relative burden than long distance transport (in % of overall transport costs). In addition, their possibilities to shift transport from road to rail is limited. If short distance transport would get lower charges (e.g. km-dependent), the burden of alpine regions would decline by some 20% by average.

› Based on these results it becomes clear that the overall economic effect is less relevant than specific cases of hardship in the most affected regions;

› The economic effects in the transport sector are based on the modal shift assumptions elaborated by ALBATRAS. Thus, the economic loss in the road transport sector is in big parts outweighed by the economic gains in the rail transport sector. The gains have also to consider the value added chain, e.g. the logistics sector where rail-oriented parts will profit from these gains.

Qualitative assessment

› Today the traffic management instruments are not widely known. Stakeholders should be more involved in additional discussions regarding a common traffic management instrument. The ACE and AETS are seen as a rather complex mechanism which creates a 'defensive attitude'. If these instruments will be further discussed, the specific mechanisms have to be communicated more transparently to remove the existing fears from the stakeholders.

› Overall, the interviews provide a coherent picture. The answers differ not significantly between different kinds of stakeholders or different countries. The aspect with the greatest discrepancy between answers was the aspect of efficiency improvements: while larger operators see some potential for further improvements, smaller operators feel that all potentials are already used due to existing cost and competitiveness pressures.

› The interviews have made clear that planning security is a key aspect: transport operators need a clear signal regarding future political framework conditions. Links and trade-offs with other instruments need to be considered, especially regarding incentives for optimising the vehicle mix (current framework conditions focus on Euroclasses, AETS could focus on CO_2/fuel use which is not improved with Euro 6).

› Rail infrastructure and rail mode today do not meet the requirements for shifting a large share of international transalpine transport to rail and for using chances for structural shifts, especially in the trailer market. Crucial points are better punctuality, more international harmonisation and more flexibility (e.g. 4m corridors, higher capacities). The interviewees mentioned also that the quality of rail modes is not in every country the same. For example one Swiss stakeholder mentioned that a share of national transports might be shifted to rail but because of quality reasons this would not be true for international transports.

› The regional economies in alpine areas are more affected by the traffic management instruments as regions outside of the alpine area. Because of the high economic impact and the often missing alternatives to road transports, relief measures for these regions are of crucial importance to boost the acceptance of the traffic management instrument.

› Road operators have a negative attitude towards all three instruments, but state that a TOLL+ system would be the 'lesser evil'. Operators of combined transport prefer a cap-and-trade instrument as this gives the clearest signals towards modal shift. However, an AETS would also be effective if it would provide clear signals to use all avoidance options.

Overall long term economic impacts (ASTRA model runs)

› The figures computed within the quantitative regional analysis only consider the additional burden, but no specific costs of adjustment processes or compensatory effect due to use of revenues. The ASTRA model runs are completing the picture of economic impacts including such effects.

› The overall effects lead to a reduction of GDP. Within the tolerant scenarios 2020, the reduction is minimal, especially if the income is used to reduce taxes. If the structural shift in the transalpine transport sector (e.g. from road to rail) is not possible, the reduction is considerably more relevant for 2030 and within the restrictive scenarios, especially for Italy and Slovenia. The overall magnitudes are however less than 0.4%. Some structural effects might however be significant, e.g. employment gains in transport service sectors or employment losses in labour-intense and export-oriented industries. It could also be confirmed that refunding the revenues of the pricing policy to consumers would have a positive impact, though it did not make a difference if the refunding occurred via reductions of direct taxes or via reductions of indirect taxes.

› The scenarios concentrate on the pricing impact and do not consider possible positive effects of the realisation of improved railways such as the base tunnels at Brenner and Mont Cenis. Considering these investments, the overall effects on GDP could be positive.

› The results suggest that it would be very important to allocate the revenues fairly so that all alpine countries can profit considering the different level of burdens.

6.2. WELFARE CONSIDERATIONS

From a welfare economic point of view, one can state that the economic effects would be negative if the related prices of the traffic management instruments are above external costs. Therefore it is useful to compare the price changes computed for the different scenarios with external cost calculations. In order to apply existing practice, three values of external costs are considered:

› The chargeable environmental cost based on the revised Eurovignette Directive dated 27.9.2011.

› The resulting cost by applying the values for environmental costs within the handbook on the estimation of external cost in the transport sector (Maibach, Schreyer et.al. 2007). The value for climate change has been varied considering as well a higher value.

› The cost resulting by applying the values for all type of external costs (including accidents and congestion) based on the handbook. This estimation is similar to the calculation of the Swiss HGV fee.

The following table compares these values (for Alpine regions) with the prices per km for the different scenarios.

COMPARISON OF CHARGES WITH EXTERNAL COST		
	Value in €cent per km	
Charges scenario Tolerant	2020 2030	11–16 34–60
Charges scenario Restrictive	2020 2030	29 80
Chargeable external cost based on revised Eurovignette Directive (max. value night)	2005	6.3
Total environmental costs acc. to handbook (max. value night)	2005	18–22
Total external accident, environmental and congestion cost acc. to handbook (max. value day) for comparison: Swiss HGV fee (40 tonne truck EURO V)	2005 2012	54–109 75

Table 34 Source handbook 2007, own calculations.

Although a direct comparison is difficult due to different time horizons and specific traffic situations, one can state the following: Compared to the cost rates of the revised Eurovignette directive, the price changes (esp. of restrictive scenarios) are significantly above external costs. Compared to the cost rates of the full external cost calculation (according to the handbook and the Swiss HGV fee), the price signals are of a similar magnitude. However, it has to be considered that in Switzerland the prices would be on top of the existing HGV fee (which already internalises the external costs for the distance driven in Switzerland)

6.3. CONCLUDING REMARKS

Based on the different analytical steps the following conclusions can be drawn:

› The lower the possible price increase of the new transalpine management instrument, the better the (rail) alternative and the better the anticipation of the possible mechanisms by the economic actors, the lower the risks of negative economic impacts. The introduction of a restrictive

system without a considerable improvement of rail capacity and quality in freight transport might lead to considerable economic risks.

› The distribution of impacts is more critical than the level of impacts. Notably, small road transport operators in alpine regions and some transport-intensive industries might face excess burdens leading to structural changes.

› The instruments influence economic effects firstly by the level of restriction (e.g. choice of thresholds and price increases respectively). Secondly, however, there are possible design parameters for each instrument which are able to minimise excess burdens and unwanted effects, such as an over proportional burden for short distance transalpine transport and alpine regions.

Preconditions to minimise losses and to maximise benefits

There are the following crucial factors to consider:

› Incentives to increase road transport efficiency: Although at first sight, the potential in the road transport sector to increase efficiency is limited, the instruments should be able to maximise the incentives to improve loading factors and fleet performance without creating detours and unwanted shifts between alpine passages.

› Quality of the rail alternative: The most important challenge is to improve rail quality especially on a transnational scale at the national borders. Until 2020, the realisation of potentials is most significant at Swiss corridors (with the two base tunnels at Lötschberg and Gotthard) and at the Brenner axis (with 4 tracks between Munich and Verona). Between 2020 and 2030, the realisation of the two planned basetunnels at Brenner and Mont Cenis are supposed to create new potentials to improve transnational capacity and interoperability. At the same time, these investments create new potentials for GDP and employment increase.

› Introduction of specific relief and flanking measures: the analysis has shown clearly that the burdens of alpine regions might be above average if short distance transport will not be treated separately and specific relief measures will be introduced. Without such measures, the regional acceptance will be very low. The analysis has also shown that there are different policies available. Possible economic losses might also be reduced by introducing the traffic management instruments smoothly and well-prepared for the stakeholders involved.

  Besides, the most important flanking measures should support a boost for combined transport. Such measures are related to terminal planning and financing, to support pilot projects and specific supplies in addition to on-going EU and national programmes and efforts.

› Use of revenues: The use of revenues firstly depends on the design of each instrument analysed. In any case, there is potential to equal the different burdens by using parts of the revenues to compensate countries or regions especially south of the Alps.

Further development of instruments

The analysis has shown that there are risks and chances for the alpine regions and the transalpine transport system at the same time. The further elaboration of possible transalpine traffic management systems should further evaluate the following elements especially:

› Definition and development of thresholds: One important advantage of common transalpine traffic management systems is harmonisation. It will create transparency and synergy potentials for the transport system as a whole. The additional analysis should try to focus on the rationale and the definition of common thresholds coordinated between alpine countries and their passages.

› Optimisation of design: According to the proposals made above for relief and flanking measures and use of revenues, the additional analysis should try to concretise the potentials for optimal designs in order to prevent from unwanted effects.

› Focus on chances: The economic analysis carried out within this study is not able to focus on all benefits properly, since many effects are not linked with direct economic impacts, such as the increase of quality of life and the reduced risk of environmental costs. In addition, chances for rail and combined transport sector and chances for the alpine regions facing road freight traffic reduction (and better accessibility for passenger transport) and environmental improvements could be analysed (e.g. by case studies) more in-depth.

› Communication: Finally, it has become clear (especially with the stakeholder interviews) that knowledge especially about the new cap and trade systems is very limited. Focused communication and information on the design and the functioning of such instruments might help to improve the understanding (and the related chances) of the mechanisms and to improve acceptance for new instruments.

ANNEX

ANNEX 1 QUANTITATIVE REGIONAL ANALYSIS

ECONOMIC DATA BAU 2020: GROSS VALUE ADDED

GVA PER REGION AND SECTOR BAU 2020
(in million EUR, Pricelevel 2000)

NUTS-Code	NUTS_Name	Agriculture	Energy and Manufacturing	Construction	Services	Road Freight Transport	Rail Freight Transport
DE11	Stuttgart	1'151	49'707	5'434	84'968	807	69
DE12	Karlsruhe	539	25'496	3'456	61'051	618	53
DE13	Freiburg	811	19'902	2'778	38'945	507	44
DE14	Tübingen	761	20'111	2'362	33'970	452	39
DE21	Oberbayern	1'528	41'388	5'450	147'469	1'169	101
DE22	Niederbayern	1'032	10'163	2'059	22'920	322	28
DE23	Oberpfalz	684	10'041	1'808	22'094	353	30
DE24	Oberfranken	511	9'089	1'269	20'069	251	22
DE25	Mittelfranken	631	14'320	1'846	41'342	420	36
DE26	Unterfranken	837	10'863	1'733	26'527	343	29
DE27	Schwaben	908	16'072	2'426	35'572	461	40
DE30	Berlin	138	11'730	2'543	70'039	778	67
DE41	Brandenburg - Nordost	634	4'518	1'155	16'209	285	25
DE42	Brandenburg - Südwest	605	5'555	1'523	22'908	348	30
DE50	Bremen	100	5'948	770	20'040	374	32
DE60	Hamburg	188	12'396	2'038	82'470	819	70
DE71	Darmstadt	713	26'569	4'038	119'584	1'929	166
DE72	Gießen	315	8'294	1'169	19'692	156	13
DE73	Kassel	636	9'559	1'451	25'534	340	29
DE80	Mecklenburg-Vorpommern	1'121	4'861	1'681	27'176	380	33
DE91	Braunschweig	609	17'347	1'410	27'375	382	33
DE92	Hannover	806	13'648	2'079	45'924	544	47
DE93	Lüneburg	1'311	6'385	1'939	27'545	513	44
DE94	Weser-Ems	1'915	15'655	3'292	44'611	728	63
DEA1	Düsseldorf	980	38'958	5'091	127'317	1'892	163
DEA2	Köln	705	28'792	4'006	101'876	637	55
DEA3	Münster	1'101	17'516	2'739	46'889	688	59
DEA4	Detmold	633	18'371	1'978	37'574	814	70
DEA5	Arnsberg	698	32'434	3'547	66'702	1'267	109
DEB1	Koblenz	503	9'387	1'678	26'070	408	35
DEB2	Trier	353	2'862	596	9'089	172	15
DEB3	Rheinhessen-Pfalz	1'023	16'274	1'770	34'987	943	81
DEC0	Saarland	99	9'543	1'072	20'130	227	19
DED1	Chemnitz	333	8'086	1'883	21'435	366	32
DED2	Dresden	452	9'192	1'883	25'140	361	31
DED3	Leipzig	291	4'319	1'313	18'298	184	16
DEE0	Sachsen-Anhalt	999	12'487	2'750	35'904	774	67
DEF0	Schleswig-Holstein	1'570	12'071	2'508	55'648	736	63
DEG0	Thüringen	836	12'576	2'550	32'212	445	38
FR10	Île de France	644	56'574	13'548	396'757	5'872	372
FR21	Champagne-Ardenne	3'910	6'775	1'352	18'239	409	26
FR22	Picardie	1'626	8'131	1'691	25'296	614	39

GVA PER REGION AND SECTOR BAU 2020
(in million EUR, Pricelevel 2000)

NUTS-Code	NUTS_Name	Agriculture	Energy and Manufacturing	Construction	Services	Road Freight Transport	Rail Freight Transport
FR23	Haute-Normandie	975	10'556	2'032	27'494	804	51
FR24	Centre	2'203	12'671	2'973	38'623	814	52
FR25	Basse-Normandie	1'395	6'096	1'747	20'731	355	22
FR26	Bourgogne	2'090	7'283	1'853	23'784	530	34
FR30	Nord - Pas-de-Calais	1'659	17'214	3'500	58'129	1'119	71
FR41	Lorraine	1'062	10'203	2'186	32'534	626	40
FR42	Alsace	1'017	10'259	1'980	29'146	546	35
FR43	Franche-Comté	910	6'188	1'208	15'805	282	18
FR51	Pays de la Loire	3'070	17'426	4'901	58'508	1'159	73
FR52	Bretagne	3'392	12'063	4'592	53'366	989	63
FR53	Poitou-Charentes	1'890	6'409	2'050	26'862	493	31
FR61	Aquitaine	4'021	11'906	4'341	56'167	1'025	65
FR62	Midi-Pyrénées	2'038	11'631	4'282	52'631	871	55
FR63	Limousin	777	2'473	884	10'765	227	14
FR71	Rhône-Alpes	2'428	35'449	8'612	116'392	2'365	150
FR72	Auvergne	1'011	6'011	1'513	19'215	362	23
FR81	Languedoc-Roussillon	1'902	6'261	3'236	44'503	716	45
FR82	Provence-Alpes-Côte d'Azur	2'416	16'439	5'913	98'753	1'939	123
FR83	Corse	168	438	445	5'374	125	8
ITC1	Piemonte	2'361	22'840	3'867	64'518	1'371	61
ITC2	Valle d'Aosta/Vallée d'Aoste	39	414	277	2'283	45	2
ITC3	Liguria	458	3'156	1'250	24'423	486	22
ITC4	Lombardia	3'770	61'635	10'241	171'127	2'612	116
ITD1	Provincia Autonoma Bolzano-Bozen	697	2'031	861	10'422	243	11
ITD2	Provincia Autonoma Trento	413	2'251	754	9'161	237	11
ITD3	Veneto	2'732	28'471	6'184	74'056	1'508	67
ITD4	Friuli-Venezia Giulia	689	6'250	947	19'639	379	17
ITD5	Emilia-Romagna	2'986	26'563	5'198	70'602	1'275	57
ITE1	Toscana	1'795	14'785	3'449	56'385	925	41
ITE2	Umbria	666	3'189	949	11'766	245	11
ITE3	Marche	789	7'825	1'375	21'322	376	17
ITE4	Lazio	1'652	13'945	4'442	108'655	1'720	76
ITF1	Abruzzo	637	4'315	1'100	13'633	271	12
ITF2	Molise	233	760	217	2'898	63	3
ITF3	Campania	1'914	7'891	3'727	53'090	1'253	56
ITF4	Puglia	2'433	7'433	3'067	36'704	661	29
ITF5	Basilicata	550	1'214	555	5'203	126	6
ITF6	Calabria	1'130	2'132	1'178	16'823	334	15
ITG1	Sicilia	2'914	9'629	3'031	52'964	772	34
ITG2	Sardegna	955	3'174	1'160	19'087	351	16
SI01	Vzhodna Slovenija	405	4'381	703	6'362	255	14
SI02	Zahodna Slovenija	181	3'580	680	11'531	350	20
AT111	Mittelburgenland	48	124	127	340	11	2
AT112	Nordburgenland	182	807	173	1'913	73	10
AT113	Südburgenland	37	473	111	1'011	36	5
AT121	Mostviertel-Eisenwurzen	224	2'925	442	2'505	210	30
AT122	Niederösterreich-Süd	151	2'550	264	2'600	137	20
AT123	Sankt Pölten	73	1'075	356	2'806	101	14

GVA PER REGION AND SECTOR BAU 2020
(in million EUR, Pricelevel 2000)

NUTS-Code	NUTS_Name	Agriculture	Energy and Manufacturing	Construction	Services	Road Freight Transport	Rail Freight Transport
AT124	Waldviertel	263	1'237	316	2'239	109	15
AT125	Weinviertel	172	260	129	1'042	37	5
AT126	Wiener Umland/Nordteil	163	2'271	419	3'898	145	21
AT127	Wiener Umland/Südteil	72	3'620	395	7'093	748	106
AT130	Wien	143	10'841	2'032	54'799	1'704	243
AT211	Klagenfurt-Villach	78	2'129	248	4'502	177	25
AT212	Oberkärnten	121	521	387	1'417	89	13
AT213	Unterkärnten	143	2'080	259	1'535	72	10
AT221	Graz	111	4'617	625	7'947	284	40
AT222	Liezen	103	631	87	974	64	9
AT223	Östliche Obersteiermark	148	2'621	207	1'699	63	9
AT224	Oststeiermark	229	1'601	497	2'907	176	25
AT225	West- und Südsteiermark	127	1'452	200	2'068	107	15
AT226	Westliche Obersteiermark	120	923	129	912	31	4
AT311	Innviertel	232	3'274	408	2'581	161	23
AT312	Linz-Wels	107	6'943	954	12'384	521	74
AT313	Mühlviertel	188	965	297	1'675	75	11
AT314	Steyr-Kirchdorf	129	3'143	304	2'053	71	10
AT315	Traunviertel	143	3'601	350	2'334	124	18
AT321	Lungau	17	71	62	296	22	3
AT322	Pinzgau-Pongau	75	1'335	331	2'893	232	33
AT323	Salzburg und Umgebung	104	3'763	494	8'019	467	66
AT331	Außerfern	13	599	45	562	49	7
AT332	Innsbruck	50	2'719	345	5'806	219	31
AT333	Osttirol	22	253	64	554	29	4
AT334	Tiroler Oberland	30	493	250	2'204	250	36
AT335	Tiroler Unterland	121	2'585	467	4'258	325	46
AT341	Bludenz-Bregenzer Wald	40	1'248	194	1'424	130	19
AT342	Rheintal-Bodenseegebiet	42	3'700	422	4'627	197	28
CH011	Vaud	363	5'179	1'696	24'278	436	45
CH012	Valais	208	2'914	1'156	7'723	207	21
CH013	Geneva	53	3'695	1'121	23'466	417	43
CH021	Berne	837	10'413	2'657	32'166	768	79
CH022	Fribourg	250	2'543	758	6'370	118	12
CH023	Solothurn	106	3'682	621	6'314	273	28
CH024	Neuchâtel	72	3'553	336	4'585	83	9
CH025	Jura	84	1'435	176	1'486	29	3
CH031	Basel-Stadt	1	4'661	574	11'294	394	41
CH032	Basel-Landschaft	78	3'761	769	7'416	237	24
CH033	Aargau	258	9'321	1'622	15'310	444	46
CH040	Zürich	291	10'468	3'545	63'442	1'213	125
CH051	Glarus	28	668	159	847	17	2
CH052	Schaffhausen	45	1'460	177	2'101	61	6
CH053	Appenzell Ausserrhoden	44	645	110	1'138	17	2
CH054	Appenzell Innerrhoden	29	149	50	329	5	1
CH055	St. Gallen	298	7'572	1'433	13'878	295	30
CH056	Grisons	181	1'332	956	5'833	162	17
CH057	Thurgau	226	3'420	695	5'803	121	12
CH061	Lucerne	345	3'946	1'132	11'425	268	28

GVA PER REGION AND SECTOR BAU 2020
(in million EUR, Pricelevel 2000)

NUTS-Code	NUTS_Name	Agriculture	Energy and Manufacturing	Construction	Services	Road Freight Transport	Rail Freight Transport
CH062	Uri	34	459	128	713	27	3
CH063	Schwyz	106	1'215	525	3'752	72	7
CH064	Obwalden	42	488	162	827	17	2
CH065	Nidwalden	32	412	127	1'119	19	2
CH066	Zug	45	1'710	434	6'080	61	6
CH070	Ticino	71	3'600	1'239	12'231	248	26

The following table shows the growth rates for the different sectors of the E3ME model. The growth rate for the transport sector is used for the road and rail freight transport sectors.

