Innovative approaches for the Alpine transport system – the regional viewpoint

Linking technological change, steering instruments and organisational innovations

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Authors:
Helen Lückge, Markus Maibach,
Jürg Heldstab, Damaris Bertschmann

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Innovative approaches: a cross-cutting element for the iMONITRAF! project

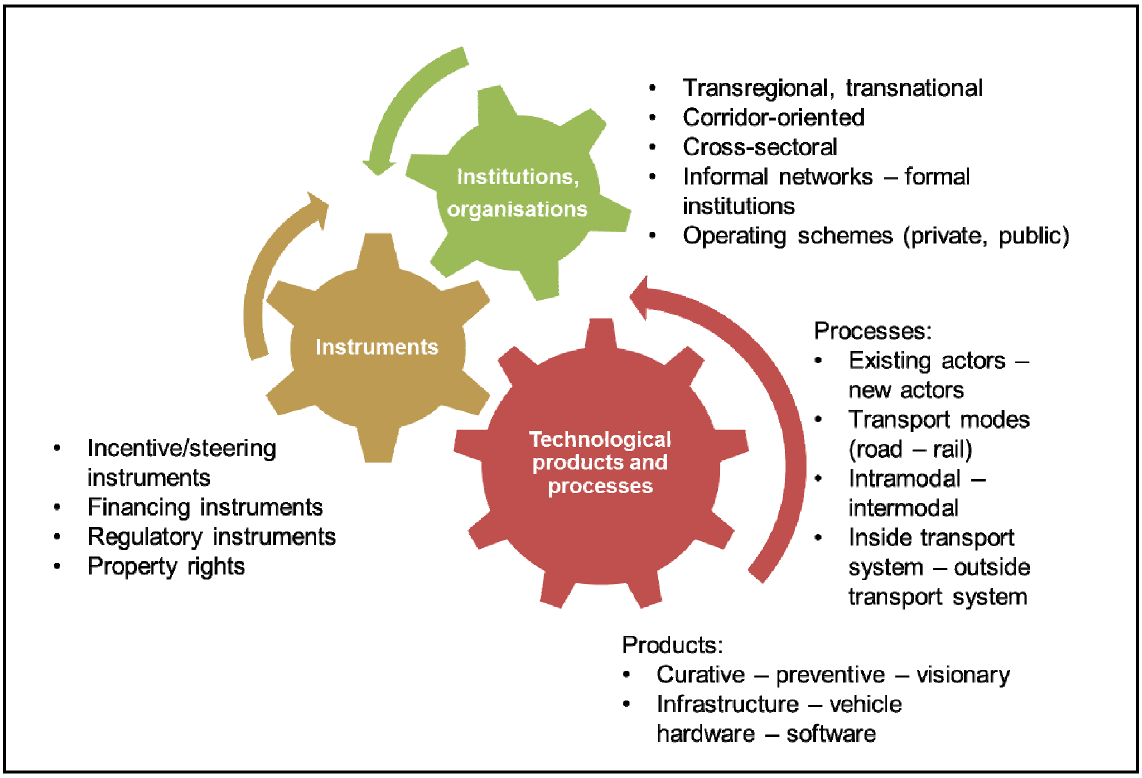
The iMONITRAF! Best Practice Guide shows several opportunities for the harmonisation of existing regional measures. However, it also becomes clear that regional measures have a limited potential to reduce the negative impacts from transalpine transport. Especially in the sensitive environment of the Alpine Space, the best-available-technology approach is an important concept for the further development. The incentives from existing regional measures are however not sufficient to fully use the potentials from new technologies. Also, the Best Practice Guide has made clear that even comprehensive policies have up to now not been successful in limiting a further growth of traffic volumes or in leading to a long-lasting change in the transport sector.

To reach the ambitious objectives of the Alpine regions, it will thus be necessary to make use of innovative approaches to work towards a more sustainable transport system in the Alps. The role of innovative approaches is highlighted in this report. It analyses the potential of innovative approaches for the common iMONITRAF! strategy and action plan and at the same time provides the basis for the definition of scenarios that are further analysed in the frame of the iMONITRAF! monitoring activities.

The different spheres of innovation and their role for iMONITRAF!