ANNUAL GVA GROWTH RATES PER SECTOR AND REGION						
(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport	Services
DE11	Stuttgart	1.6%	1.1%	0.5%	1.3%	1.4%
DE12	Karlsruhe	1.6%	1.0%	0.8%	1.3%	1.6%
DE13	Freiburg	1.6%	1.1%	0.5%	1.3%	1.4%
DE14	Tübingen	1.6%	1.2%	0.5%	1.5%	1.6%
DE21	Oberbayern	1.6%	1.1%	1.1%	2.1%	2.3%
DE22	Niederbayern	1.6%	1.5%	0.7%	1.5%	1.8%
DE23	Oberpfalz	1.7%	1.4%	0.5%	1.7%	1.7%
DE24	Oberfranken	1.7%	1.4%	0.7%	1.3%	1.1%
DE25	Mittelfranken	1.7%	1.2%	0.8%	1.7%	1.4%
DE26	Unterfranken	1.7%	1.4%	0.6%	1.3%	1.3%
DE27	Schwaben	1.7%	1.3%	0.8%	1.4%	1.5%
DE30	Berlin	1.4%	0.9%	2.1%	1.1%	1.5%
DE41	Brandenburg - Nordost	1.6%	1.4%	1.7%	1.3%	1.3%
DE42	Brandenburg - Südwest	1.6%	1.5%	1.7%	1.1%	1.5%
DE5	Bremen	1.7%	1.4%	1.4%	1.1%	1.8%
DE6	Hamburg	1.4%	1.2%	2.0%	1.6%	2.7%
DE71	Darmstadt	1.8%	1.2%	1.3%	1.2%	1.4%
DE72	Gießen	1.8%	1.3%	1.2%	1.3%	1.4%
DE73	Kassel	1.9%	1.5%	1.1%	1.2%	1.2%
DE8	Mecklenburg-Vorpommern	1.5%	1.6%	1.7%	1.2%	1.2%
DE91	Braunschweig	1.8%	1.3%	1.3%	1.6%	1.6%
DE92	Hannover	1.7%	1.4%	1.1%	1.4%	1.5%
DE93	Lüneburg	1.8%	1.6%	0.9%	1.0%	1.5%
DE94	Weser-Ems	1.6%	1.4%	0.9%	1.2%	1.9%
DEA1	Düsseldorf	1.6%	1.3%	1.1%	1.4%	1.5%
DEA2	Köln	1.6%	1.2%	0.9%	1.4%	1.7%
DEA3	Münster	1.7%	1.4%	0.8%	1.5%	1.7%
DEA4	Detmold	1.7%	1.4%	0.6%	1.3%	1.4%
DEA5	Arnsberg	1.9%	1.4%	0.9%	1.5%	1.5%
DEB1	Koblenz	1.7%	1.4%	0.8%	1.5%	1.4%
DEB2	Trier	1.6%	1.1%	1.4%	1.8%	2.1%
DEB3	Rheinhessen-Pfalz	1.6%	1.1%	1.1%	1.5%	1.5%
DEC	Saarland	1.6%	1.5%	1.2%	1.9%	1.3%
DED1	Chemnitz	1.6%	1.7%	1.2%	1.4%	1.1%
DED2	Dresden	1.6%	1.6%	1.2%	1.3%	1.0%
DED3	Leipzig	1.5%	1.3%	1.1%	1.4%	1.4%
DEE	Sachsen-Anhalt	1.6%	1.8%	1.5%	1.3%	1.1%
DEF	Schleswig-Holstein	1.6%	1.2%	1.2%	1.2%	1.4%
DEG	Thüringen	1.6%	1.6%	1.3%	1.3%	1.1%

(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport	Services
fr10	Île de France	1.0%	1.1%	0.0%	0.9%	1.4%
FR21	Champagne-Ardenne	1.6%	1.1%	-0.5%	0.2%	0.6%
FR22	Picardie	1.2%	1.0%	-0.5%	0.4%	1.0%
FR23	Haute-Normandie	1.3%	1.1%	-0.5%	0.4%	1.0%
FR24	Centre	1.2%	1.1%	-0.4%	0.6%	1.1%
FR25	Basse-Normandie	1.2%	1.1%	-0.5%	0.5%	0.9%
FR26	Bourgogne	1.3%	1.0%	-0.4%	0.4%	0.8%
fr30	Nord - Pas-de-Calais	1.4%	1.1%	-0.3%	0.3%	0.9%
FR41	Lorraine	1.3%	0.9%	-0.5%	0.2%	0.7%
FR42	Alsace	1.3%	0.8%	-0.5%	0.6%	1.2%
FR43	Franche-Comté	1.5%	1.0%	-0.5%	0.5%	0.9%
FR51	Pays de la Loire	1.2%	1.4%	0.0%	1.1%	1.6%
FR52	Bretagne	1.3%	1.5%	0.1%	1.0%	1.5%
FR53	Poitou-Charentes	1.3%	1.2%	-0.2%	0.8%	1.2%
FR61	Aquitaine	1.3%	1.5%	0.1%	1.1%	1.5%
FR62	Midi-Pyrénées	1.2%	1.7%	0.3%	1.3%	1.7%
FR63	Limousin	1.5%	1.1%	-0.3%	0.5%	0.9%
FR71	Rhône-Alpes	1.4%	1.4%	0.0%	1.0%	1.4%
FR72	Auvergne	1.3%	1.1%	-0.4%	0.4%	0.8%
FR81	Languedoc-Roussillon	1.2%	1.7%	0.2%	1.5%	1.7%
FR82	Provence-Alpes-Côte d'Azu	1.4%	1.5%	0.1%	1.1%	1.4%
FR83	Corse	1.5%	1.4%	-0.2%	1.6%	1.8%
ITC1	Piemonte	0.6%	0.1%	-1.6%	0.5%	0.3%
ITC2	Valle d'Aosta/Vallée d'Aost	0.2%	0.5%	-0.9%	0.8%	1.1%
ITC3	Liguria	-0.3%	-1.4%	-1.6%	0.0%	-0.5%
ITC4	Lombardia	0.5%	-0.7%	-0.5%	0.3%	0.7%
ITD1	Provincia Autonoma Bolzan	0.8%	0.9%	-0.3%	1.0%	1.7%
ITD2	Provincia Autonoma Trento	0.5%	0.0%	-0.1%	0.6%	1.3%
ITD3	Veneto	0.3%	-0.3%	-0.8%	0.4%	0.9%
ITD4	Friuli-Venezia Giulia	0.6%	0.5%	-1.4%	0.7%	0.4%
ITD5	Emilia-Romagna	0.2%	-0.3%	-0.6%	0.5%	1.0%
ITE1	Toscana	0.5%	-0.6%	-1.2%	0.3%	0.4%
ITE2	Umbria	0.8%	-0.3%	-0.6%	0.5%	1.0%
ITE3	Marche	0.3%	-0.2%	-0.7%	0.5%	0.8%
ITE4	Lazio	0.4%	0.7%	-2.0%	0.3%	1.1%
ITF1	Abruzzo	0.1%	-1.0%	-1.2%	0.1%	0.1%
ITF2	Molise	0.5%	-1.2%	-2.0%	0.1%	-0.8%
ITF3	Campania	0.0%	-1.6%	-1.3%	0.1%	-0.5%
ITF4	Puglia	0.0%	-1.1%	-1.2%	0.3%	-0.3%
ITF5	Basilicata	0.4%	-0.7%	-2.3%	0.2%	-0.9%
ITF6	Calabria	-0.2%	-1.8%	-2.4%	-0.1%	-1.2%
ITG1	Sicilia	0.3%	0.4%	-0.7%	1.0%	0.4%
ITG2	Sardegna	0.2%	-0.4%	-1.1%	0.5%	0.0%

(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport	Services
SI01	Vzhodna Slovenija	-0.1%	0.1%	-3.1%	0.1%	1.6%
SI02	Zahodna Slovenija	-0.7%	0.1%	-3.1%	0.7%	2.1%
AT111	Mittelburgenland	-0.6%	0.0%	0.8%	-0.6%	0.7%
AT112	Nordburgenland	1.2%	2.6%	-2.9%	0.0%	0.6%
AT113	Südburgenland	-3.8%	2.5%	-2.9%	0.2%	0.2%
AT121	Mostviertel-Eisenwurzen	-0.7%	3.4%	-0.9%	2.0%	1.0%
AT122	Niederösterreich-Süd	-0.2%	3.1%	-3.5%	-1.1%	1.0%
AT123	Sankt Pölten	-1.2%	1.5%	-1.5%	-2.2%	1.4%
AT124	Waldviertel	0.0%	2.1%	-1.8%	-1.7%	0.9%
AT125	Weinviertel	0.4%	0.0%	-3.1%	-2.3%	1.7%
AT126	Wiener Umland/Nordteil	-0.1%	2.2%	-1.7%	-1.8%	3.0%
AT127	Wiener Umland/Südteil	-0.4%	1.8%	-1.9%	1.3%	1.4%
AT130	Wien	-0.1%	2.0%	-2.2%	0.1%	2.5%
AT211	Klagenfurt-Villach	-0.8%	1.6%	-4.3%	-0.8%	-2.1%
AT212	Oberkärnten	0.8%	-0.5%	-0.6%	0.8%	-1.4%
AT213	Unterkärnten	0.0%	4.3%	-1.3%	1.0%	-1.5%
AT221	Graz	1.2%	2.9%	-1.8%	-0.4%	-0.5%
AT222	Liezen	0.2%	2.5%	-3.0%	0.4%	-1.7%
AT223	Östliche Obersteiermark	1.8%	2.2%	-2.1%	-1.6%	-1.1%
AT224	Oststeiermark	-1.4%	2.0%	-1.0%	1.8%	0.2%
AT225	West- und Südsteiermark	-0.8%	2.0%	-3.8%	1.4%	0.4%
AT226	Westliche Obersteiermark	0.8%	1.9%	-1.6%	-3.0%	-1.1%
AT311	Innviertel	-0.4%	3.5%	-1.9%	1.6%	-0.7%
AT312	Linz-Wels	-1.4%	1.4%	-2.2%	-0.1%	-0.1%
AT313	Mühlviertel	0.2%	1.6%	-2.5%	0.0%	0.6%
AT314	Steyr-Kirchdorf	0.3%	3.7%	-0.6%	-0.1%	0.8%
AT315	Traunviertel	0.4%	3.2%	-1.9%	-0.3%	0.0%
AT321	Lungau	-1.1%	1.3%	1.1%	0.9%	0.9%
AT322	Pinzgau-Pongau	-0.9%	2.5%	-1.5%	0.4%	0.9%
AT323	Salzburg und Umgebung	0.7%	2.3%	-2.5%	-0.2%	0.4%
AT331	Außerfern	-0.4%	2.8%	-1.8%	1.9%	0.0%
AT332	Innsbruck	-0.4%	3.5%	-3.5%	-2.3%	1.0%
AT333	Osttirol	0.0%	-0.7%	-2.8%	-1.1%	0.4%
AT334	Tiroler Oberland	-1.2%	0.2%	-0.3%	2.6%	2.2%
AT335	Tiroler Unterland	0.3%	1.4%	-1.5%	0.1%	2.0%
AT341	Bludenz-Bregenzer Wald	0.7%	1.7%	-1.8%	1.1%	0.9%
AT342	Rheintal-Bodenseegebiet	-0.7%	2.4%	-2.1%	-0.5%	1.7%
ch01	Région lémanique	-1.8%	0.1%	0.6%	0.7%	1.1%
ch02	Espace Mittelland	-1.8%	0.1%	0.2%	0.6%	0.7%
ch03	Nordwestschweiz	-1.8%	0.1%	0.3%	0.7%	0.9%
ch04	Zürich	-1.8%	0.1%	0.6%	0.3%	0.9%
ch05	Ostschweiz	-1.8%	0.0%	0.3%	0.5%	1.0%
ch06	Zentralschweiz	-1.8%	0.0%	0.6%	0.8%	0.9%
ch07	Ticino	-1.9%	0.0%	0.1%	0.4%	0.7%

ECONOMIC DATA BAU 2020: EMPLOYMENT

EMPLOYMENT PER REGION AND SECTOR 2020 (in 1000)							
NUTS Code	**NUTS Name**	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Services**	**Road Freight Transport**	**Rail Freight Transport**
DE11	Stuttgart	31.8	634.0	108.6	1'522.0	19.4	1.2
DE12	Karlsruhe	14.1	339.5	69.3	1'113.9	15.2	0.9
DE13	Freiburg	25.6	284.4	62.7	782.8	12.4	0.8
DE14	Tübingen	20.4	261.5	51.7	640.9	10.8	0.7
DE21	Oberbayern	46.3	459.5	124.9	2'016.7	23.6	1.5
DE22	Niederbayern	28.4	153.7	49.1	405.0	7.6	0.5
DE23	Oberpfalz	19.3	150.5	39.6	385.8	8.2	0.5
DE24	Oberfranken	15.2	150.2	31.5	373.5	6.3	0.4
DE25	Mittelfranken	18.1	215.3	42.9	719.5	9.7	0.6
DE26	Unterfranken	18.4	165.2	41.9	490.7	8.7	0.5
DE27	Schwaben	26.1	226.2	60.2	633.8	11.5	0.7
DE30	Berlin	4.6	145.6	73.7	1'562.8	21.9	1.4
DE41	Brandenburg - Nordost	16.1	58.7	44.2	348.7	6.8	0.4
DE42	Brandenburg - Südwest	17.5	82.7	51.0	501.7	8.4	0.5
DE50	Bremen	1.2	64.4	15.9	342.3	6.3	0.4
DE60	Hamburg	4.8	123.8	38.0	1'059.6	11.1	0.7
DE71	Darmstadt	17.9	298.6	92.8	1'773.3	37.1	2.3
DE72	Gießen	8.1	114.2	27.4	366.2	4.3	0.3
DE73	Kassel	13.4	129.7	35.2	463.0	8.0	0.5
DE80	Mecklenburg-Vorpommern	25.9	83.4	53.7	624.9	8.8	0.5
DE91	Braunschweig	12.5	190.8	35.7	590.1	10.0	0.6
DE92	Hannover	18.2	163.9	52.1	888.7	12.7	0.8
DE93	Lüneburg	29.8	96.4	48.6	546.7	11.0	0.7
DE94	Weser-Ems	47.5	225.2	83.5	915.5	17.0	1.1
DEA1	Düsseldorf	29.1	461.8	120.6	2'169.7	38.9	2.4
DEA2	Köln	21.6	319.9	97.7	1'919.4	18.4	1.1
DEA3	Münster	28.2	230.7	67.9	950.8	20.2	1.3
DEA4	Detmold	19.9	263.9	49.1	756.2	21.0	1.3
DEA5	Arnsberg	19.3	418.4	81.9	1'326.0	29.1	1.8
DEB1	Koblenz	14.2	138.7	46.3	542.0	10.3	0.6
DEB2	Trier	9.1	45.5	16.6	187.5	3.9	0.2
DEB3	Rheinhessen-Pfalz	23.8	182.4	50.7	714.9	22.3	1.4
DEC0	Saarland	3.5	123.0	26.6	401.2	6.4	0.4
DED1	Chemnitz	13.7	153.7	60.6	491.7	10.6	0.7
DED2	Dresden	15.0	139.0	59.0	613.5	10.1	0.6
DED3	Leipzig	9.4	70.7	41.6	428.4	5.3	0.3
DEE0	Sachsen-Anhalt	26.3	164.9	79.5	819.0	16.6	1.0
DEF0	Schleswig-Holstein	37.4	169.7	69.8	1'081.1	17.3	1.1
DEG0	Thüringen	24.7	215.5	84.9	768.8	12.8	0.8
FR10	Île de France	13.6	475.7	248.9	5'007.5	130.2	8.1
FR21	Champagne-Ardenne	27.0	85.9	30.6	369.5	11.8	0.7
FR22	Picardie	18.7	110.2	39.0	487.2	16.4	1.0
FR23	Haute-Normandie	13.3	122.4	45.9	518.6	21.4	1.3
FR24	Centre	32.5	164.1	66.0	732.0	22.5	1.4
FR25	Basse-Normandie	29.1	88.0	38.9	415.2	10.5	0.7
FR26	Bourgogne	26.3	101.6	41.0	475.0	15.5	1.0
FR30	Nord - Pas-de-Calais	23.4	204.5	83.2	1'150.3	32.9	2.0