In the understanding of the iMONITRAF! project, innovative approaches include technological developments (innovations of products and processes), innovative policy instruments as well as innovative forms of cooperation that set the necessary organisational framework.

THE SPHERES OF INNOVATION IN THE ALPINE SPACE



Based on the analysis of Best Practices, it becomes clear that new policy instruments in the form of a common steering instrument are the most important field of action for the regions. Thus, the main focus of this report lies on a regional analysis of common steering instruments. It also contains an overview on relevant technological developments to get a better feeling on how to set the right incentives with such a new instrument. As the steering instruments need to be embedded in a new organisational framework, the report furthermore includes a proposition on how to design the necessary organisational structures.

Technological changes and their link to a common steering instrument

The regions have limited potential to influence the deployment of new technologies. However, the implementation of a common steering instrument will set incentives to make use of efficient vehicles. On the other side, the common steering instrument will only be feasible, if new and innovative rail and intermodal services are provided. In the framework of the iMONITRAF! strategy and action plan, it is thus necessary to get a feeling on current dynamics in the market. A proposal for a common steering instrument will require a clear statement on technologies that are supported by the Alpine regions and – even more important – on developments that seem contradictory.

The analysis makes clear that the improvement of engines, the use of sustainable biofuels as well as alternative drivetrain technologies (fuelled by renewable energies) offer a considerable potential in the Alpine regions. However, all proposals that go towards an increase of HGV size (mega-trucks) undermine the regional modal shift strategy. Innovative trailer systems and a broader use of intelligent transport solutions will support the ambitious modal shift to rail.

Towards a common steering instrument

A common steering instrument supplements the existing regional policy mix with a clear mechanisms to meet traffic and/or environmental targets (cap-and-trade approach) or to guarantee the full internalisation of external costs (pricing approach). The regional analysis builds on existing results from the national level and from the Suivi de Zurich process. Thus, the analysis also includes the three proposals under discussion: Toll Plus system, Emissions Trading System and Alpine Crossing Exchange.

The existing studies make clear that all three instruments have a great potential to reduce transalpine road freight transport and to improve modal shift. The Alpine Crossing Exchange in this respect has the "strongest" mechanisms as it sets a direct limit for transalpine trips on the road. The impact channels of a Toll+ system and an Emissions Trading System are less direct, they also depend on technological developments and mitigation costs in the transport sector.

In order to avoid negative regional impacts (if short distance transport is overburdened and not able to change from road to rail), specific exemption or compensation measures are necessary. The regional economic impacts are depending very much on the specific design of the steering measure.

An evaluation of the three instruments from a regional view is summarised in the following table:

EVALUATION FROM A REGIONAL VIEWPOINT

	Toll Plus	Alpine Crossing Exchange	Emissions Trading System
Fulfil environmental targets	Unclear, depends on reactions to price increase.	Unclear, depends on vehicle mix that remains on the road.	Yes, depending on indicators that are included in target system.
Fulfil traffic targets	No, further increase is possible	Yes	Not directly. But environmental constraints also restrict traffic volumes
Supports BAT approach	Yes, with financial incentives	No	Yes, from differentiation according to emissions
Negative impacts on regional economy	Low, limited impact from higher transport prices	Medium, especially without specific mechanism to prevent overproportional burden.	Low, only limited impact from higher transport prices
Acceptance transport sector	Medium, offers highest degree of flexibility	Very low as trips will be limited	Low, still offers some flexibility on reaction patterns.
Acceptance EU	Good, builds on existing EU approach	Low, as road freight volumes are capped	Medium, link to existing EU ETS possible
Dynamic incentives	Low	High: Reduced transport intensities in the long-run, New chances due to modal shift	High: ETS sets incentives for technological innovations New chances due to modal shift
Trade-offs		Modal shift leads to an increase of rail-noise	Modal shift leads to an increase of rail noise

Table S-1 *BAT = best-available technology*

The analysis of the instruments and the existing impact studies make clear that the definition of a target-system/threshold is the crucial determinant for a common steering instrument. The target-system thus has to be the starting point for discussing the proposal with political representatives.