EMPLOYMENT PER REGION AND SECTOR 2020 (in 1000)							
NUTS Code	**NUTS Name**	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Services**	**Road Freight Transport**	**Rail Freight Transport**
FR41	Lorraine	14.4	130.7	50.2	632.0	18.1	1.1
FR42	Alsace	10.4	129.9	45.4	554.1	15.5	1.0
FR43	Franche-Comté	12.1	89.1	26.8	317.3	8.2	0.5
FR51	Pays de la Loire	57.0	252.0	105.3	1'059.7	30.1	1.9
FR52	Bretagne	57.5	188.7	88.9	957.3	26.5	1.6
FR53	Poitou-Charentes	31.4	93.6	45.7	504.6	13.3	0.8
FR61	Aquitaine	57.1	145.8	86.6	978.2	27.3	1.7
FR62	Midi-Pyrénées	46.2	151.6	81.7	908.9	23.3	1.4
FR63	Limousin	13.5	37.7	19.1	214.0	6.8	0.4
FR71	Rhône-Alpes	44.7	425.3	165.6	1'970.8	60.1	3.7
FR72	Auvergne	23.9	84.8	34.1	377.6	10.7	0.7
FR81	Languedoc-Roussillon	32.1	75.8	70.2	793.7	19.0	1.2
FR82	Provence-Alpes-Côte d'Azur	33.1	167.8	120.1	1'649.0	48.0	3.0
FR83	Corse	3.5	6.5	11.0	95.7	3.5	0.2
ITC1	Piemonte	94.8	427.9	135.0	1'369.1	31.9	1.3
ITC2	Valle d'Aosta/Vallée d'Aoste	3.4	6.4	9.8	42.7	0.9	0.0
ITC3	Liguria	22.0	64.0	49.9	513.4	10.8	0.5
ITC4	Lombardia	95.5	1'117.7	350.5	3'187.9	57.5	2.4
ITD1	Provincia Autonoma Bolzano-Bozen	13.5	37.0	27.9	198.7	4.6	0.2
ITD2	Provincia Autonoma Trento	18.0	40.0	22.9	169.1	4.2	0.2
ITD3	Veneto	107.0	584.7	213.8	1'433.7	33.1	1.4
ITD4	Friuli-Venezia Giulia	33.1	123.8	27.4	407.8	8.9	0.4
ITD5	Emilia-Romagna	111.2	496.1	164.3	1'418.6	30.0	1.3
ITE1	Toscana	60.8	315.9	134.9	1'201.1	22.4	0.9
ITE2	Umbria	17.1	70.0	34.6	276.4	6.4	0.3
ITE3	Marche	36.4	200.2	51.3	457.6	9.4	0.4
ITE4	Lazio	65.2	208.1	186.2	2'155.8	37.4	1.6
ITF1	Abruzzo	39.3	105.5	40.9	320.5	7.1	0.3
ITF2	Molise	12.1	20.1	10.1	72.7	1.6	0.1
ITF3	Campania	109.2	200.6	159.3	1'361.9	31.0	1.3
ITF4	Puglia	135.1	188.4	137.0	855.0	16.5	0.7
ITF5	Basilicata	25.3	31.5	24.4	126.7	3.0	0.1
ITF6	Calabria	110.9	50.8	53.0	420.6	8.9	0.4
ITG1	Sicilia	152.2	156.6	126.1	1'194.1	19.6	0.8
ITG2	Sardegna	53.3	61.9	48.4	468.7	8.9	0.4
SI01	Vzhodna Slovenija	51.1	116.7	42.0	252.2	11.9	0.7
SI02	Zahodna Slovenija	19.7	82.6	41.6	366.2	12.3	0.7
AT111	Mittelburgenland	2.0	2.4	2.2	9.0	0.5	0.1
AT112	Nordburgenland	6.3	9.0	4.8	43.7	1.7	0.2
AT113	Südburgenland	4.1	6.0	3.9	26.1	1.2	0.1
AT121	Mostviertel-Eisenwurzen	12.8	28.1	9.7	56.5	3.8	0.4
AT122	Niederösterreich-Süd	6.5	25.9	7.6	66.2	4.0	0.4
AT123	Sankt Pölten	3.6	12.8	5.6	57.9	2.8	0.3
AT124	Waldviertel	14.9	16.1	8.1	60.5	3.9	0.4
AT125	Weinviertel	5.1	4.5	2.6	26.2	1.5	0.2
AT126	Wiener Umland/Nordteil	7.3	17.7	8.6	75.3	4.9	0.5
AT127	Wiener Umland/Südteil	3.6	20.1	9.7	125.1	11.7	1.2
AT130	Wien	3.5	81.3	46.4	860.1	28.8	2.9
AT211	Klagenfurt-Villach	5.9	19.4	8.1	112.8	4.3	0.4
AT212	Oberkärnten	7.2	6.7	6.8	33.7	2.1	0.2

EMPLOYMENT PER REGION AND SECTOR 2020 (in 1000)							
NUTS Code	**NUTS Name**	**Agriculture**	**Energy and Manufacturing**	**Construction**	**Services**	**Road Freight Transport**	**Rail Freight Transport**
AT213	Unterkärnten	7.3	19.9	5.7	37.6	1.9	0.2
AT221	Graz	5.6	40.5	12.1	197.9	6.8	0.7
AT222	Liezen	3.1	8.6	2.3	23.9	1.6	0.2
AT223	Östliche Obersteiermark	3.1	18.9	4.7	44.2	2.4	0.2
AT224	Oststeiermark	21.7	25.0	14.1	66.1	4.0	0.4
AT225	West- und Südsteiermark	9.7	17.9	5.7	43.6	2.6	0.3
AT226	Westliche Obersteiermark	4.0	8.9	2.8	24.9	1.5	0.2
AT311	Innviertel	11.6	39.0	9.3	66.2	4.5	0.5
AT312	Linz-Wels	8.3	62.9	22.8	270.8	11.8	1.2
AT313	Mühlviertel	12.9	14.5	8.5	41.1	2.8	0.3
AT314	Steyr-Kirchdorf	4.6	24.8	7.6	37.3	2.0	0.2
AT315	Traunviertel	7.3	29.9	7.4	56.8	2.9	0.3
AT321	Lungau	1.4	1.3	1.0	5.6	0.4	0.0
AT322	Pinzgau-Pongau	5.4	13.2	8.1	58.6	3.8	0.4
AT323	Salzburg und Umgebung	6.4	30.7	13.0	167.7	9.1	0.9
AT331	Außerfern	1.1	3.6	0.7	9.1	0.7	0.1
AT332	Innsbruck	4.4	25.6	8.1	130.5	5.6	0.6
AT333	Osttirol	2.6	5.9	1.8	12.8	0.8	0.1
AT334	Tiroler Oberland	5.1	4.0	6.0	36.0	2.9	0.3
AT335	Tiroler Unterland	7.2	24.3	12.5	80.1	6.1	0.6
AT341	Bludenz-Bregenzer Wald	2.6	11.0	4.7	26.0	1.9	0.2
AT342	Rheintal-Bodenseegebiet	2.4	34.7	8.9	90.6	4.7	0.5
CH011	Vaud	11.3	43.1	25.1	280.7	6.9	0.7
CH012	Valais	8.5	21.6	17.0	99.5	3.3	0.3
CH013	Geneva	1.5	29.0	16.4	249.5	6.5	0.7
CH021	Berne	29.4	95.5	39.6	384.3	12.6	1.3
CH022	Fribourg	7.6	22.9	11.1	77.4	1.9	0.2
CH023	Solothurn	3.7	32.4	9.3	76.9	4.3	0.4
CH024	Neuchâtel	2.1	30.4	4.9	55.5	1.3	0.1
CH025	Jura	2.6	13.1	2.6	18.9	0.5	0.0
CH031	Basel-Stadt	0.0	27.5	8.3	126.5	6.2	0.6
CH032	Basel-Landschaft	2.7	29.3	11.2	87.3	3.7	0.4
CH033	Aargau	9.2	73.7	23.8	183.9	7.6	0.8
CH040	Zürich	10.0	94.9	53.3	675.7	19.3	2.0
CH051	Glarus	0.9	5.9	2.3	10.3	0.3	0.0
CH052	Schaffhausen	1.6	11.2	2.7	25.2	1.0	0.1
CH053	Appenzell Ausserrhoden	1.4	6.1	1.6	14.3	0.3	0.0
CH054	Appenzell Innerrhoden	0.9	1.5	0.8	4.1	0.1	0.0
CH055	St. Gallen	9.9	66.9	21.3	161.9	4.9	0.5
CH056	Grisons	6.3	11.5	13.9	73.1	2.6	0.3
CH057	Thurgau	7.2	30.5	10.3	68.9	1.9	0.2
CH061	Lucerne	12.1	35.8	17.0	139.3	4.3	0.4
CH062	Uri	1.4	3.6	1.9	10.0	0.4	0.0
CH063	Schwyz	3.8	11.3	7.9	44.3	1.2	0.1
CH064	Obwalden	1.5	4.2	2.4	10.8	0.3	0.0
CH065	Nidwalden	1.1	4.4	1.9	12.9	0.3	0.0
CH066	Zug	1.5	14.7	6.4	66.0	1.0	0.1
CH070	Ticino	2.5	30.6	17.5	131.3	3.8	0.4

The following table shows the growth rates for the different sectors of the E3ME model. The growth rate for the transport sector is used for the road and rail freight transport sectors.

ANNUAL EMPLOYMENT GROWTH RATES PER SECTOR AND REGION						
(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport sector	Services
de11	Stuttgart	-0.85%	-0.13%	0.48%	0.64%	1.27%
de12	Karlsruhe	-0.87%	-0.29%	0.54%	0.64%	1.33%
de13	Freiburg	-0.90%	-0.22%	0.49%	0.64%	1.28%
de14	Tübingen	-0.92%	-0.07%	0.51%	0.65%	1.33%
de21	Oberbayern	-1.01%	-0.04%	0.54%	0.72%	1.53%
de22	Niederbayern	-0.96%	-0.07%	0.55%	0.66%	1.39%
de23	Oberpfalz	-1.01%	0.01%	0.52%	0.68%	1.36%
de24	Oberfranken	-0.99%	-0.22%	0.42%	0.64%	1.21%
de25	Mittelfranken	-1.02%	-0.27%	0.47%	0.68%	1.30%
de26	Unterfranken	-1.07%	-0.18%	0.46%	0.64%	1.26%
de27	Schwaben	-0.99%	-0.23%	0.48%	0.64%	1.31%
de3	Berlin	-0.95%	-0.29%	0.08%	0.62%	1.30%
de41	Brandenburg - Nordost	-0.90%	0.12%	0.08%	0.64%	1.26%
de42	Brandenburg - Südwest	-0.90%	-0.09%	0.10%	0.63%	1.29%
de5	Bremen	-1.02%	-0.18%	0.54%	0.62%	1.39%
de6	Hamburg	-0.81%	-0.29%	0.68%	0.67%	1.64%
de71	Darmstadt	-1.03%	-0.29%	0.44%	0.63%	1.28%
de72	Gießen	-0.97%	-0.01%	0.35%	0.64%	1.27%
de73	Kassel	-1.04%	-0.08%	0.37%	0.62%	1.24%
de8	Mecklenburg-Vorpommern	-0.80%	0.11%	-0.04%	0.64%	1.23%
de91	Braunschweig	-0.91%	-0.01%	0.63%	0.67%	1.32%
de92	Hannover	-0.83%	-0.16%	0.60%	0.65%	1.30%
de93	Lüneburg	-0.96%	-0.13%	0.61%	0.61%	1.33%
de94	Weser-Ems	-0.83%	-0.06%	0.77%	0.63%	1.43%
dea1	Düsseldorf	-0.68%	-0.13%	0.52%	0.65%	1.30%
dea2	Köln	-0.74%	-0.15%	0.58%	0.65%	1.34%
dea3	Münster	-0.86%	0.09%	0.60%	0.66%	1.38%
dea4	Detmold	-0.74%	-0.03%	0.57%	0.63%	1.27%
dea5	Arnsberg	-1.00%	-0.03%	0.53%	0.66%	1.28%
deb1	Koblenz	-0.82%	-0.07%	0.43%	0.66%	1.25%
deb2	Trier	-0.80%	-0.14%	0.58%	0.69%	1.47%
deb3	Rheinhessen-Pfalz	-0.79%	-0.15%	0.47%	0.66%	1.31%
dec	Saarland	-0.92%	0.16%	0.49%	0.70%	1.25%
ded1	Chemnitz	-0.81%	0.09%	0.08%	0.66%	1.19%
ded2	Dresden	-0.84%	0.06%	0.03%	0.65%	1.17%
ded3	Leipzig	-0.79%	0.10%	0.02%	0.66%	1.29%
dee	Sachsen-Anhalt	-0.83%	0.22%	0.14%	0.65%	1.20%
def	Schleswig-Holstein	-0.82%	-0.38%	0.25%	0.63%	1.25%
deg	Thüringen	-0.82%	0.10%	0.08%	0.65%	1.19%

(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport sector	Services
fr1	Île de France	-2.33%	-1.06%	-0.38%	0.83%	0.77%
fr21	Champagne-Ardenne	-2.28%	-1.13%	-0.55%	0.34%	0.54%
fr22	Picardie	-2.30%	-1.42%	-0.59%	0.44%	0.59%
fr23	Haute-Normandie	-2.30%	-1.01%	-0.52%	0.51%	0.61%
fr24	Centre	-2.30%	-0.99%	-0.46%	0.54%	0.66%
fr25	Basse-Normandie	-2.30%	-0.99%	-0.51%	0.51%	0.64%
fr26	Bourgogne	-2.30%	-1.10%	-0.49%	0.51%	0.63%
fr3	Nord - Pas-de-Calais	-2.29%	-1.14%	-0.48%	0.51%	0.60%
fr41	Lorraine	-2.30%	-1.28%	-0.65%	0.34%	0.58%
fr42	Alsace	-2.30%	-1.17%	-0.58%	0.62%	0.68%
fr43	Franche-Comté	-2.28%	-1.39%	-0.53%	0.49%	0.66%
fr51	Pays de la Loire	-2.31%	-0.79%	-0.21%	0.92%	0.79%
fr52	Bretagne	-2.30%	-0.66%	-0.13%	1.00%	0.79%
fr53	Poitou-Charentes	-2.30%	-0.96%	-0.34%	0.79%	0.72%
fr61	Aquitaine	-2.29%	-0.74%	-0.09%	0.91%	0.83%
fr62	Midi-Pyrénées	-2.31%	-0.41%	0.11%	0.97%	0.92%
fr63	Limousin	-2.27%	-1.20%	-0.40%	0.46%	0.69%
fr71	Rhône-Alpes	-2.28%	-0.82%	-0.18%	0.93%	0.85%
fr72	Auvergne	-2.29%	-1.08%	-0.41%	0.55%	0.66%
fr81	Languedoc-Roussillon	-2.30%	-0.50%	0.05%	1.12%	0.99%
fr82	Provence-Alpes-Côte d'Azur	-2.28%	-0.43%	-0.16%	0.93%	0.87%
fr83	Corse	-2.30%	-0.37%	-0.10%	1.24%	0.99%
itc1	Piemonte	0.07%	-0.97%	0.30%	0.39%	0.74%
itc2	Valle d'Aosta/Vallée d'Aoste	0.02%	-0.60%	0.65%	0.49%	0.98%
itc3	Liguria	-0.02%	-1.50%	-0.19%	0.30%	0.43%
itc4	Lombardia	0.06%	-1.23%	0.45%	0.37%	0.87%
itd1	Provincia Autonoma Bolzano-	0.06%	-0.44%	0.92%	0.57%	1.22%
itd2	Provincia Autonoma Trento	0.06%	-0.84%	0.84%	0.45%	1.09%
itd3	Veneto	0.03%	-1.06%	0.74%	0.39%	0.92%
itd4	Friuli-Venezia Giulia	0.07%	-0.68%	-0.08%	0.50%	0.82%
itd5	Emilia-Romagna	0.02%	-0.98%	0.95%	0.44%	0.97%
ite1	Toscana	0.07%	-1.23%	0.38%	0.32%	0.74%
ite2	Umbria	0.08%	-1.02%	0.59%	0.42%	0.91%
ite3	Marche	0.04%	-0.92%	0.57%	0.43%	0.90%
ite4	Lazio	0.05%	-0.70%	0.11%	0.34%	0.96%
itf1	Abruzzo	0.01%	-1.34%	0.41%	0.33%	0.63%
itf2	Molise	0.04%	-1.30%	-0.43%	0.26%	0.29%
itf3	Campania	-0.02%	-1.44%	0.40%	0.26%	0.42%
itf4	Puglia	0.00%	-1.18%	0.43%	0.34%	0.51%
itf5	Basilicata	0.04%	-1.32%	0.17%	0.22%	0.29%
itf6	Calabria	-0.02%	-1.44%	-0.26%	0.24%	0.18%
itg1	Sicilia	0.04%	0.03%	0.24%	0.55%	0.79%
itg2	Sardegna	0.02%	-0.98%	0.01%	0.36%	0.63%