New institutional and organisation approaches

Innovative approaches in the fields of institutions and organisations are necessary to set the relevant framework for implementing a common steering instrument but also to use the windows of opportunity that might come along with an effective modal shift policy and a reduction of environmental burdens.

The iMONITRAF! network itself is an innovative approach as it follows an integrated philosophy, bringing together the technical and political spheres as well as transport and environmental expertise. To further work towards a common steering instrument, it will be necessary to find innovative solutions on how to continue the iMONITRAF! network beyond the project duration. For an effective implementation of common measures, it will also be necessary to strengthen the cooperation between the regions along the main transit corridors (trans-Alpine approach). While a slightly different finetuning and implementation of measures on the different corridors seems reasonable and even necessary, the approach along one corridor needs to be harmonised to reach the full impact of common measures.

Recommendations for the iMONITRAF! strategy

The analysis of this report has outlined some major elements that should be tackled in the common iMONITRAF! strategy – with a proposition for specific actions. The recommendations include an outline of the next steps that should be taken towards implementing a common steering instrument (agreement on target system, design of the instrument, regional involvement) as well as a statement on technological developments that are supported by the regions.

1 Introduction and Aim

Innovative approaches: a cross-cutting element for the iMONITRAF! project

Already in the MONITRAF resolution, the political representatives of the Alpine regions have recognised the need to further discuss a common steering instrument to support the regional measures. As first step in the iMONITRAF! project, the regions have compiled an in-depth analyses of existing regional measures (Good Practices) and have assessed the possibility to transfer and harmonise these measures towards a more coherent approach. The regions have recognised that the harmonisation and coordination of regional measures is vital to prevent unwanted distributional and environmental effects (e.g. from traffic detouring).

However, the iMONITRAF! Best Practice Guide clearly shows the limitations of harmonising regional measures. Even comprehensive policies have up to now not been successful in limiting a further growth of traffic volumes or in leading to a long-lasting change in the transport sector. As recent projections predict a further increase in European transport volumes,[1] it might be possible that current achievements concerning environmental, safety and modal shift targets are overcompensated by further growth.

There is thus a great need to make use of innovative approaches and to further develop a common strategy in a forward looking and dynamic approach. This report analyses the role of innovative approaches for a common strategy of the Alpine regions, considering the different spheres of innovation. It thus serves as background document to the political discussion. While the main field of action for the Alpine regions is the support on implementing a common steering instrument as innovative measure, they have to be linked to technological innovations and innovative forms of cooperation. At the same time, the report provides the basis for the definition of scenarios that are further analysed in the frame of the iMONITRAF! monitoring activities.

The role of innovative approaches for the iMONITRAF strategy

The iMONITRAF! activities on common measures have been clustered up to now along four policy pillars. The pillars "1: Information, monitoring, awareness raising", "2: Limiting impacts of Alpine traffic" and "3: Modal Shift" pick up the main directions of the MONITRAF resolution. An additional pillar has been added for passenger transport to take a more integrated approach to the challenge and to guarantee that linkages between freight and passenger transport are considered.

The innovative approaches can be seen as fifth pillar of a common strategy. This pillar has however other characteristics as it needs to be seen as cross-cutting pillar with interfaces to all other activities on political level and within the project. Measures from the other pillars build the framework and accompany the innovative approaches.

Innovative approaches are new for all regions and thus provide the chance to jointly work towards a new approach. The transfer of existing measures is often difficult as the measures have been designed for a given regional/national framework.

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[1] The iMONITRAF! scenarios base on the results of the PRIMES transport model that is also used by the European Commission. A summary can be found in the Impact Assessment accompanying the 2011 Transport White Paper (European Commission 2011). Also, national analysis predict a further traffic growth (e.g. Swiss Perspective Study (INFRAS 2005), Transport scenarios for the Brenner corridor (ProgTrans 2008)

THE 5 PILLARS OF IMONITRAF!