(2008-2020 resp. 2008-2030)		Agriculture	Energy and Manufacturing	Construction	Transport sector	Services
si01	Vzhodna Slovenija	-1.44%	-1.99%	-0.58%	0.61%	1.21%
si02	Zahodna Slovenija	-1.82%	-1.88%	-0.60%	0.71%	1.25%
ch01	Région lémanique	-1.85%	0.10%	0.55%	0.71%	1.07%
ch02	Espace Mittelland	-1.84%	0.08%	0.19%	0.55%	0.68%
ch03	Nordwestschweiz	-1.81%	0.09%	0.29%	0.70%	0.94%
ch04	Zürich	-1.85%	0.11%	0.60%	0.33%	0.89%
ch05	Ostschweiz	-1.83%	-0.04%	0.35%	0.51%	0.96%
ch06	Zentralschweiz	-1.82%	0.02%	0.56%	0.76%	0.88%
ch07	Ticino	-1.90%	-0.01%	0.14%	0.43%	0.69%
at111	Mittelburgenland	-0.0042	-0.00996	0.00518	0.02569	0.00125
at112	Nordburgenland	-0.01128	0.00066	0.00159	-0.00829	0.01385
at113	Südburgenland	-2.20%	-0.83%	1.17%	0.84%	0.43%
at121	Mostviertel-Eisenwurzen	-1.08%	1.18%	1.32%	-0.05%	0.56%
at122	Niederösterreich-Süd	-0.83%	0.21%	-0.33%	-0.32%	1.28%
at123	Sankt Pölten	-2.17%	0.11%	-0.66%	-0.81%	0.80%
at124	Waldviertel	-1.51%	-0.08%	1.17%	0.15%	1.09%
at125	Weinviertel	-2.91%	-0.30%	-0.92%	0.12%	1.87%
at126	Wiener Umland/Nordteil	-1.04%	-0.28%	0.80%	0.45%	1.56%
at127	Wiener Umland/Südteil	-0.45%	-1.33%	0.74%	0.75%	0.53%
at13	Wien	-1.38%	-0.27%	-0.06%	-0.23%	1.13%
at211	Klagenfurt-Villach	-1.30%	-0.49%	-0.01%	-0.83%	0.70%
at212	Oberkärnten	-0.90%	-1.59%	0.79%	0.64%	0.92%
at213	Unterkärnten	-1.86%	1.05%	0.86%	0.87%	0.49%
at221	Graz	-1.55%	0.28%	-0.43%	-1.01%	1.25%
at222	Liezen	-1.32%	0.78%	-0.30%	0.51%	-0.10%
at223	Östliche Obersteiermark	-1.40%	-0.93%	0.55%	0.05%	0.03%
at224	Oststeiermark	-1.13%	0.53%	2.63%	0.89%	0.93%
at225	West- und Südsteiermark	-1.80%	-0.04%	-0.16%	0.84%	0.58%
at226	Westliche Obersteiermark	-1.42%	-1.39%	0.16%	0.49%	-0.25%
at311	Innviertel	-1.74%	0.87%	0.20%	1.61%	1.22%
at312	Linz-Wels	-0.99%	-0.75%	-0.08%	-0.35%	0.73%
at313	Mühlviertel	-1.46%	0.27%	0.95%	1.31%	1.46%
at314	Steyr-Kirchdorf	-1.67%	0.50%	2.67%	-0.55%	0.73%
at315	Traunviertel	-0.98%	-0.25%	-0.12%	-1.41%	0.97%
at321	Lungau	-1.59%	0.25%	0.24%	0.12%	1.40%
at322	Pinzgau-Pongau	-1.48%	0.56%	0.83%	-0.63%	1.68%
at323	Salzburg und Umgebung	-1.28%	-0.05%	0.49%	0.49%	0.66%
at331	Außerfern	-2.33%	-1.14%	-2.38%	-0.64%	-0.76%
at332	Innsbruck	-1.24%	0.45%	-1.05%	-0.75%	1.11%
at333	Osttirol	-2.08%	1.78%	0.54%	0.32%	-0.20%
at334	Tiroler Oberland	-0.66%	-1.36%	1.59%	0.59%	1.59%
at335	Tiroler Unterland	-1.56%	-0.14%	1.28%	0.59%	1.07%
at341	Bludenz-Bregenzer Wald	-1.25%	0.76%	1.35%	-0.66%	0.95%
at342	Rheintal-Bodenseegebiet	-1.57%	-0.23%	-0.04%	0.14%	1.06%

REGIONAL ANALYSIS: SUMMARY OF THE RESULTS

SUMMARY SCENARIO TOLERANT 2020						
	Transport intensive sectors		Transport sector			
in Mill EUR	additional costs	excess burden	loss in GVA road freight transport	*estimate: road freight transport with SLA and infrastructure**	increase in GVA rail freight transport	*estimate: rail freight transport with SLA and infrastructure**
DE	52.8	5.5	44.1	*48.5*	20.4	*41.4*
FR	42.3	2.5	31.5	*34.6*	15.5	*31.4*
IT	154.9	15.5	69.9	*76.8*	31.6	*64.1*
AT	40.4	2.7	20.4	*22.4*	9.4	*19.1*
SI	6.4	0.8	3.5	*3.9*	1.6	*3.2*
CH	8.1	4.0	19.5	*21.5*	8.9	*18.0*
Total	304.8	31.0	188.9	*207.8*	87.3	*177.2*

Table 35 Overview of the results of scenario Tolerant 2020 in absolute values.
*Rough estimate on the basis of Swiss data.

SUMMARY SCENARIO RESTRICTIVE 2020						
	Transport intensive sectors		Transport sector			
in Mill EUR	additional costs	excess burden	loss in GVA road freight transport	*estimate: road freight transport with infrastructure**	increase in GVA rail freight transport	*estimate: rail freight transport with SLA and infrastructure**
DE	95.2	47.6	85.8	*94.4*	40.6	*82.4*
FR	67.5	17.3	51.0	*56.2*	26.2	*53.3*
IT	271.9	90.2	126.1	*138.7*	59.5	*120.7*
AT	83.5	35.4	50.1	*55.1*	23.3	*47.3*
SI	12.4	7.3	7.9	*8.7*	3.6	*7.3*
CH	9.6	8.0	19.5	*21.4*	9.1	*18.4*
Total	540.0	205.9	340.4	*374.4*	162.3	*329.5*

Table 36 Overview of the results of scenario Restrictive 2020 in absolute values.
*Rough estimate on the basis of Swiss data.

SUMMARY SCENARIO TOLERANT 2030						
	Transport intensive sectors		Transport sector			
in Mill EUR	additional costs	excess burden	loss in GVA road freight transport	*estimate: road freight transport with SLA and infrastructure**	increase in GVA rail freight transport	*estimate: rail freight transport with SLA and infrastructure**
DE	129.2	87.6	145.0	*159.6*	67.8	*137.5*
FR	105.5	69.5	132.6	*145.9*	67.7	*137.4*
IT	393.2	215.3	264.4	*290.8*	123.6	*250.8*
AT	103.1	55.5	74.9	*82.4*	34.9	*70.8*
SI	23.7	16.6	18.4	*20.3*	8.5	*17.3*
CH	13.3	31.0	49.6	*54.5*	22.8	*46.2*
Total	768.0	475.6	685.0	*753.5*	325.2	*660.1*

Table 37 Overview of the results of scenario Tolerant 2030 in absolute values.
*Rough estimate on the basis of Swiss data.

SUMMARY SZENARIO RESTRICTIVE 2030						
	Transport intensive sectors		Transport sector			
in Mill EUR	additional costs	excess burden	loss in GVA road freight transport	*estimate: road freight transport with SLA and infrastructure**	increase in GVA rail freight transport	*estimate: rail freight transport with SLA and infrastructure**
DE	148.6	316.6	235.0	*258.5*	111.3	*225.9*
FR	125.0	130.1	172.9	*190.2*	89.0	*180.6*
IT	484.9	621.5	415.3	*456.8*	197.8	*401.6*
AT	126.5	237.5	140.1	*154.1*	65.8	*133.6*
SI	28.7	64.6	32.8	*36.1*	15.3	*31.1*
CH	13.1	53.2	56.2	*61.8*	26.3	*53.4*
Total	926.9	1'423.5	1'052.3	*1'157.6*	505.5	*1'026.1*

Table 38 Overview of the results of scenario Restrictive 2030 in absolute values.
*Rough estimate on the basis of Swiss data.

SUMMARY SCENARIO RESTRICTIVE 2020				
	Transport intensive sectors		Transport sector	
in % of the sectors GVA	additional costs	excess burden	loss in GVA road freight transport	increase in GVA rail freight transport
DE	0.01%	0.01%	0.37%	2.04%
FR	0.02%	0.00%	0.23%	1.86%
IT	0.09%	0.03%	0.83%	8.77%
AT	0.09%	0.04%	0.69%	2.26%
SI	0.12%	0.07%	1.30%	10.60%
CH	0.01%	0.01%	0.32%	1.46%

Table 39 Overview of the results of scenario Restrictive 2020 in relative values.

SUMMARY SCENARIO TOLERANT 2020				
	Transport intensive sectors		Transport sector	
in % of the sectors GVA	additional costs	excess burden	loss in GVA road freight transport	increase in GVA rail freight transport
DE	0.01%	0.00%	0.19%	1.02%
FR	0.01%	0.00%	0.14%	1.10%
IT	0.05%	0.01%	0.46%	4.65%
AT	0.04%	0.01%	0.28%	0.91%
SI	0.06%	0.01%	0.58%	4.65%
CH	0.01%	0.01%	0.33%	1.43%

Table 40 Overview of the results of scenario Tolerant 2020 in relative values.

SUMMARY SZENARIO RESTRICTIVE 2030				
	Transport intensive sectors		Transport sector	
in % of the sectors GVA	additional costs	excess burden	loss in GVA road freight transport	increase in GVA rail freight transport
DE	0.02%	0.04%	0.88%	4.85%
FR	0.03%	0.03%	0.71%	5.81%
IT	0.16%	0.21%	2.62%	28.07%
AT	0.11%	0.21%	1.89%	6.24%
SI	0.30%	0.67%	5.20%	43.08%
CH	0.01%	0.04%	0.76%	3.43%
Total	0.05%	0.08%	1.28%	8%

Table 41 Overview of the results of scenario Restrictive 2030 in relative values.

SUMMARY SCENARIO TOLERANT 2030				
	Transport intensive sectors		Transport sector	
in % of the sectors GVA	additional costs	excess burden	loss in GVA road freight transport	increase in GVA rail freight transport
DE	0.02%	0.01%	0.54%	2.96%
FR	0.02%	0.02%	0.55%	4.42%
IT	0.13%	0.07%	1.67%	17.53%
AT	0.09%	0.05%	1.01%	3.31%
SI	0.25%	0.17%	2.92%	23.93%
CH	0.01%	0.02%	0.67%	2.97%

Table 42 Overview of the results of scenario Tolerant 2030 in relative values.

REGIONAL ANALYSIS: RESULTS OF THE CALCULATION OF THE SCENARIOS

The following table shows the burden per sector in % of its GVA in the different scenarios. “T” stands for scenario Tolerant, “R” for scenario Restrictive.

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
DE11	Stuttgart	0.02%	0.04%	0.05%	0.09%	0.01%	0.01%	0.02%	0.03%	0.01%	0.01%	0.02%	0.03%	0.31%	0.63%	0.92%	1.57%	1.65%	3.47%	5.03%	8.66%
DE12	Karlsruhe	0.03%	0.07%	0.08%	0.15%	0.01%	0.01%	0.02%	0.04%	0.00%	0.01%	0.01%	0.02%	0.34%	0.58%	0.98%	1.47%	1.81%	3.18%	5.32%	8.07%
DE13	Freiburg	0.02%	0.04%	0.05%	0.09%	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.03%	0.13%	0.22%	0.37%	0.58%	0.70%	1.23%	1.99%	3.20%
DE14	Tübingen	0.02%	0.04%	0.04%	0.08%	0.01%	0.01%	0.02%	0.03%	0.01%	0.02%	0.02%	0.03%	0.29%	0.59%	0.78%	1.21%	1.58%	3.24%	4.26%	6.67%
DE21	Oberbayern	0.02%	0.05%	0.05%	0.10%	0.01%	0.03%	0.03%	0.06%	0.00%	0.01%	0.01%	0.02%	0.59%	1.31%	1.51%	2.43%	3.21%	7.23%	8.31%	13.37 %
DE22	Nieder-bayern	0.01%	0.03%	0.03%	0.05%	0.01%	0.03%	0.03%	0.05%	0.01%	0.01%	0.01%	0.03%	0.27%	0.67%	0.88%	1.72%	1.47%	3.71%	4.84%	9.48%
DE23	Oberpfalz	0.01%	0.03%	0.03%	0.05%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.02%	0.29%	0.68%	0.83%	1.41%	1.58%	3.71%	4.58%	7.76%
DE24	Oberfrank-en	0.01%	0.03%	0.04%	0.07%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.02%	0.23%	0.55%	0.79%	1.48%	1.25%	3.02%	4.33%	8.12%
DE25	Mittelfrank-en	0.01%	0.03%	0.04%	0.07%	0.01%	0.02%	0.03%	0.05%	0.01%	0.01%	0.02%	0.03%	0.41%	0.89%	1.06%	1.65%	2.26%	4.91%	5.83%	9.07%
DE26	Unterfrank-en	0.01%	0.02%	0.03%	0.05%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.01%	0.10%	0.21%	0.32%	0.52%	0.56%	1.16%	1.72%	2.84%
DE27	Schwaben	0.02%	0.05%	0.05%	0.09%	0.01%	0.02%	0.03%	0.05%	0.01%	0.01%	0.01%	0.03%	0.42%	0.91%	1.14%	1.90%	2.26%	5.00%	6.23%	10.44 %
DE30	Berlin	0.07%	0.16%	0.19%	0.35%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.01%	0.04%	0.09%	0.13%	0.25%	0.21%	0.48%	0.69%	1.36%
DE41	Branden-burg - Nordost	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.02%	0.05%	0.07%	0.13%	0.12%	0.28%	0.39%	0.74%
DE42	Branden-burg - Südwest	0.01%	0.02%	0.02%	0.03%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.01%	0.15%	0.31%	0.45%	0.78%	0.78%	1.69%	2.44%	4.31%
DE50	Bremen	0.10%	0.19%	0.23%	0.40%	0.02%	0.03%	0.04%	0.07%	0.01%	0.01%	0.01%	0.02%	0.19%	0.36%	0.55%	0.93%	0.98%	1.97%	2.94%	5.13%
DE60	Hamburg	0.08%	0.17%	0.22%	0.40%	0.01%	0.03%	0.03%	0.06%	0.00%	0.01%	0.01%	0.02%	0.12%	0.22%	0.33%	0.56%	0.61%	1.20%	1.77%	3.06%
DE71	Darmstadt	0.01%	0.02%	0.03%	0.06%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.02%	0.05%	0.09%	0.15%	0.23%	0.26%	0.48%	0.79%	1.27%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
DE72	Gießen	0.00%	0.01%	0.01%	0.02%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.00%	0.01%	0.87%	1.34%	2.48%	3.36%	4.67%	7.34%	13.48 %	18.49 %
DE73	Kassel	0.01%	0.02%	0.02%	0.03%	0.01%	0.01%	0.01%	0.03%	0.00%	0.01%	0.01%	0.02%	0.11%	0.21%	0.33%	0.54%	0.57%	1.16%	1.77%	2.98%
DE80	Mecklenb.-Vor-pommern	0.01%	0.02%	0.03%	0.06%	0.02%	0.04%	0.05%	0.09%	0.00%	0.00%	0.00%	0.01%	0.23%	0.50%	0.78%	1.44%	1.22%	2.78%	4.23%	7.93%
DE91	Braun-schweig	0.00%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.16%	0.32%	0.48%	0.85%	0.86%	1.78%	2.59%	4.66%
DE92	Hannover	0.00%	0.01%	0.01%	0.02%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.02%	0.11%	0.22%	0.35%	0.58%	0.61%	1.23%	1.86%	3.19%
DE93	Lüneburg	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.00%	0.01%	0.06%	0.12%	0.18%	0.32%	0.33%	0.67%	0.96%	1.75%
DE94	Weser-Ems	0.01%	0.01%	0.02%	0.03%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.00%	0.01%	0.08%	0.14%	0.23%	0.40%	0.40%	0.79%	1.20%	2.21%
DEA1	Düsseldorf	0.01%	0.02%	0.02%	0.04%	0.01%	0.02%	0.02%	0.04%	0.01%	0.01%	0.02%	0.04%	0.12%	0.20%	0.33%	0.51%	0.64%	1.08%	1.78%	2.83%
DEA2	Köln	0.03%	0.05%	0.07%	0.12%	0.01%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.03%	0.65%	1.07%	1.81%	2.67%	3.50%	5.90%	9.84%	14.7%
DEA3	Münster	0.00%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.08%	0.14%	0.22%	0.36%	0.42%	0.75%	1.20%	2.01%
DEA4	Detmold	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.06%	0.12%	0.18%	0.33%	0.31%	0.67%	0.96%	1.81%
DEA5	Arnsberg	0.01%	0.02%	0.03%	0.06%	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%	0.02%	0.03%	0.12%	0.19%	0.33%	0.50%	0.64%	1.07%	1.80%	2.76%
DEB1	Koblenz	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.00%	0.00%	0.12%	0.21%	0.33%	0.53%	0.65%	1.18%	1.78%	2.92%
DEB2	Trier	0.01%	0.02%	0.02%	0.03%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.01%	0.06%	0.08%	0.15%	0.23%	0.30%	0.47%	0.82%	1.24%
DEB3	Rheinhes-sen-Pfalz	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.01%	0.01%	0.22%	0.35%	0.59%	0.84%	1.19%	1.93%	3.19%	4.61%
DEC0	Saarland	0.03%	0.06%	0.08%	0.14%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.01%	0.33%	0.49%	0.85%	1.21%	1.75%	2.71%	4.54%	6.68%
DED1	Chemnitz	0.01%	0.02%	0.03%	0.05%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.02%	0.10%	0.23%	0.29%	0.54%	0.53%	1.24%	1.59%	2.97%
DED2	Dresden	0.01%	0.02%	0.02%	0.04%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.02%	0.16%	0.34%	0.49%	0.88%	0.85%	1.87%	2.62%	4.84%
DED3	Leipzig	0.02%	0.04%	0.04%	0.08%	0.02%	0.03%	0.04%	0.07%	0.00%	0.01%	0.01%	0.02%	0.24%	0.49%	0.64%	1.14%	1.26%	2.71%	3.43%	6.26%
DEE0	Sachsen-Anhalt	0.01%	0.02%	0.02%	0.03%	0.01%	0.02%	0.02%	0.04%	0.00%	0.00%	0.00%	0.01%	0.08%	0.18%	0.26%	0.50%	0.43%	0.98%	1.43%	2.73%
DEF0	Schleswig-Holstein	0.01%	0.01%	0.02%	0.03%	0.01%	0.02%	0.02%	0.04%	0.00%	0.00%	0.00%	0.01%	0.15%	0.28%	0.48%	0.78%	0.81%	1.53%	2.57%	4.31%
DEG0	Thüringen	0.02%	0.04%	0.04%	0.08%	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.03%	0.10%	0.24%	0.34%	0.65%	0.56%	1.29%	1.86%	3.58%
FR10	Île de France	0.05%	0.09%	0.14%	0.20%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.00%	0.01%	0.07%	0.11%	0.26%	0.33%	0.54%	0.90%	2.07%	2.68%
FR21	Cham-pagne-Ardenne	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.03%	0.04%	0.00%	0.01%	0.01%	0.01%	0.26%	0.39%	0.85%	1.08%	1.98%	3.15%	6.77%	8.68%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
FR22	Picardie	0.01%	0.02%	0.02%	0.03%	0.02%	0.03%	0.05%	0.06%	0.00%	0.01%	0.01%	0.01%	0.21%	0.32%	0.77%	1.01%	1.58%	2.58%	6.05%	8.10%
FR23	Haute-Normandie	0.01%	0.01%	0.01%	0.02%	0.01%	0.02%	0.03%	0.05%	0.00%	0.00%	0.00%	0.01%	0.14%	0.22%	0.57%	0.74%	1.06%	1.76%	4.52%	5.95%
FR24	Centre	0.01%	0.02%	0.02%	0.03%	0.01%	0.01%	0.02%	0.03%	0.00%	0.01%	0.01%	0.01%	0.11%	0.18%	0.44%	0.58%	0.85%	1.47%	3.51%	4.74%
FR25	Basse-Normandie	0.00%	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.00%	0.00%	0.07%	0.11%	0.30%	0.40%	0.51%	0.85%	2.32%	3.24%
FR26	Bourgogne	0.02%	0.03%	0.03%	0.04%	0.01%	0.02%	0.04%	0.05%	0.00%	0.01%	0.01%	0.02%	0.41%	0.66%	1.33%	1.59%	3.33%	5.42%	10.8%	13.0%
FR30	Nord - Pas-de-Calais	0.01%	0.02%	0.03%	0.04%	0.02%	0.03%	0.05%	0.07%	0.00%	0.01%	0.01%	0.01%	0.28%	0.41%	1.08%	1.41%	2.05%	3.31%	8.48%	11.3%
FR41	Lorraine	0.01%	0.01%	0.02%	0.02%	0.01%	0.02%	0.04%	0.05%	0.00%	0.00%	0.01%	0.01%	0.34%	0.44%	1.04%	1.32%	2.47%	3.46%	8.0%	10.3%
FR42	Alsace	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.00%	0.01%	0.14%	0.18%	0.39%	0.50%	1.00%	1.34%	2.9%	3.8%
FR43	Franche-Comté	0.01%	0.01%	0.01%	0.02%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.00%	0.01%	0.26%	0.41%	0.88%	1.13%	2.09%	3.35%	7.1%	9.1%
FR51	Pays de la Loire	0.00%	0.01%	0.01%	0.01%	0.01%	0.02%	0.03%	0.03%	0.00%	0.01%	0.01%	0.01%	0.06%	0.10%	0.27%	0.36%	0.45%	0.77%	2.1%	2.9%
FR52	Bretagne	0.00%	0.00%	0.01%	0.01%	0.01%	0.01%	0.03%	0.03%	0.00%	0.00%	0.00%	0.00%	0.05%	0.07%	0.20%	0.27%	0.33%	0.55%	1.5%	2.2%
FR53	Poitou-Charentes	0.00%	0.00%	0.01%	0.01%	0.01%	0.02%	0.03%	0.04%	0.00%	0.00%	0.01%	0.01%	0.03%	0.05%	0.16%	0.23%	0.20%	0.37%	1.3%	1.9%
FR61	Aquitaine	0.01%	0.01%	0.02%	0.03%	0.01%	0.02%	0.05%	0.06%	0.00%	0.00%	0.01%	0.01%	0.04%	0.07%	0.26%	0.38%	0.30%	0.58%	2.1%	3.1%
FR62	Midi-Pyrénées	0.01%	0.01%	0.02%	0.03%	0.01%	0.02%	0.03%	0.04%	0.00%	0.00%	0.01%	0.01%	0.01%	0.03%	0.09%	0.16%	0.10%	0.21%	0.8%	1.3%
FR63	Limousin	0.01%	0.02%	0.03%	0.03%	0.02%	0.03%	0.05%	0.07%	0.00%	0.00%	0.00%	0.00%	0.12%	0.22%	0.67%	0.93%	0.95%	1.79%	5.4%	7.6%
FR71	Rhône-Alpes	0.02%	0.04%	0.05%	0.06%	0.02%	0.03%	0.05%	0.06%	0.01%	0.01%	0.01%	0.02%	0.26%	0.45%	0.99%	1.26%	2.12%	3.68%	8.2%	10.4%
FR72	Auvergne	0.01%	0.01%	0.02%	0.02%	0.02%	0.03%	0.04%	0.06%	0.00%	0.01%	0.01%	0.01%	0.20%	0.36%	0.99%	1.32%	1.63%	2.99%	8.1%	10.8%
FR81	Languedoc-Roussillon	0.01%	0.02%	0.03%	0.05%	0.02%	0.03%	0.06%	0.07%	0.00%	0.00%	0.01%	0.01%	0.07%	0.13%	0.36%	0.50%	0.56%	1.07%	3.0%	4.1%
FR82	Provence-Alpes-Côte d'Azur	0.01%	0.02%	0.04%	0.05%	0.04%	0.06%	0.10%	0.12%	0.01%	0.01%	0.02%	0.02%	0.22%	0.41%	1.00%	1.34%	1.80%	3.42%	8.3%	11.1%
FR83	Corse	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.0%	0.0%
ITC1	Piemonte	0.05%	0.08%	0.14%	0.20%	0.07%	0.11%	0.20%	0.28%	0.04%	0.06%	0.11%	0.15%	0.83%	1.30%	2.82%	3.78%	8.85%	14.4%	30.9%	41.9%
ITC2	Valle d'Aosta	0.04%	0.07%	0.13%	0.17%	0.09%	0.15%	0.27%	0.38%	0.01%	0.02%	0.03%	0.04%	0.36%	0.57%	1.39%	2.08%	3.57%	6.08%	14.9%	22.6%
ITC3	Liguria	0.09%	0.15%	0.28%	0.40%	0.09%	0.16%	0.33%	0.48%	0.01%	0.03%	0.05%	0.07%	0.4%	0.7%	1.5%	2.2%	4.2%	7.0%	16.4%	23.7%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
ITC4	Lombardia	0.05%	0.09%	0.14%	0.22%	0.05%	0.09%	0.17%	0.25%	0.03%	0.06%	0.09%	0.13%	0.8%	1.4%	2.9%	4.2%	8.6%	14.7%	31.2%	45.5%
ITD1	Bolzano-Bozen	0.07%	0.15%	0.15%	0.27%	0.13%	0.30%	0.30%	0.53%	0.03%	0.07%	0.06%	0.10%	0.9%	2.0%	2.8%	4.9%	8.9%	20.6%	29.2%	51.3%
ITD2	P. A. Trento	0.03%	0.07%	0.09%	0.14%	0.07%	0.15%	0.20%	0.34%	0.01%	0.03%	0.03%	0.05%	0.4%	0.9%	1.6%	2.8%	4.3%	9.8%	16.8%	29.3%
ITD3	Veneto	0.06%	0.12%	0.16%	0.26%	0.07%	0.15%	0.22%	0.38%	0.02%	0.05%	0.06%	0.10%	0.8%	1.7%	2.9%	5.0%	8.2%	17.6%	30.7%	52.7%
ITD4	Friuli-Venezia Giulia	0.09%	0.21%	0.26%	0.52%	0.17%	0.40%	0.51%	1.01%	0.11%	0.27%	0.36%	0.74%	0.8%	1.9%	3.2%	6.9%	7.7%	19.2%	32.0%	71.5%
ITD5	Emilia-Romagna	0.04%	0.08%	0.12%	0.19%	0.06%	0.11%	0.19%	0.30%	0.02%	0.04%	0.06%	0.09%	0.7%	1.2%	2.6%	4.2%	6.8%	13.0%	26.7%	44.3%
ITE1	Toscana	0.03%	0.06%	0.10%	0.15%	0.04%	0.08%	0.15%	0.22%	0.01%	0.02%	0.04%	0.05%	0.3%	0.6%	1.3%	2.1%	3.2%	6.0%	13.6%	22.3%
ITE2	Umbria	0.01%	0.01%	0.02%	0.03%	0.03%	0.06%	0.10%	0.16%	0.01%	0.02%	0.03%	0.04%	0.1%	0.2%	0.4%	0.7%	0.9%	1.8%	3.9%	7.4%
ITE3	Marche	0.02%	0.04%	0.05%	0.09%	0.03%	0.06%	0.10%	0.16%	0.01%	0.02%	0.03%	0.04%	0.2%	0.4%	0.9%	1.5%	2.2%	4.4%	9.0%	16.3%
ITE4	Lazio	0.03%	0.06%	0.10%	0.16%	0.04%	0.08%	0.12%	0.19%	0.01%	0.02%	0.03%	0.05%	0.1%	0.1%	0.2%	0.4%	0.5%	1.0%	2.3%	4.2%
ITF1	Abruzzo	0.01%	0.03%	0.04%	0.06%	0.04%	0.07%	0.14%	0.23%	0.01%	0.02%	0.04%	0.06%	0.2%	0.4%	0.8%	1.4%	2.0%	3.8%	8.6%	14.7%
ITF2	Molise	0.00%	0.01%	0.01%	0.01%	0.04%	0.08%	0.15%	0.27%	0.00%	0.00%	0.00%	0.00%	0.2%	0.3%	0.6%	1.2%	1.4%	3.0%	5.7%	12.6%
ITF3	Campania	0.04%	0.08%	0.12%	0.21%	0.07%	0.13%	0.25%	0.42%	0.01%	0.01%	0.03%	0.04%	0.1%	0.2%	0.4%	0.7%	0.8%	1.6%	3.3%	7.0%
ITF4	Puglia	0.03%	0.06%	0.09%	0.16%	0.03%	0.05%	0.09%	0.16%	0.00%	0.01%	0.01%	0.02%	0.1%	0.1%	0.3%	0.5%	0.6%	1.3%	2.5%	5.3%
ITF5	Basilicata	0.00%	0.01%	0.01%	0.02%	0.03%	0.06%	0.10%	0.16%	0.01%	0.02%	0.03%	0.06%	0.1%	0.1%	0.2%	0.4%	0.6%	1.0%	2.1%	4.2%
ITF6	Calabria	0.01%	0.02%	0.03%	0.06%	0.02%	0.05%	0.09%	0.16%	0.01%	0.01%	0.02%	0.03%	0.0%	0.1%	0.2%	0.3%	0.3%	0.7%	1.4%	3.0%
ITG1	Sicilia	0.01%	0.01%	0.02%	0.03%	0.01%	0.01%	0.02%	0.04%	0.00%	0.00%	0.00%	0.01%	0.0%	0.0%	0.1%	0.1%	0.2%	0.4%	0.7%	1.3%
ITG2	Sardegna	0.00%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.04%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
SI01	Vzhodna Slovenija	0.03%	0.07%	0.11%	0.20%	0.04%	0.09%	0.16%	0.30%	0.01%	0.03%	0.07%	0.13%	0.5%	1.2%	2.8%	4.7%	4.4%	9.8%	22.7%	39.1%
SI02	Zahodna Slovenija	0.13%	0.30%	0.61%	1.18%	0.11%	0.26%	0.52%	0.99%	0.05%	0.13%	0.39%	0.81%	0.6%	1.4%	3.0%	5.5%	4.8%	11.2%	24.8%	45.8%
AT111	Mittelburgenland	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
AT112	Nordburgenland	0.02%	0.04%	0.04%	0.07%	0.01%	0.02%	0.02%	0.03%	0.00%	0.01%	0.01%	0.02%	0.1%	0.2%	0.2%	0.4%	0.3%	0.6%	0.8%	1.2%
AT113	Südburgenland	0.11%	0.26%	0.44%	0.83%	0.02%	0.05%	0.04%	0.08%	0.00%	0.00%	0.01%	0.01%	0.1%	0.3%	0.4%	0.7%	0.4%	1.0%	1.4%	2.3%
AT121	Mostviertel-Eisenwurz.	0.02%	0.05%	0.06%	0.11%	0.01%	0.02%	0.02%	0.03%	0.00%	0.01%	0.01%	0.01%	0.1%	0.1%	0.2%	0.3%	0.2%	0.5%	0.5%	0.9%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
AT122	Niederö-sterr.-Süd	0.01%	0.02%	0.02%	0.04%	0.01%	0.02%	0.02%	0.03%	0.00%	0.01%	0.02%	0.02%	0.1%	0.1%	0.3%	0.5%	0.2%	0.5%	0.9%	1.6%
AT123	Sankt Pölten	0.03%	0.08%	0.11%	0.20%	0.01%	0.03%	0.03%	0.06%	0.00%	0.01%	0.01%	0.02%	0.0%	0.0%	0.1%	0.2%	0.1%	0.2%	0.3%	0.5%
AT124	Waldviertel	0.01%	0.02%	0.02%	0.04%	0.01%	0.02%	0.02%	0.04%	0.00%	0.00%	0.00%	0.01%	0.0%	0.1%	0.1%	0.2%	0.1%	0.2%	0.4%	0.6%
AT125	Weinviertel	0.01%	0.01%	0.01%	0.02%	0.02%	0.05%	0.05%	0.10%	0.00%	0.01%	0.01%	0.02%	0.1%	0.2%	0.4%	0.7%	0.4%	0.8%	1.4%	2.3%
AT126	Wiener Um-land/Nordt.	0.01%	0.03%	0.04%	0.07%	0.00%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.0%	0.1%	0.1%	0.2%	0.1%	0.2%	0.4%	0.6%
AT127	Wiener Um-land/Südteil	0.31%	0.69%	0.83%	1.56%	0.01%	0.03%	0.04%	0.06%	0.01%	0.02%	0.03%	0.05%	0.1%	0.2%	0.2%	0.3%	0.2%	0.5%	0.7%	1.1%
AT130	Wien	0.05%	0.11%	0.17%	0.30%	0.01%	0.02%	0.02%	0.04%	0.00%	0.01%	0.01%	0.03%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.2%	0.4%
AT211	Klagenfurt-Villach	1.10%	2.71%	3.82%	7.68%	0.36%	0.84%	1.00%	1.88%	0.26%	0.64%	1.32%	2.58%	2.2%	5.6%	10.2%	20.8%	6.7%	17.6%	32.3%	67.9%
AT212	Oberkärn-ten	0.28%	0.72%	0.77%	1.61%	0.24%	0.59%	0.77%	1.55%	0.02%	0.04%	0.06%	0.11%	0.7%	1.8%	2.9%	5.9%	2.1%	6.0%	9.4%	19.4%
AT213	Unterkärn-ten	0.24%	0.60%	0.72%	1.47%	0.08%	0.20%	0.15%	0.30%	0.02%	0.06%	0.09%	0.16%	0.6%	1.5%	2.4%	5.2%	1.8%	4.9%	7.6%	17.0%
AT221	Graz	0.12%	0.26%	0.34%	0.59%	0.06%	0.14%	0.15%	0.27%	0.03%	0.07%	0.12%	0.21%	0.6%	1.4%	2.5%	4.0%	2.1%	4.6%	8.4%	13.2%
AT222	Liezen	0.07%	0.15%	0.17%	0.33%	0.03%	0.07%	0.07%	0.13%	0.03%	0.06%	0.10%	0.19%	0.4%	1.0%	1.6%	2.4%	1.5%	3.5%	5.4%	8.1%
AT223	Östliche Ober-steiermark	0.03%	0.06%	0.09%	0.14%	0.01%	0.02%	0.02%	0.04%	0.01%	0.02%	0.04%	0.07%	0.3%	0.5%	1.1%	1.7%	0.8%	1.7%	3.3%	5.0%
AT224	Oststeier-mark	0.01%	0.02%	0.04%	0.07%	0.01%	0.02%	0.02%	0.05%	0.00%	0.01%	0.01%	0.02%	0.0%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.4%
AT225	West- und Südsteier-mark	0.04%	0.11%	0.14%	0.29%	0.03%	0.07%	0.08%	0.14%	0.02%	0.04%	0.08%	0.14%	0.1%	0.3%	0.5%	0.8%	0.5%	1.1%	1.5%	2.5%
AT226	Westliche Ober-steiermark	0.12%	0.28%	0.36%	0.64%	0.14%	0.30%	0.38%	0.67%	0.08%	0.17%	0.29%	0.52%	1.6%	3.9%	9.2%	16.4%	5.2%	12.6%	29.8%	54.2%
AT311	Innviertel	0.02%	0.04%	0.04%	0.08%	0.01%	0.03%	0.02%	0.04%	0.02%	0.06%	0.08%	0.14%	0.2%	0.6%	0.7%	1.2%	0.8%	2.0%	2.4%	4.1%
AT312	Linz-Wels	0.32%	0.72%	1.07%	2.00%	0.04%	0.10%	0.11%	0.20%	0.03%	0.07%	0.12%	0.22%	0.7%	1.7%	2.1%	3.5%	2.4%	5.6%	7.0%	11.5%
AT313	Mühlviertel	0.01%	0.02%	0.02%	0.04%	0.02%	0.04%	0.04%	0.06%	0.01%	0.02%	0.03%	0.06%	0.2%	0.4%	0.6%	0.9%	0.5%	1.3%	1.8%	3.1%
AT314	Steyr-Kirchdorf	0.02%	0.04%	0.05%	0.09%	0.01%	0.03%	0.02%	0.04%	0.01%	0.02%	0.02%	0.04%	0.3%	0.8%	1.1%	2.0%	1.0%	2.5%	3.7%	6.6%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
AT315	Traunviertel	0.05%	0.12%	0.14%	0.26%	0.02%	0.05%	0.05%	0.09%	0.02%	0.04%	0.06%	0.11%	0.2%	0.6%	0.9%	2.0%	0.6%	1.8%	3.0%	6.6%
AT321	Lungau	0.60%	1.51%	2.08%	4.37%	0.14%	0.34%	0.40%	0.85%	0.01%	0.04%	0.04%	0.10%	0.8%	1.8%	2.7%	4.9%	2.5%	5.9%	8.7%	16.3%
AT322	Pinzgau-Pongau	0.42%	1.04%	1.31%	2.60%	0.05%	0.13%	0.13%	0.26%	0.02%	0.05%	0.07%	0.14%	0.1%	0.4%	0.6%	1.5%	0.5%	1.4%	2.1%	5.1%
AT323	Salzburg und Umge-bung	0.41%	0.96%	1.08%	1.98%	0.06%	0.15%	0.15%	0.27%	0.05%	0.12%	0.19%	0.32%	0.3%	0.7%	1.3%	2.8%	0.9%	2.5%	4.2%	9.3%
AT331	Außerfern	0.17%	0.38%	0.34%	0.74%	0.01%	0.02%	0.01%	0.03%	0.01%	0.03%	0.04%	0.07%	0.3%	0.6%	0.4%	0.5%	0.9%	1.8%	1.3%	1.7%
AT332	Innsbruck	1.11%	2.72%	3.12%	6.50%	0.08%	0.21%	0.19%	0.38%	0.07%	0.17%	0.32%	0.62%	0.4%	1.0%	1.7%	3.7%	1.3%	3.4%	5.5%	12.1%
AT333	Osttirol	0.14%	0.36%	0.54%	1.14%	0.25%	0.60%	0.84%	1.61%	0.14%	0.31%	0.52%	0.94%	0.7%	2.0%	4.0%	8.4%	2.2%	6.4%	13.2%	27.8%
AT334	Tiroler Oberland	0.54%	1.23%	1.44%	2.73%	0.06%	0.14%	0.15%	0.28%	0.01%	0.03%	0.03%	0.05%	0.1%	0.3%	0.3%	0.5%	0.3%	0.9%	0.9%	1.6%
AT335	Tiroler Unterland	0.45%	1.02%	0.95%	1.72%	0.03%	0.08%	0.07%	0.13%	0.02%	0.05%	0.07%	0.13%	0.6%	1.4%	1.7%	2.9%	1.8%	4.6%	5.8%	9.7%
AT341	Bludenz-Bregenzer Wald	0.19%	0.40%	0.28%	0.54%	0.02%	0.05%	0.05%	0.09%	0.01%	0.02%	0.02%	0.04%	0.3%	0.7%	0.7%	1.1%	0.9%	2.3%	2.4%	3.7%
AT342	Rheintal-Boden-seegebiet	0.39%	0.90%	1.13%	1.99%	0.04%	0.08%	0.08%	0.14%	0.02%	0.04%	0.06%	0.11%	0.5%	1.2%	1.8%	3.4%	1.6%	3.9%	5.8%	11.4%
CH011	Vaud	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
CH012	Valais	0.00%	0.01%	0.02%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
CH013	Geneva	0.11%	0.17%	0.37%	0.49%	0.01%	0.02%	0.03%	0.03%	0.00%	0.01%	0.01%	0.01%	0.2%	0.3%	0.5%	0.6%	1.1%	1.3%	2.4%	2.8%
CH021	Berne	0.02%	0.02%	0.06%	0.08%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.3%	0.3%	0.5%	0.6%	1.1%	1.2%	2.4%	2.8%
CH022	Fribourg	0.02%	0.02%	0.06%	0.08%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.3%	0.3%	0.5%	0.6%	1.1%	1.2%	2.4%	2.8%
CH023	Solothurn	0.02%	0.02%	0.06%	0.08%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.3%	0.3%	0.5%	0.6%	1.1%	1.2%	2.4%	2.8%
CH024	Neuchâtel	0.02%	0.02%	0.06%	0.08%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.3%	0.3%	0.5%	0.6%	1.1%	1.2%	2.4%	2.8%
CH025	Jura	0.02%	0.02%	0.06%	0.08%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.02%	0.3%	0.3%	0.5%	0.6%	1.1%	1.2%	2.4%	2.8%
CH031	Basel-Stadt	0.04%	0.05%	0.12%	0.17%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.7%	0.8%	1.4%	1.4%	3.0%	3.5%
CH032	Basel-Landschaft	0.04%	0.05%	0.12%	0.17%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.7%	0.8%	1.4%	1.4%	3.0%	3.5%
CH033	Aargau	0.04%	0.05%	0.12%	0.17%	0.01%	0.01%	0.02%	0.03%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.7%	0.8%	1.4%	1.4%	3.0%	3.5%
CH040	Zürich	0.03%	0.03%	0.08%	0.12%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.00%	0.01%	0.1%	0.1%	0.2%	0.3%	0.5%	0.5%	1.0%	1.1%