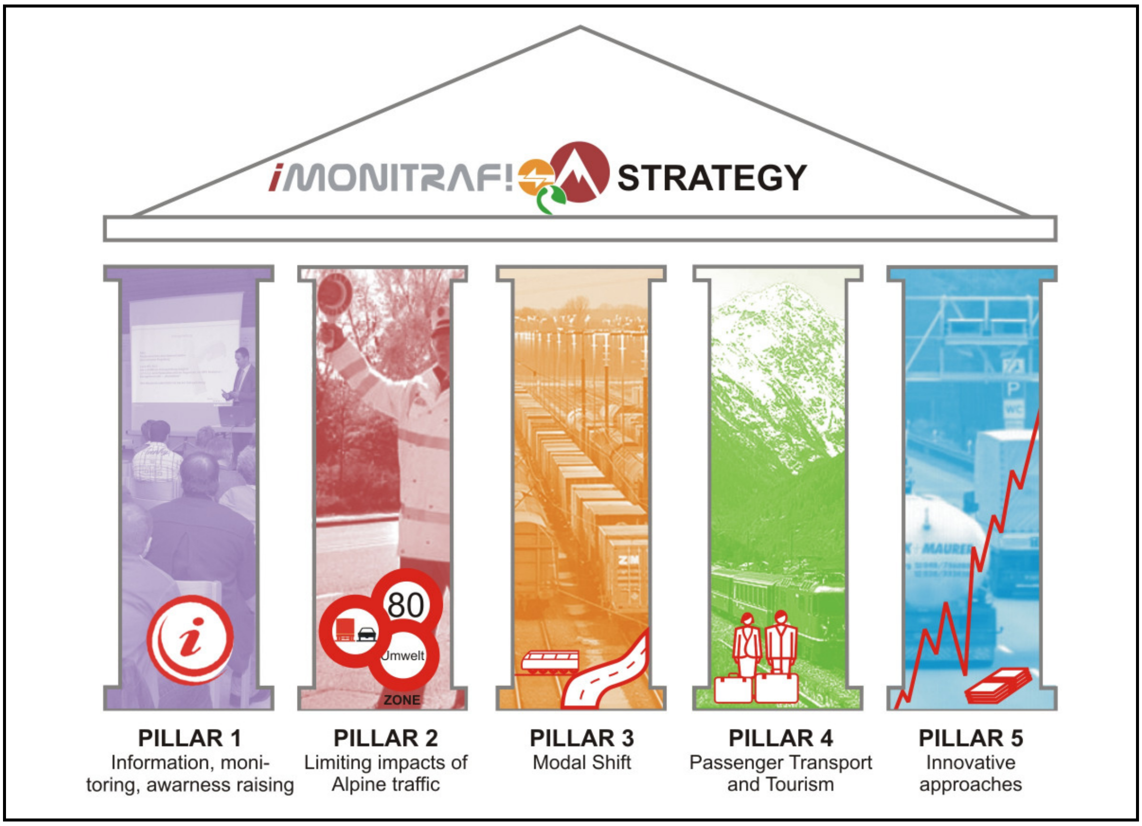


Figure 1

The Alpine Space as laboratory for innovative approaches

The Alpine Space has a special need to make use of innovative approaches and to establish itself as a model region for sustainable development and innovation:

- The sensitivity of the Alpine Space requires a "best-available-technology" approach. Common measures and activities have to set the necessary framework and incentives to push the relevant technological developments.
- The Alpine Space as geographic entity requires innovative approaches for cooperation. The political network which is developed under iMONITRAF! needs to be continued to move along with the action plan of the common strategy.
- The Alpine Space faces both limited environmental and infrastructure capacities. A future transport system has to keep within these capacities. The development of a common steering instrument has the potential to set the necessary framework.

Structure of the report

The report is built around the analysis of innovative steering instruments which are the main field of action for a common iMONITRAF! strategy. Chapter 2 gives an overview on the different spheres of innovation and shows the link between steering instruments, technological developments and innovative organisational/institutional approaches. At the end of the chapter, the relevance for the iMONITRAF! regions and the Alpine Space is assessed, to better focus the further analysis and to identify potential iMONITRAF! actions.

The following chapters three to five provide an in-depth analysis of the innovative approaches which have been identified in the overview. Chapter 3 analyses the different levels of technological innovations, with a special view on their role for a common steering instrument. Chapter 4 is the “core” of the report and provides an overview of the state-of-the-art discussion of steering instruments. It summarizes existing work on regional impacts and develops the regional viewpoint. Chapter 5 looks at innovative organisational approaches and explores opportunities beyond the project.