Burden in % of the sectors GVA		Agriculture				Energy and Manufacturing				Construction				Road Transport				Rail Transport			
		2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R	2020T	2020R	2030T	2030R
CH051	Glarus	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH052	Schaffhau-sen	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH053	Appenzell Ausserrhod.	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH054	Appenzell Innerrhoden	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.7%	0.8%	1.2%	1.4%	2.8%	3.7%
CH055	St. Gallen	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH056	Grisons	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH057	Thurgau	0.02%	0.02%	0.04%	0.06%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.3%	0.3%	0.6%	0.8%	1.2%	1.3%	2.8%	3.6%
CH061	Lucerne	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH062	Uri	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH063	Schwyz	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH064	Obwalden	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH065	Nidwalden	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.02%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH066	Zug	0.02%	0.02%	0.05%	0.07%	0.01%	0.01%	0.01%	0.02%	0.00%	0.00%	0.01%	0.01%	0.4%	0.4%	0.7%	0.7%	1.7%	1.7%	3.1%	3.4%
CH070	Ticino	0.23%	0.23%	0.56%	0.72%	0.08%	0.08%	0.16%	0.20%	0.03%	0.03%	0.05%	0.06%	2.7%	2.6%	5.4%	6.0%	12.0%	11.8%	24.1%	27.0%

ANNEX 2 QUALITATIVE ASSESSMENT

STUDIES ON ECONOMIC INSTRUMENTS

The following tables summarize the main results of some further key studies regarding:

› Reaction mechanisms of road transport operators

› Reaction mechanisms of transport-intensive sectors (shippers)

› Impacts in regional economies in the Alpine Space.

RESULTS FOR MAIN REACTION PATTERNS – ROAD OPERATORS			
Name of study	**Reaction patterns carriers and logistic service providers**	**Information on cost-pass through rates**	**Further information**
Internalisation measures and policy IMPACT (2008)	No specific assumptions on reaction patterns. The impact assessment uses the TREMOVE and TRANSTOOL models.	No specific information is provided.	
Potential effects of differentiated user charges on intermodal chains and modal change Deliverable D10.2 of the project DIFFERENT (2008)	Optimisation of efficiency: › Road operators already search for ways of minimizing costs in order to compete on the market Modal shift: › Differentiated charges lead to a higher use of intermodal services. › According to simulations, intermodal haulages are attractive on medium and long routes (i.e. from 500 km)	The study assumes that an increase of transport costs will be incurred by the final user, i.e. costs can be passed on.	A survey provides information on barriers to modal shift and to using intermodal solutions.

RESULTS FOR MAIN REACTION PATTERNS – ROAD OPERATORS			
Name of study	**Reaction patterns carriers and logistic service providers**	**Information on cost-pass through rates**	**Further information**
EU COM impact assessment Eurovignette Directive (2008)	The impact assessment does not provide detailed information on reaction mechanisms. It provides some overall estimates: › The implementation of charges/taxes would lead to a decrease in transport volumes on the road. › Detour of traffic can be one of the adverse effects of pricing if the toll is only applied on motorways. › A shift from road to rail becomes only attractive on longer distances.	No specific information is provided.	Barriers to modal shift: › Need for greater flexibility (Just-in-time processes)
Evaluation LSVA Ecoplan and INFRAS (2007)	Optimisation of vehicle fleet: › Short-term: higher use of light duty vehicles as they are not charged. This strategy has been changed again due to an increase of labour costs. › Use of higher weight classes (due to higher weight limits). › Higher use of HGV from higher Euro classes due to differentiation of HGV fee. Optimisation of processes: › Higher use of cross-docking › More cooperations and mergers › Pooling of transport orders Dynamic adjustments: › Concentration process in the road transport market	› Logistic service providers have a greater potential to pass on the cost than pure road carriers › Logistic service providers: cost pass-through on national market: 90%, on international market: 20% › Road carriers: Full pass-through possible in the short-term, long-term only about 50% The pass-through rates also depend on the types of goods and the status of the shipper (private, public)	For some transport companies, the HGV fee has triggered an optimisation process that brought an advantage on other market segments. Barriers for optimisation: › Trends in transport sector to smaller shipments › High competitive pressure
Evaluation Swiss Modal shift policy Vatter and Synergo (2009)	See results of Ecolplan and INFRAS (2007) Additional interviews made clear that for long-distance transport, the incentive from the Swiss HGV fee is not high enough to lead to a modal shift.	The reimbursement of the HGV fee for up- and downstream services of combined transport is not fully passed on to shippers.	

RESULTS FOR MAIN REACTION PATTERNS – ROAD OPERATORS			
Name of study	**Reaction patterns carriers and logistic service providers**	**Information on cost-pass through rates**	**Further information**
Regional impacts of ACE Infras (2010)	› Further vehicle efficiency potentials are limited as efficiency has already been optimized with introduction of HGV fee. › In short-distance traffic, there is a high potential to reduce empty runs. › The use of rolling motorway is only attractive if the overall transport distance is > 180 km and if up- and downstream services are < 110 km	It is assumed that cost pass-through rates depend on value of goods: › Pass-through of 50% for low-value goods (agriculture, bulk goods, steel, etc.) › Pass-through of 75% for medium value goods (chemical products, paper) › Pass-through of 100% for high-value products	Discussions during the workshop made clear that transport operators fear an obstruction of traffic flow from a traffic management instrument (e.g. through shortage of allowances).
Evaluation German HGV toll Bundesamt für Güterverkehr (2006)	Vehicle fleet: › The differentiation of the toll has led to a shift in the vehicle fleet towards Euro 5 › The toll has led to an increase of light duty vehcles < 12 t Optimisation of processes to reduce empty runs: › Optimisation of routes › Pooling of transport orders with help of freight platforms › Cooperations Rerouting: The German HGV toll is only applied on motorways. This has led to some shifts to the subordinate road network. This shift is however limited due to an increase in travel time.	› In most segments, costs of the HGV toll can be fully passed on to shippers. › The pass-through of costs is not fully possible in the food sector, the construction sector, automobiles and furniture transports. › Also, on the spot-market the full cost pass-through is not possible due to high competition. › The toll cost of empty retour runs or transfers is mostly borne by the operator.	The time difference between the payment of the HGV toll and the invoicing leads to a higher financial capital need of transport operators. Barriers to optimisation: › Structural effect of consumption patterns with higher focus on high value goods.

Table 43

RESULTS MAIN REACTION PATTERNS – TRANSPORT-INTENSIVE SECTORS		
Name of study	**Reaction patterns carriers and logistic service providers**	**Information on cost-pass through rates**
Potential effects of differentiated user charges on intermodal chains and modal change Deliverable D10.2 of the project DIFFERENT (2008)	A survey of transport-intensive industries provided the following crucial results: › The transport price is not the only aspect to determine the mode choice. › Some companies have developed logistic strategies over a long time. Changes are taken if planning security is provided.	The study assumes that an increase of transport costs will be incurred by the final user, i.e. costs can be passed on.
EU COM impact assessment Eurovignette Directive (2008)	No specific information on transport-intensive industries.	
Evaluation LSVA Ecoplan and INFRAS (2007)	Construction sector: › Only few possibilities for adjustment due to specific transport demand Food sector: › Reduction of empty runs › Cross-docking › ITS solutions to increase efficiency	Construction sector: high cost pass-through rates, especially for public projects. Food sector: about 50% cost pass-through possible Cross-subsidisation of products in the food sector
Evaluation Swiss Modal shift policy	No specific information on transport-intensive industries	
Regional impacts of ACE Infras (2010)	› Impacts on different transport-intensive sectors are analysed, with a special focus on local and short-distance transport. › No specific assumptions on reaction patterns.	It is assumed that costs are not passed on to clients on the production chain or consumers (maximum scenario).
Evaluation German HGV toll Bundesamt für Güterverkehr (2006)	Shift to rail: › Some shippers increased their use of rail (especially container transport). › Some however reacted with a demand strategy towards their road operators: they only paid a part of the HGV toll, up to the level where road transport costs equal combined transport costs. Dynamic adjustments: › Private haulage (Werksverkehr) is partly outsourced to transport operators as they have a greater potential for optimization.	› Additonal costs of private haulage (Werksverkehr) are difficult to pass-on to clients.

Table 44

Up to now, only few studies have analysed the regional impacts of new traffic management instruments like the Alpine Crossing Exchange, an Emissions Trading or Toll Plus System. The following table gives an overview of the most important results.

RESULTS REGIONAL ECONOMIC IMPACTS		
Name of study	**Impacts on regional transport sector**	**Overall regional economic impacts**
Evaluation LSVA Ecoplan and INFRAS (2007)	› Small transport operators from Alpine regions often have less and shorter transport distances and thus use their vehicles much longer. They have less potential for optimization.	Impacts on regional economies: › The increase of transport costs in mountain regions per employee is higher than the average increase. › The transport sector and the transport-intensive industries are located in both mountain and flat areas and there are no specific impacts.
Regional impacts of ACE Infras (2011)	› Impacts on the transport sector in the Alpine regions differ per region. › The increase of transport costs amounts to less than 1% in most Swiss Alpine regions. In Ticino, the impact is 1.9% of value added, with the highest impact in the MS region Tre Valli of 6%.	› The impact on transport-intensive industries is limited. In the worst case (MS region Tre Valli), the impact amounts to 0.4% of value added.
Tirol study on night driving ban (2011)	*[will be added as soon as available]*	›

Table 45

STUDIES ON CLOSURES OF ALPINE CORRIDORS

Closure of Gotthard Tunnel

After the fire in the Gotthard tunnel 2001, the road tunnel had to be closed for 2 months. A study commissioned by the canton of Ticino (Rudel 2002) has analysed the short term economic impacts. Concerning freight transport, the following conclusions were drawn:

› The rolling motorway as an alternative to lorry transport has increased significantly,

› The reduction of total freight transport compared to other years was also due to a reduction of empty lorry transport. The loading factors – and hence the efficiency of road transport has increased significantly.

› The additional costs for the transport and logistics sector – due to additional waiting and detouring times – were estimated at 200 CHF per trip of 10 million CHF in total. Major impacts became visible for time critical goods (especially agriculture and food industry).

Closure of Mont Blanc tunnel

The fire in the Mont Blanc Tunnel 1999 resulted in a tunnel closure of 3 years. A French study (Conseil Général des Alpes Marittimes 1999) also has analysed the short term economic impacts. Also this study has shown – besides major detouring effects – a significant increase of road transport efficiency and major economic impacts especially on medium and small sized enterpries in the Aosta valley (manufacturing industry, individual cargo, KEP-industry). The study estimated an economic loss for these industries of 16 Mill €/a.

POSITION PAPERS OF THE TRANSPORT INDUSTRY

During the revision of the Eurovignette Directive and the implementation of road tolls across Europe, the road transport industry has developed several position papers and background documents as input to the discussion. These inputs can be used to get a first impression on reaction patterns as seen from the industry viewpoint. The following table summarizes the main results:

POSITION PAPERS OF THE TRANSPORT INDUSTRY			
Name of study	**Reaction patterns**	**Information on cost-pass through rates**	**Further information**
Joint industry position on revision of Eurovignette Directive CLECAT et al. (June 2011)	The position paper challenges the influence of price incentives on road transport patterns. Differentiation in time: According to the paper, road transport patterns are determined by customer demands and regulatory requirements so that a strict shift to the cheapest time zone is impossible.	Without viable alternatives, road freight transport will become more expensive. Hauliers are unable to absorb or pass on the extra costs will struggle to survive.	
European Express Association 2010 Statement on Eurovignette Directive	Differentiation in time and inclusion of external costs of congestion: › The express industry provides time-bound delivery services so that a differentiated road charging will have a highly negative impact. › A charging system should include all road users to prevent a discrimination of freight transport.	-	
BIEK Position Paper on German HGV Toll (2003)	The express industry delivers mostly overnight with a very limited potential to shift to rail.	The express industry is not able to absorb any additional costs so that the road toll has to be passed on to customers.	Regional impacts: The toll will lead to an overproportional burden in remote areas as there is less potential for pooling of transports.

POSITION PAPERS OF THE TRANSPORT INDUSTRY			
Name of study	**Reaction patterns**	**Information on cost-pass through rates**	**Further information**
Alliance for European Logistics Response to consultation on future EU 2020 strategy	› Road transport patterns are commanded by customers and regulatory demand so that flexibility is limited. › A shift to more efficient vehicles and new fuels seems feasible and should be the main direction of EU policies. › A shift to rail is often not efficient due to the short distance of transportation, poor service quality, missing rail and intermodal infrastructures.		
European Shippers Council Response to Transport White Paper (2011)	› Increasing the costs of road transport will not by itself produce the modal shift that the Commission seeks › It will be necessary to improve rail and intermodal services to improve modal shift.		
ASTAG Switzerland Fact sheet on Alpine Crossing Exchange (2011)	› Logistic services rely on punctuality and flexibility (just-in-time). Freight contracts cannot be exactly planned over the year but have to be carried out immediately. › If the Alpine Crossing Exchange is implemented in CH only, this would lead to traffic shifts to other corridors.	The transport price would increase considerably. This will lead to higher prices for the transport-intensive sectors.	› Speculation could lead to additional insecurity. › If there are no specific solutions for inland transport, the ACE would lead to high burdens for industry in remote areas.