The last chapter provides a summary and discusses the link to the common iMONITRAF! strategy.

2 Innovative approaches – Scope of action for iMONITRAF!

2.1 The spheres of innovation for transport in the Alps

The term "innovation" is a widely-used buzzword with different meanings and focuses. In the literature, innovative approaches are generally distinguished by their underlying nature of change (OECD 2009). They can be called the spheres of innovation:

- Innovations in transport products and processes (technological change).
- Innovative policy instruments which set the necessary framework to trigger technological innovations, to guarantee the fulfilment of pre-defined targets and to regulate demand.
- Innovative approaches in organisations and institutions (non-technological mechanisms) that provide the necessary structures to implement innovative policy-instruments.

The following figure shows that these spheres of innovation are closely interlinked. Technological (eco)innovations in products and processes are a key innovative element which influence environmental, social and economic impacts. Organisations as well as formal and informal institutions can serve as driver but also as barrier to these technological innovations and are crucial to shape the policy and social framework for the necessary transition. The use of policy instruments and measures is necessary for incentivising and financing the transition as well as to prevent potential adverse effects.

→ For iMONITRAF!, it becomes clear that the innovative instruments are the crucial missing mechanism to make use of technological developments and to further develop the institutional/organisational framework.

THE SPHERES OF INNOVATION IN THE ALPINE SPACE

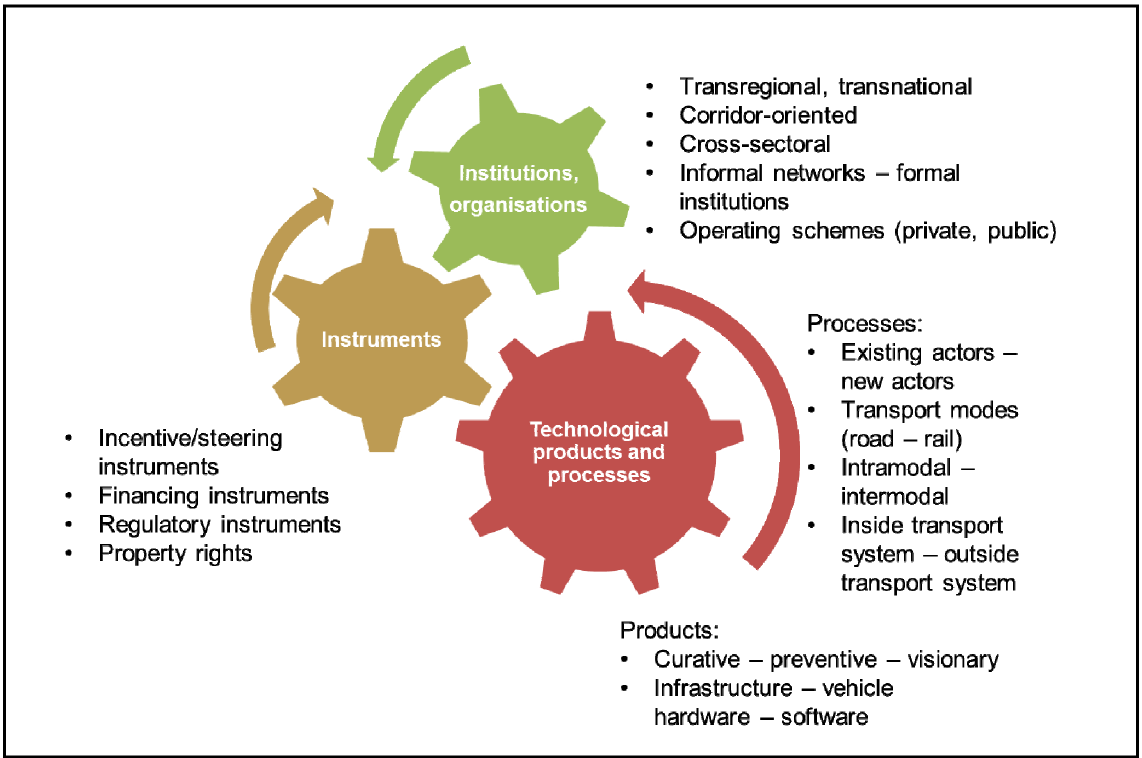


Figure 2

The following paragraphs provide a short overview on the different spheres of innovation and illustrate their different dimensions and mechanisms. This overview helps to identify the scope of action for the Alpine regions and to narrow down the fields for further action.

Technological innovations in products and processes

Innovations in the field of products and processes are mostly based on technological developments. As iMONITRAF! has the objective to improve overall efficiency of the transport system in the Alpine Space, to work towards a sustainable situation, we propose to differentiate technological innovations in products and processes according to their "levels" towards efficiency:

- **Road Vehicle-specific improvements:** The first level includes technological innovations that reduce environmental pressures in the existing transport system and the existing composition of modal shares.
- **Improvements focusing on modal shift:** This especially includes innovations in the rail transport sector which make rail more competitive with respect to quality and efficiency.
- **Improvements focusing on the overall transport system:** The third level of technological innovations focuses on the overall transport system and has the objective to optimize efficiency via: i) Improved traffic management (schedule and route planning), ii) better capacity management (e.g. vehicle-to-load matching, platforms to locate empty trucks) and iii) an improvement in overall freight logistics management.
- **Efficiency improvements outside the transport system and transformative approaches:** On a more visionary level, technological improvements can also focus on innovations outside the transport system (e.g. to reduce overall transport intensity of goods) and breakthrough technologies that would revolutionize the existing transport sector. Such breakthrough technologies might be a fully automated motorway with electrified guideway systems[2] or a magnetic pipe system for the transportation of goods (as developed, for example, at the University of Perugia in Italy). Breakthrough technologies might also involve the construction of infrastructures which reduce nuisances, e.g. through a thin cover of solar panels.

It becomes clear, that technological innovations also have a close link to the organizational and institutional spheres. While technologies aiming at an improvement of HGV efficiency can be organized in the current framework, the implementation of more far-reaching technological changes can only be effective in a broader alliance with other regions. For example, the use of innovative trailer systems in combined transport would need to be become a standardized approach beyond the Alpine Space to reach the necessary scale effects.

[2] The electrified guideway system has been developed at the Texas A&M University's Center for Energy, Environment and Transportation Innovation (CEETI). A short description is provided in the following article: http://www.ceeti.org/articles/Electrical_Guideways_a_Transportation_Solution.pdf