Table 46

INTERVIEW QUESTIONS

ROAD TRANSPORT SECTOR (CARRIERS AND LOGISTIC SERVICE PROVIDERS)
Question
Reaction patterns: › How would you adjust to a new traffic management instrument for transalpine freight transport? › What role will the following reaction mechanisms have: e. Use of more efficient HGV (= higher Euroclasses) f. Better use of capacities and reduction of empty runs g. Detour the Alpine Space h. Use the rolling motorway i. Use other rail options › Are these priorities the same under the three proposed traffic management instruments (ACE, ETS, TOLL+)?
Existing barriers and accompanying measures: › Which operational and organisation barriers do currently exist that influence the use of these reaction mechanisms? › Which accompanying measures should be implemented to support the use of the different reaction patterns? a. New rail infrastructures b. New rail services c. Organisational support (e.g. freight platforms)
Cost pass-through rates: › Which part of the additional costs (due to permits/toll) can be passed on to the shippers? › Are there different cost-pass through rates in different transport segments (e.g. long-distance vs. short-distance transport, urban vs. rural areas, etc.).
Structural changes and integration: › Do you expect any structural changes in the road transport sector that will come along with the implementation of a new traffic management instrument (e.g. stronger consolidation towards big logistic service providers)? › Dou you expect a closer integration of road and rail services? › What will be necessary, to improve the interfaces between the road and rail sector?
Hardship cases: › Do you expect any hardship cases from the implementation of a new traffic management instrument? If yes, why? › Will this be the same for all three proposed instruments?
General aspects: › What is your overall impression on the feasibility of the proposed instruments? › Will any of the instruments lead to disruptions of transport supply? › How do you prioritize the instruments?

Table 47

QUESTIONS TRANSPORT-INTENSIVE SECTORS
Question
Reaction patterns: › Do you know if your transport providers would fully pass-on additional transport costs from a new traffic management instrument? › How would you adjust to a further increase of road transport prices on transalpine transports? › What role will the following reaction mechanisms have: a. Use of other transport modes b. Avoidance of transport c. Efficiency improvements in other fields to compensate higher transport costs › If answer b) is mentioned: How will you reduce the transport-intensity of your goods: a. Stronger geographical cluster of industries (e.g. different companies along the production chain). b. Making stronger use of in-sourcing/back-sourcing c. Changes in buying and/or delivery markets d. Relocation
Existing barriers and accompanying measures: › Which operational and organisational barriers do currently exist that influence the use of these reaction mechanisms? › Which accompanying measures should be implemented to support the use of the different reaction patterns? a. New infrastructures b. New rail services c. Organisation support (e.g. freight platforms)
Cost pass-through rates: › Which part of the remaining costs (after adjustments) can be passed on to consumers?
Structural changes and integration: › What will be necessary, to improve the interfaces between the road and rail sector so that rail services will also become attractive for you? › How can intermodal services become more attractive?
Hardship cases: › Do you expect any hardship cases from an increase of transport costs in transalpine transport?
General aspects: › What is your overall impression on the feasibility of the proposed instruments? › What are the chances and risks that come along with the instruments? › Which accompanying measures are necessary to make the traffic management instruments feasible? › How do you prioritize the instruments?

Table 48

QUESTIONS RAIL OPERATORS AND INTERMODAL SERVICE PROVIDERS
Question
Reaction patterns: › Do you expect an increase in rail demand and intermodal services with an increase of road transport prices? › Which type of rail transport will see the highest increase: a. Rolling motorway b. Unaccompanied combined transport c. Wagon load › Do you think that this will change if transport prices will increase over a long-term with clear planning security for transport operators and shippers?
Existing barriers and accompanying measures: › Which operational and organisation barriers do currently exist that influence the use of these rail services? › Which accompanying measures should be implemented to support the use of the different rail services? d. New infrastructures e. New rail services f. Subsidies g. Organisational support (e.g. freight platforms) › Which volumes of public support will be necessary to provide the necessary infrastructures and services? › Which challenges do you see for capacity management on existing and new rail infrastructures? Will it be necessary to have a clear prioritization for freight transport?
Structural changes and integration: › Do you expect any structural changes in the transport sector that will come along with the implementation of a new traffic management instrument (e.g. stronger consolidation towards big logistic service providers)? › Dou you expect a closer integration of road and rail services? › What will be necessary, to improve the interfaces between the road and rail sector so that rail services will also become attractive for you? › Which innovative approaches could have a potential to allow the rail transport sector to deal with an increased demand?
General aspects: › What is your overall impression on the feasibility of the proposed instruments? › Will any of the instruments lead to an over-demand or peak demand on rail services that might lead to a disruption of services? › How do you prioritize the instruments?

Table 49

QUESTIONS REGIONAL ECONOMIC ACTORS (E.G. CHAMBERS OF COMMERCE)
Question
Impacts regional transport sector: › Which impacts will the proposed traffic management instruments have on the regional transport sector? › Do you know any potential hardship-cases in your area? (This might be, for example, a transport operator with a lot of one-way transports and resulting empty runs.)
Impacts on commerce and industry: › What are the vulnerable sectors in your region with high transport-intensities? › Are there any specific sectors or regional industries that will be highly impacted from an increase of transport prices? › Do you see the risk that transport chains are interrupted due to higher transport prices or a limited availability of allowances? › Do you know any potential hardship-cases?
Impacts on the overall regional economy: › Do you see the risk of rising consumer prices due to an increase of transport costs?
Dynamic aspects: › Do you see any positive aspects that could come along with implementing any of the traffic management instruments? › Which chances do you see for your region with a reduction of pressures from road transport?
General aspects: › What is your overall impression on the feasibility of the proposed instruments? › Will any of the instruments lead to an over-demand or peak demand on rail services that might lead to a disruption of services? › How do you prioritize the instruments?

Table 50

INTERVIEW PARTNERS

Germany

Transport sector:

› DB Schenker Logistics (

› Herzig GmbH

› Karl Fischer, Logistic Competence Centre Prien

Shippers:

› IHK München und Oberbayern

Other:

› National Association for freight transport, logistics and disposal (BGL)

› Studiengesellschaft Kombinierter Verkehr (SGKV)

› Kombiverkehr/ Kombiconsult

France

Transport sector:

› Dupessey group

› Sotracom

› STEF-TEF

Shippers:

› Evian-Volvic (Danone Groupe)

Other:

› Office Interconsulaire des Transports et des Communications du Sud-Est

› Région Rhône-Alpes, Direction des Transports

Austria

Transport sector:

› Gebrüder Weiss Konzern

› ÖBB-Holding AG

Shippers:

› Wirtschaftskammer Tirol

› Holzindustrie Pfeiffer

Switzerland

Transport sector:

› Wipfli AG

Shippers:

› Producer of luxury goods located in the canton Ticino (anonymous)

› Store of a big trade chain in the canton Ticino (anonymous)

Others:

› Economiesuisse Ticino

› Associazione Industrie Ticinesi

Italy

Transport sector:

› Autoroute Ferrovaire Alpine

› Consorzio TransOpt

› Brigl SpA

› Arcese Trasporti SpA

Shippers:

› BASF

Slovenia

› Chamber of Commerce and Industry of Slovenia, Branch Association for Transport and Communications

ANNEX 3 ASTRA MODEL

MODEL DESCRIPTION

History and overview of ASTRA

ASTRA (Assessment of Transport Strategies) is developed since the 4th European Research Framework Programme. The model is applied for the integrated assessment of policy strategies. It is implemented as a system dynamics model. The ASTRA model has been developed and applied in a number of European research and consultancy projects for more than 12 years now by two institutions: Fraunhofer ISI, Germany, and TRT, Italy. Applications included analysis of transport policy (e.g. TIPMAC, TRIAS, iTREN-2030), climate policy (e.g. ADAM, GHG-TransPoRD) or renewables policy (e.g. Employ-RES project). A comprehensive description of the model can be found in W. Schade *Strategic Sustainability Analysis: Concept and application for the assessment of European Transport Policy* (2005) with extensions in Krail (2009). TRT and ISI also maintain a website that comprehensively describes the application and description of the ASTRA model: http://www.astra-model.eu/.

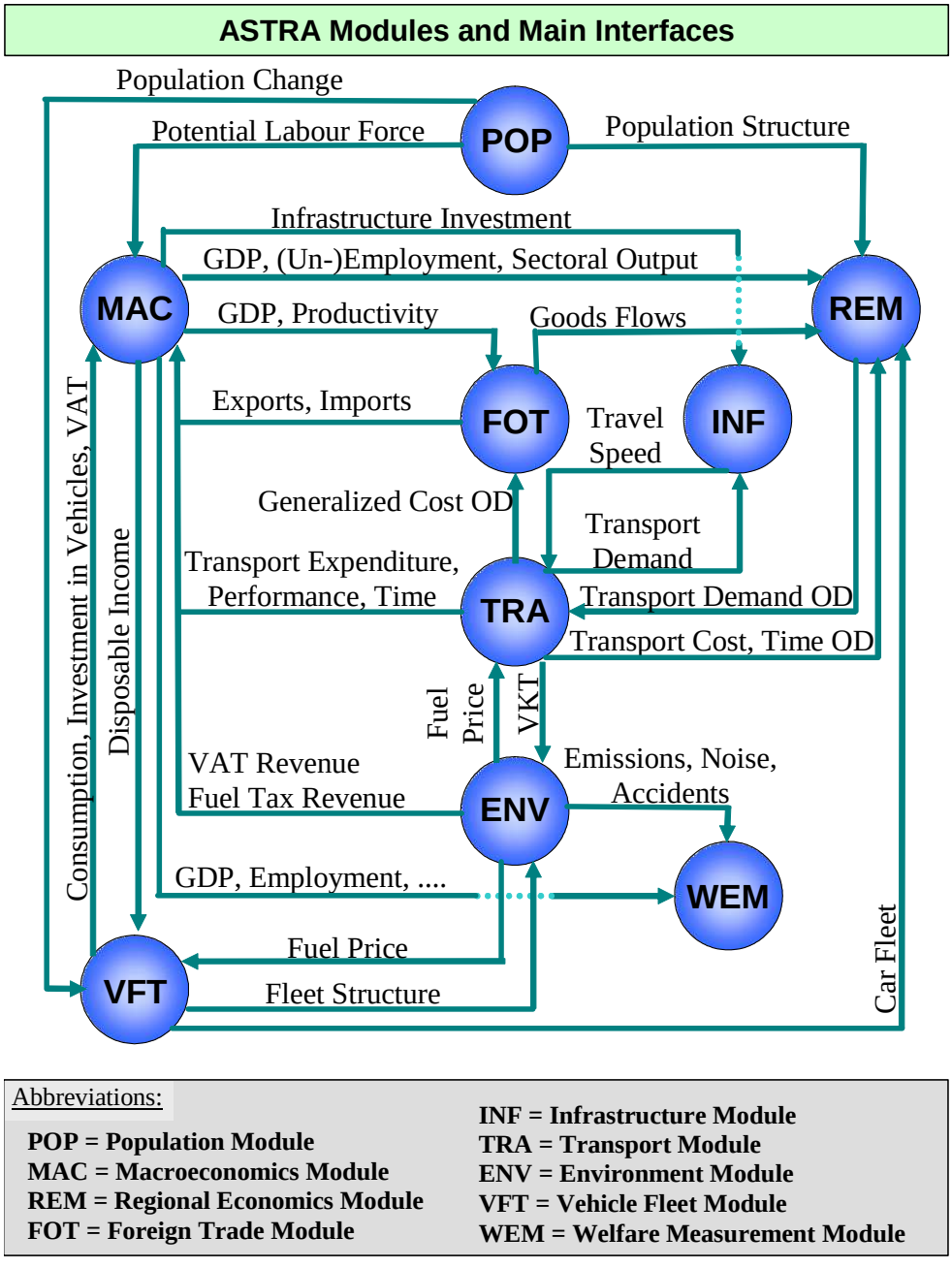
The ASTRA model consists of nine modules that are all implemented within one Vensim© system dynamics software file:

1. Population module (POP)
2. Macro-economic module (MAC)
3. Regional economic module (REM)
4. Foreign trade module (FOT)
5. Infrastructure module (INF)
6. Transport module (TRA)
7. Environment module (ENV)
8. Vehicle fleet module (VFT) and
9. Welfare Measurement module (WEM).

An overview of the nine modules and their main interfaces is presented in Figure 27.

The Population module (POP) provides the population development for the 29 European countries with one-year age cohorts. The model depends on fertility rates, death rates and immigration of the EU27+2 countries. Based on the age structure, given by the one-year age cohorts, important information is provided for other modules, like the number of persons of working age

or the number of persons in age classes who are permitted to acquire a driving licence. POP is calibrated to EUROSTAT and UN population predictions.



Source: Fraunhofer-ISI

Figure 27 Overview of the structure of the ASTRA modules

The MAC provides the national economic framework, which imbeds the other modules. The MAC could not be categorised explicitly into one economic category of models, for instance, a neo-classical model. Instead, it incorporates neo-classical elements like production functions. Keynesian elements are considered like the dependency of investments on consumption, which are extended by some further influences on investments, like exports or government debt. Further elements of endogenous growth theory are incorporated like the implementation of endogenous technical progress (e.g. depending on sectoral investment) as one important driver for overall economic development.

Six major elements constitute the functionality of the macroeconomics module. The first is the sectoral interchange model that reflects the economic interactions between 25 economic sectors of the national economies. Demand-supply interactions are considered by the second and third elements. The second element, the demand-side model, depicts the four major components of final demand: consumption, investments, exports-imports and government consumption. The supply-side model reflects influences of three production factors: capital stock, labour and natural resources as well as the influence of technological progress that is modelled as total factor productivity. Endogenised total factor productivity depends on investments, freight transport times and labour productivity changes. The fourth element of MAC is composed of the employment model that is based on value-added as output from input-output table calculations and labour productivity. Employment is differentiated into full-time equivalent employment and total employment, to be able to reflect the growing importance of part-time employment. Unemployment was estimated in combination with the population module. The fifth element of MAC describes government behaviour. As far as possible, government revenues and expenditures are differentiated into categories that can be modelled endogenously by ASTRA, and one category covering other revenues or other expenditures. Categories that are endogenised comprise VAT and fuel tax revenues, direct taxes, import taxes, social contributions and revenues of transport charges on the revenue side, as well as unemployment payments, transfers to retired persons and children, transport investments, interest payments for government debt and government consumption on the expenditure side. Sixth and final of the elements constituting the MAC are the micro-macro bridges. These link micro- and meso-level models, for instance, the transport module or the vehicle fleet module to components of the macroeconomics module. That means that expenditures for bus transport or rail transport of one origin-destination pair (OD) become part of final demand of the economic sector for inland transport within the sectoral interchange model. The macroeconomics module provides several important outputs to other modules. The most

important one is surely gross domestic product (GDP). This is for instance required to calculate sectoral trade flows between the European countries. Other examples are employment and unemployment, representing two factors influencing passenger transport generation. Sectoral production value drives national freight transport generation. Disposable income exerts a major influence on car purchase, finally affecting the vehicle fleet module and even passenger transport emissions.

The Regional Economic module (REM) mainly calculates the generation and spatial distribution of freight transport volume and passenger trips. The number of passenger trips is driven by the employment situation, car-ownership development and number of people in different age classes. Trip generation is performed individually for each of the 76 zones of the ASTRA model. Distribution splits trips of each zone into three distance categories of trips within the zone and two distance categories crossing the zonal borders and generating OD-trip matrices with 76x76 elements for three trip purposes. Freight transport is driven by two mechanisms: firstly, national transport depends on sectoral production value of the 15 goods-producing sectors where the monetary output of the input-output table calculations are transferred into volume of tonnes by means of value-to-volume ratios. For freight distribution and the further calculations in the transport module the 15 goods sectors are aggregated into three goods categories. Secondly, international freight transport i.e. freight transport flows that cross national borders are generated from monetary Intra-European trade flows of the 15 goods-producing sectors. Again, transfer into volume of tonnes is performed by applying value-to-volume ratios that are different from the ones applied for national transport. In that sense the export model provides generation and distribution of international transport flows within one step on the basis of monetary flows.

The Foreign Trade module (FOT) is divided into two parts: trade between the EU27+2 European countries (INTRA-EU model) and trade between the EU27+2 European countries and the rest of the world (RoW) that is divided into nine regions (EU-RoW model with Oceania, China, East Asia, India, Japan, Latin America, North America, Turkey, Rest of the World). Both models are differentiated into bilateral relationships by country pair by sector. The INTRA-EU trade model depends on three endogenous and one exogenous factor. World GDP growth exerts an exogenous influence on trade. Endogenous influences are provided by GDP growth of the importing country of each country pair relation, by relative change of sectoral labour productivity between the countries and by averaged generalised cost of passenger and freight transport between the countries. The latter is chosen to represent an accessibility indicator for transport between the countries. The EU-RoW trade model is mainly driven by relative productivity between the Eu-

ropean countries and the rest-of-the-world regions. Productivity changes together with GDP growth of the importing RoW country and world GDP growth drive the export-import relationships between the countries. Since transport cost and time are not modelled for transport relations outside EU27+2, transport is not considered in the EU-RoW model. The resulting sectoral export-import flows of the two trade models are fed back into the macroeconomics module as part of final demand and national final use, respectively. Secondly, the INTRA-EU model provides the input for international freight generation and distribution within the REM module.