LEVELS OF TECHNOLOGICAL INNOVATIONS IN PRODUCTS AND PROCESSES

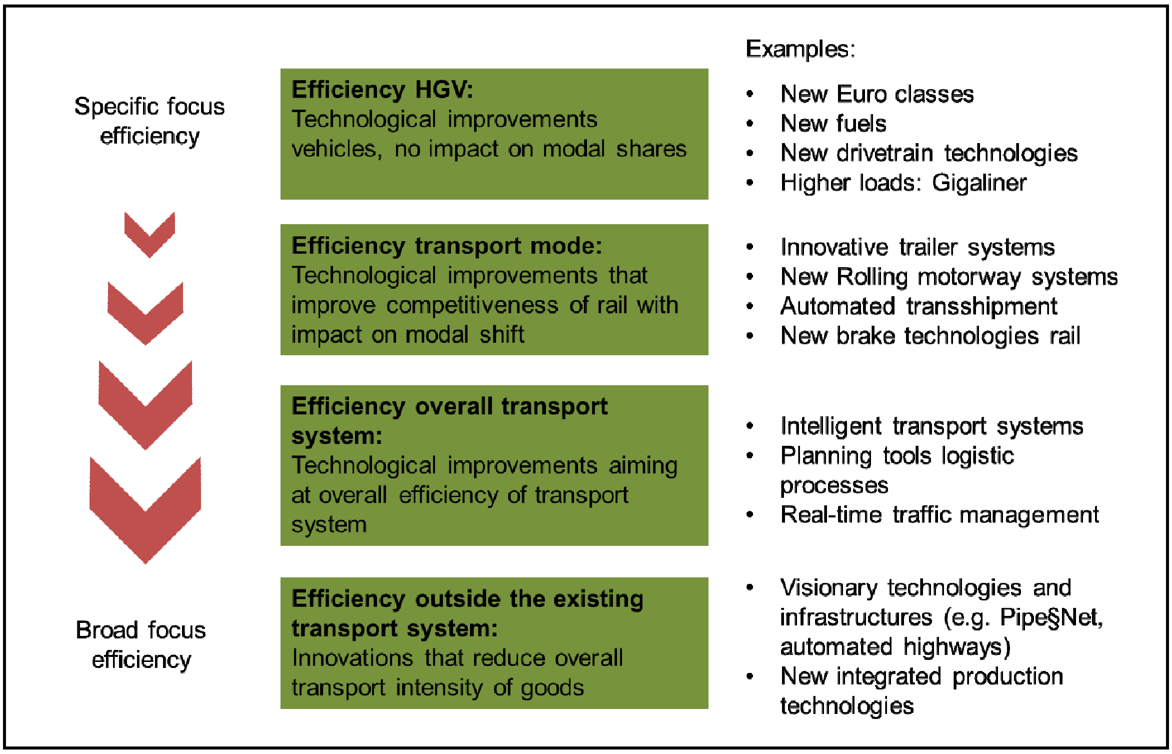


Figure 3

Innovative policy instruments

Innovative approaches also include the use of new policy instruments to trigger the desired technological innovations and to reach political objectives. To prevent unwanted distributional impacts and to strengthen the cooperation of the Alpine regions, new policy instruments should be implemented as common measures in all Alpine regions or at least along a corridor. The following range of instruments is available, reaching from market-based mechanisms to regulatory approaches:

- Incentive/steering instruments: Market-based steering instruments with a cap-and-trade approach have several advantages over pricing systems: they also set financial incentives towards the deployment of best-available-technology but also guarantee the fulfilment of pre-defined policy-targets in an efficient way.
- Innovative financing instruments: New policy instruments could also focus on the financing aspect, e.g. with a provision of funds for financing of regional infrastructures. This could include a fund to finance intermodal transport infrastructures in the Alpine regions to provide the necessary transport capacities. Also, it would be possible to build on the idea of insurance, with a fund that is used for financing negative health impacts or for compensation of nuisances. Such innovative financing instruments can be interlinked with new steering instruments which provide the necessary revenue.
- Command-and-control measures: Regulatory measures are generally not perceived as innovative but can still take on an innovative approach if they are used under new circumstances. The transfer of the concept of urban environmental zones to the Alpine transit corridors might be an example. Also, a prioritization of best-available technology HGV in congested areas or in tunnel dosing systems might be an approach. Regulatory approaches

further have a close link to steering instruments when they define critical loads or traffic targets.

- New approaches to property rights: A far reaching innovative instrument might be a new definition of property rights in the Alpine Space. A visionary approach could for example define a right on a pollution-free Alpine Space for the local population. These property rights could then be sold to freight transport operators. This idea is already discussed for noise pollution at airports. A good example is the proposed “Anti-Noise-Pact” at Frankfurt airport, where a financial compensation of affected residents is discussed. Such an approach would only be feasible with big actors, e.g. the motorway operators.

Innovative approaches in organisations and institutions

Innovative approaches can also focus on structural changes in formal organisations and institutions as well as on changes in informal institutions like values, beliefs, knowledge, norms, etc. Organisations and formal institutions have a crucial role in shaping the transformation to a sustainable transport system as they provide the necessary exchange platforms for politicians, stakeholders and the population and as they have the possibility to shape the political framework conditions. Innovative organization and institutional approaches include:

- New political organizational and institutional structures: These can include new co-operations and networks that go beyond national boundaries and existing political structures.
- New roles for stakeholders: Innovative approaches could also include the cooperation between different sectors or new roles for some stakeholders.
- New perceptions and objectives: Innovations in the field of organisations and institutions can also include the definition of new objectives, perceptions and attitudes. The definition of a common rationale as discussed in the iMONITRAF! framework seems the most important innovation in this field, as it provides the basis for all further actions.
- New tasks for regional organisations: Innovative approaches might also include changes in the overall responsibilities and legal situation. This can include a lobbying towards more responsibilities for the regional level, a better visibility on the European level or new forms of cooperation with the national levels or private stakeholders in the transport sector.