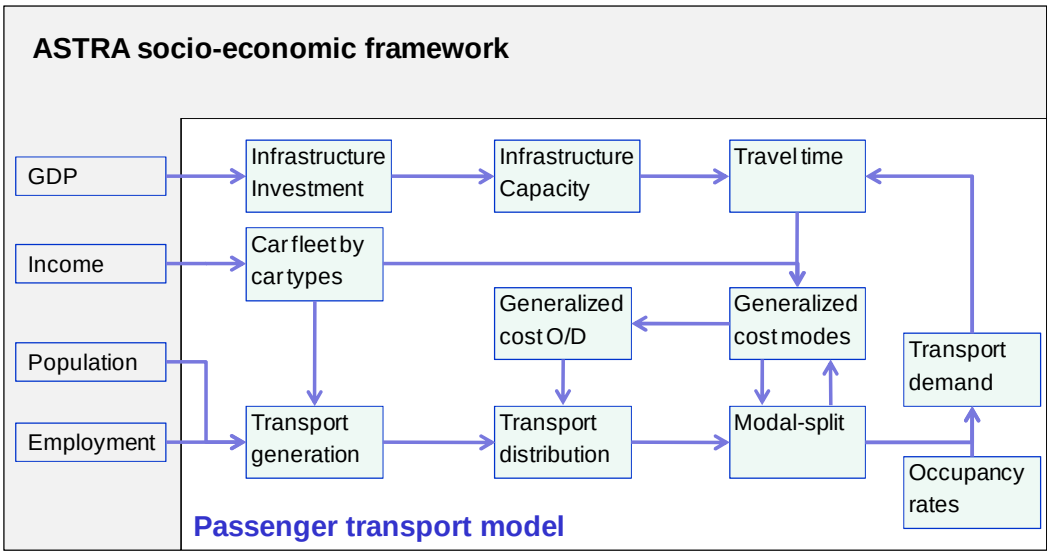
The transport related models in ASTRA

The Infrastructure module (INF) provides the network capacity for the different transport modes. Infrastructure investments derived both from the economic development provided by the MAC and from infrastructure investment policies alter the infrastructure capacity. Using speed flow curves for the different infrastructure types and aggregate transport demand, the changes of average travel speeds over time are estimated and transferred to the TRA where they affect the modal choice.

Figure 28 presents the major interdependencies of the passenger transport model. The main output of the model is the passenger transport performance by mode as well as the vehicle-kilometres-travelled (VKT) by mode. The core of the model is a classical four-stage transport model (see Ortuzar/Willumsen Modelling Transport, 1998/2004) with a rather limited assignment component (4th stage). However, the first three stages act in an integrated and dynamic way, i.e. at none of these stages (generation, distribution, mode choice) are any assumptions made about structural stability. In the generation stage, e.g. changes in population, degree of (un-)employment or the car fleet may alter the number of generated trips. In the distribution stage, of course, changes may stem from generation, but more important is the **aggregated generalised transport cost** between any origin (O) and destination (D) in Europe. These aggregated costs consist of monetary costs and time costs and thus represent an accessibility measure for each European OD-relation described by the ASTRA functional zoning system.

Accessibility is influenced by the travel time (depending on infrastructure and network load) and the travel cost (depending, e.g. on tariffs, car prices, fuel prices, car taxes etc.) by mode. The same influences also affect the mode choice for each OD relation and each distance band (0-3.2 km, 3.2-8km, 8-40km, 40-160km, >160km distance). As a starting point for travel distances and travel times for each OD relation, the input from a European network model (in iTREN-2030 this input was updated from the SCENES model to the TRANS-TOOLS model) is integrated

into ASTRA. Distances and travel times change due to exogenous (e.g. growth of average distances within distance bands) and endogenous influences (e.g. investment in infrastructure, destination choice shifts to further away destination zones).
In the final step, passenger transport performances by mode are converted into vehicle kilometres using distance- and mode-specific occupancy rates. The occupancy rates are taken from national travel surveys (e.g. UK national travel survey) and decrease over time. The major outputs of the passenger transport model comprise the energy demand, emissions, transport expenditures, transport tax and toll revenues.



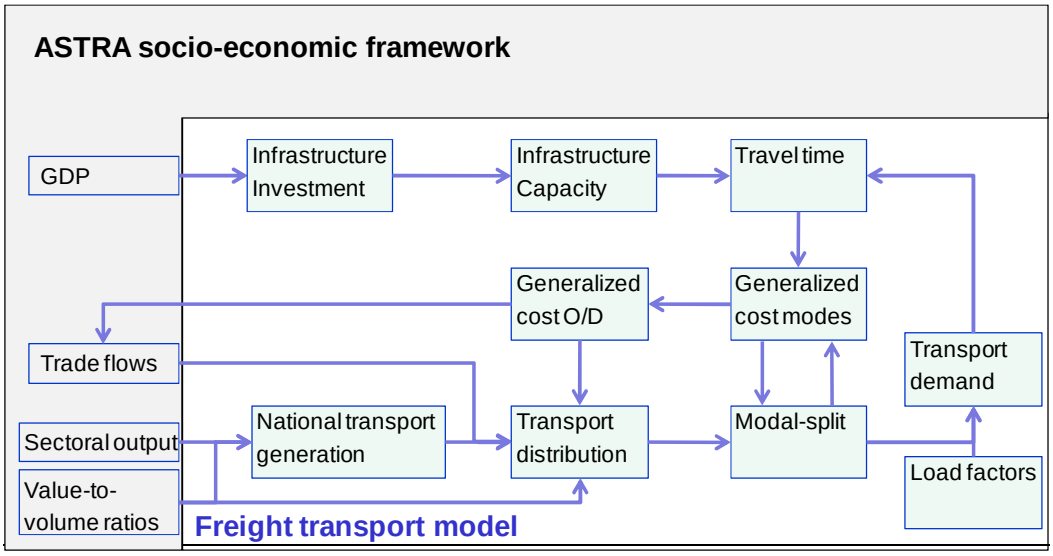
Source: Fraunhofer-ISI

Figure 28 ASTRA passenger transport model

Figure 29 shows the major interdependencies of the freight transport model. The main outputs of the model are the freight transport performance by mode as well as the vehicle-kilometres-travelled (VKT) by mode. The basic structure of the freight transport model is similar to that of passenger transport; it is a classical four-stage transport model including only a limited 4th stage for assignment. A major difference concerns the distribution model of international freight transport, which derives the freight flows for the OD relations based on foreign trade flows. National transport flows are derived from the sectoral output of each goods-producing sector (15 sectors) in the 29 European countries.

In the final step, freight transport performances by mode are converted into vehicle kilometres using distance- and mode-specific load factors. The load factors are taken from the SCENES

model and exogenously increase over time due to the assumption of improved logistics. Further, the load factors are endogenously altered by transport cost, e.g. to reflect organisational improvements in response to higher fuel prices or fuel taxes. Derived from such major outputs of the freight transport model are indicators like energy demand, emissions, investments in freight vehicle fleets, transport tax revenues and toll revenues.



Source: Fraunhofer-ISI

Figure 29 ASTRA freight transport model

Major outputs of the TRA provided to the Environment Module (ENV) are the vehicle-km travelled (VKT) per mode and per distance band and traffic situation, respectively. Based on these traffic flows and the information from the vehicle fleet model on the national composition of the vehicle fleets and hence on the emission factors, the environmental module calculates the emissions from transport. Besides emissions, fuel consumption and, based on this, fuel tax revenues from transport are estimated by the ENV. Traffic flows and accident rates for each mode form the input to calculate the number of accidents in the European countries. Expenditures for fuel, revenues from fuel taxes and value-added tax (VAT) on fuel consumption are transferred to the macroeconomics module and provide input to the economic sectors producing fuel products and to the government model.

ASTRA stands for assessment of transport strategies, and is a European System Dynamics based integrated assessment model. The macro-economic components of ASTRA apply different theoretical concepts e.g. endogenous growth by linking total factor productivity to investments, neo-

classical production functions that consider capital, labor and the total factor productivity, Keynesian consumption-driven and export-driven investment functions. The macro-economic model consists of five elements: supply side, demand side, an input-output model based on 25 economic sectors, employment model and government model. The differentiation into 25 economic sectors by country is also applied within the two trade models: Intra-EU trade and EU to rest-of-the-world trade. The trade models are also used to drive freight transport generation. The population module depends on fertility rates, death rates and immigration of the EU27+2 countries. Based on the one-year-age cohorts structure, important information is provided for other modules like the number of persons in the working age or the number of persons in age classes that permit to acquire a driving licence. The core of ASTRA models is described by Schade (2005). Recently, the capability to differentiate the impact of policies on different income groups has been added by Krail (2009). ASTRA is calibrated using time series from 1990 until 2005/2007 for major variables, where data comes largely from European statistics (Eurostat, transport statistics) and OECD statistics (e.g. STAN, trade statistics).

The transport-environment component of the ASTRA model consists of two classical 4-stage transport models for passenger and freight transport, vehicle fleet models, transport energy demand and emission models. The advantage of the ASTRA transport model is that although it is implemented as a classical 4-stage model, it considers endogenous reactions on all stages i.e. there is no fixed generation and no fixed OD matrix. The vehicle fleet models include a discrete choice component to decide on the chosen engine technology and car size, depending on the parameters of the vehicles and the socio-economic drivers. Development of technologies and ageing of vehicles is based on cohort models..

Due to the integration with the economic models of ASTRA, the changes in the economic system immediately feed into changes of the transport demand. Via the micro-macro bridges the changes in the transport system feed back into the economic system e.g. adapting the consumption behaviour of households or the sectoral interchange of intermediate goods and services.

Policy assessment capabilities in ASTRA cover a wide range of policies with flexible timing and variable levels of policy implementation. Potential policies include standard-setting, infrastructure pricing, fuel taxation, speed limits, carbon taxes, trade policies etc. A strong feature of ASTRA is the ability to simulate and test integrated policy packages and to provide indicators for the indirect effects of transport on the economic system (e.g. sectoral value-added, sectoral employment, GDP, trade flows,).

FURTHER MODEL RESULTS

ECONOMIC IMPACTS IN AUSTRIA							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.04%	-0.03%	-0.03%	-0.18%	-0.15%	-0.15%
	Consumption	-0.03%	0.05%	0.05%	-0.17%	0.03%	0.03%
	Investment	-0.01%	0.02%	0.02%	-0.09%	0.03%	0.03%
	Export	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%	-0.09%
	Employment	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%

Table 51 summary of changes in Austra (Source : ASTRA).

ECONOMIC IMPACTS IN FRANCE							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.04%	-0.03%	-0.03%	-0.17%	-0.15%	-0.15%
	Consumption	-0.04%	-0.02%	-0.02%	-0.18%	-0.14%	-0.14%
	Investment	-0.09%	-0.05%	-0.05%	-0.40%	-0.33%	-0.33%
	Export	-0.05%	-0.05%	-0.05%	-0.12%	-0.13%	-0.13%
	Employment	-0.02%	-0.02%	-0.02%	-0.04%	-0.01%	-0.01%

Table 52 summary of changes in France (Source : ASTRA).

ECONOMIC IMPACTS IN SWITZERLAND							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.02%	-0.02%	-0.02%	-0.10%	-0.06%	-0.06%
	Consumption	-0.02%	0.05%	0.05%	-0.11%	0.10%	0.09%
	Investment	-0.02%	0.02%	0.02%	-0.14%	0.05%	0.08%
	Export	-0.05%	-0.05%	-0.05%	-0.23%	-0.23%	-0.23%
	Employment	0.00%	0.00%	0.00%	-0.04%	-0.03%	-0.02%

Table 53 summary of changes in Switzerland (Source : ASTRA).

ECONOMIC IMPACTS IN GERMANY							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.02%	-0.02%	-0.02%	-0.09%	-0.09%	-0.09%
	Consumption	-0.02%	-0.02%	-0.02%	-0.09%	-0.09%	-0.09%
	Investment	-0.03%	-0.03%	-0.03%	-0.12%	-0.12%	-0.12%
	Export	-0.08%	-0.08%	-0.08%	-0.25%	-0.25%	-0.26%
	Employment	-0.02%	-0.02%	-0.02%	-0.04%	-0.04%	-0.04%

Table 54 summary of changes in Germany (Source : ASTRA).

ECONOMIC IMPACTS IN ITALY							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.05%	-0.05%	-0.05%	-0.25%	-0.25%	-0.25%
	Consumption	-0.08%	-0.08%	-0.08%	-0.28%	-0.28%	-0.28%
	Investment	-0.09%	-0.09%	-0.09%	-0.78%	-0.78%	-0.78%
	Export	-0.11%	-0.11%	-0.11%	-0.48%	-0.48%	-0.48%
	Employment	-0.09%	-0.09%	-0.09%	-0.34%	-0.35%	-0.35%

Table 55 summary of changes in Italy (Source : ASTRA).

ECONOMIC IMPACTS IN SLOVENIA							
		TOL-GOV 2020	TOL-TAX 2020	TOL-VAT 2020	RES-GOV 2030	RES-TAX 2030	RES-VAT 2030
Austria	GDP	-0.03%	-0.03%	-0.03%	-0.33%	-0.33%	-0.33%
	Consumption	0.09%	0.09%	0.09%	-0.38%	-0.38%	-0.38%
	Investment	-0.01%	-0.01%	-0.01%	-0.24%	-0.24%	-0.24%
	Export	-0.08%	-0.08%	-0.08%	-0.29%	-0.29%	-0.29%
	Employment	-0.04%	-0.04%	-0.04%	-0.06%	-0.06%	-0.06%

Table 56 summary of changes in Slovenia (Source : ASTRA).

GLOSSARY AND ABBREVIATIONS

ACE	Alpine Crossing Exchange acc. to ALBATRAS: The idea of an Alpine Crossing Exchange (ACE) was launched in 2002 as a possible solution for the future requirement of the Swiss government to shift transalpine freight transport from road to rail and to balance the capacity of transalpine road corridors in the Alpine region, as determined by the 1994 referendum. The ACE would make use of the available capacity of the Alpine crossings (tunnels, mountain passes) for road freight transport by requiring every heavy goods vehicle to have an Alpine Crossing Permit (ACP) when crossing the Alpine passages. ACPs would be limited in number and purchased using Alpine Crossing Units (ACU). The Exchange would periodically auction Alpine Crossing Units (ACU), which could then be bought and sold on an electronic ACE platform. These ACU would be converted at a given rate to ACP, depending on the vehicle's characteristics (size, emission class etc.) and on the length of the trip (local trips pay less ACU). At every journey over the Alpine crossing, an ACP would automatically be validated.
ACP	Alpine Crossing Permit
ACU	Alpine Crossing Unite
AETS	Alpine emission trading scheme acc. to ALBATRAS: The Alpine Emission Trading System (AETS) is based on policy targets for reducing selected emissions and thus indirectly limiting the available capacity on transalpine road corridors. In addition to this, one main initiative for AETS is the Austrian policy target to reduce long distance road freight transport crossing the Austrian Alps. Emission certificates have to be purchased depending on standard emissions per vehicle class in g/km. It is suggested to take CO_2 as the relevant emission indicator for deriving the certificates. Thus, the focus of the AETS is on the CO_2-emissions of trips crossing the Alps. The emissions depend on the distance driven in the Alpine region which is defined according to the borders of the Alpine convention. For each unit of CO_2 emitted (e.g. one kg) one certificate has to be obtained. The basic principle is similar to the emission trading concept which is applied in other contexts (e.g. CO_2

	trading for industrial CO_2-emissions; planned CO_2 trading for the air transport sector). All of the CO_2 certificates available for the full range of liable crossings and regions would be released in a single auction.
ALBATRAS	Alignment of the heavy traffic management instruments ACE, AETS and TOLL+ on a comparable scientific, technical and operational level taking into account the introduction of different thresholds in order to analyse transport flow impacts on Alpine routes
ALPIFRET	Observatoire des trafics marchandises transalpines
A – I/SLO	Austria – Italy/Slovenia, transalpine corridors between Austria and Italy/Slovenia
BAU	Business as usual
CAFT	Transalpine Data base (OD figures per type of transport and goods) (Cross Alpine freight transport survey)
CH – I	Switzerland – Italy, transalpine corridors between Switzerland and Italy
C.T.	Combined Transport
E3ME	Economic data basis of Cambridge Economics
F – I	France – Italy, transalpine corridors between France and Italy
GDP	Gross domestic product
GVA	Gross value added
HGV	Heavy Goods Vehicle
NUTS	Nomenclature des unités territoriales statistiques NUTS II : Provincial level (bigger regions) NUTS III : Smaller regions/major cities
NSTR	Type of goods within the CAFT data base
OD-Matrix	Origin Destination Matrix
RES-GOV	Scenario Restrictive as implemented in ASTRA for 2030, where revenues of pricing are added to the general government revenues.
RES-TAX	Scenario Restrictive as implemented in ASTRA for 2030, where revenues of pricing are refunded to consumers via reduction of direct taxation.
RES-VAT	Scenario Restrictive as implemented in ASTRA for 2030, where revenues of pricing are refunded to consumers via reduction of indirect taxation (value-added tax).
RMW	Rolling Motorway

Scenario Restrictive	Acc. to ALBATRAS scenario TOLL+ restrictive
Scenario Tolerant	Acc. to ALBATRAS scenario Mix tolerant
SLA	Service level agreement
TAMM	Transalpine Multimodal Freight Transport Model (NEA)
TOLL+	Alpine km-dependent surcharge acc. to ALBATRAS
	The concept of differentiated toll systems (TOLL+) is based on two characteristics: the internalisation of the external effects of road freight transport in terms of air pollution, noise and congestion, by implementing the "polluter pays" principle as described in the amendment of the Directive 1999/62/EC on charging of heavy goods vehicles for the use of infrastructure (Eurovignette), and, the optimisation of the use of the road network with differentiated toll rates according to the time of day. Similar to the ACE and AETS concepts, the TOLL+ concept requires a passage right to cross the Alpine passage. Whereas the "currency" for the ACE and AETS have been ACP or emission certificates, in the TOLL+ concept, the price of the "passage permit" is the charged toll rate. Within this concept, the toll may be charged as one (modulated) rate or in addition to the already existing toll schemes (such as the new HGV charging scheme for France, GO-Maut in Austria, heavy vehicle fee in Switzerland) for the passage over or through the Alps. The passage over the Alps is defined by the section which needs to be crossed and its length.
TOL-GOV	Scenario Tolerant as implemented in ASTRA for 2020, where revenues of pricing are added to the general government revenues.
TOL-TAX	Scenario Tolerant as implemented in ASTRA for 2020, where revenues of pricing are refunded to consumers via reduction of direct taxation.
TOL-VAT	Scenario Tolerant as implemented in ASTRA for 2020, where revenues of pricing are refunded to consumers via reduction of indirect taxation (value-added tax).
TOR	Terms of reference

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