2.2 The role of iMONITRAF! – Defining the focus for further action

The iMONITRAF! regions have different possibilities to influence the described innovative approaches. For example on the level of technology, most regions have limited possibilities to directly influence technological change. While in most countries, the financial support to research and development or pilot projects mainly comes from the national bodies, the regions in France also provide a large share of research and development financing. The other regions can influence technological change through the specific design of the relevant political framework. In the scope of organisations and institutions, however, all regions have far-reaching potentials and are free to build new networks and co-operations.

The following table gives an overview on the possibilities for regional action and shows the link to the local, national and European/international levels:

POSSIBILITIES FOR REGIONAL ACTION

	Local level	Regional level	National level	European/ int. level
Innovations in products & processes				
Vehicle-specific improvements	Local measures	Regional measures Innovative incentive/steering instruments	Standards Financial support R&D	
Improvements focusing on modal shift		Regional infrastructures Innovative incentive/steering instruments	Standards, interoperability infrastructures	
Improvements focusing on overall transport system		Innovative incentive/steering instruments	Financing of systems, R&D	
Visionary innovative approaches			Financial support R&D	
Innovations in organisations & institutions				
New structures across regions and sectors		iMONITRAF! Corridor cooperations, e.g. Brenner Corridor Platform		
New perceptions, objectives, attitudes		Andermatt project, Regione Gottardo		
New tasks/roles		Changes in responsibilities have to be discussed with all political level		
Innovative policy instruments				
Incentive/steering instruments		Different regional responsibilities, at least lobbying towards implementation	Provision of national frameworks	Support on European level
Financing instruments		If linked to steering instruments	Public finances and social security Infrastructure financing	
Regulatory measures		Regional measures	National and European measures	
New property rights concerning pollution-free Alpine Space			Changes have to be defined on national or even European scale	

Table 1:

This overview shows the priorities for further in-depth analysis in this report and to feed the iMONITRAF! strategy.

- **Innovative policy instruments are the core field of action for the regions** as they include the possibility to **trigger the desired technological innovations**. Technological innovations have an important role for transforming the transport system in the Alpine Space to a more sustainable system, so that the relevant incentive instruments should gain high acceptance.

  As policy instruments have a limited role in incentivizing visionary changes outside the existing transport system, this last level of technological development will not be included in the in-depth analysis. **All other levels of technological innovation are further analysed, especially with a view on designing the steering instruments.**

→ Chapter 3

- **Concerning policy instruments, the regions have the greatest potential on the implementation of or lobbying towards regulatory measures and the design of incentive/steering instruments** (depending on their legal responsibilities)**.** Financing instruments are also a field of action, but only if the revenue comes from a common steering instrument. These innovative steering instruments provide the possibility for specific actions of the iMONITRAF! network, so that they will be the focus of further analysis.

  → Chapter 4

- Innovative approaches in the field **of organisations and institutions** are also an important field of action for the regions. These approaches **are crucial for combining approaches from the different spheres of innovation**. In fact, the iMONITRAF! network itself represents such an approach. Further analysis will thus focus on how to build on this network in the future and beyond the project duration.

  → Chapter 5.

3 Technological innovations – A parameter for innovative steering instruments

The overview of innovative approaches in chapter 2 has made clear that the Alpine regions have limited possibilities to directly influence technological innovations. However, common instruments can be used to set financial and regulatory incentives for technological change.

In order to develop more specific proposals for new and common steering instruments and to evaluate their impacts on the Alpine regions, it is necessary to **get a feeling on technological developments** that could support a sustainable transport system in the Alpine Space. The following chapter provides more in-depth information on the technological innovations with direct relevance for the Alpine Space and analyses their link to a common steering instrument..

3.1 Vehicle-specific innovations – Efficiency improvements

The first level of technological innovations focuses on efficiency improvements in the existing transport system, without influencing modal split. The most important technological trends and developments to improve efficiency of HGV are illustrated in this chapter.

Improvement of emissions from conventional engines (Euro-Standards):

The European Commission has decided to introduce the new Euro VI-Standard. All new HGV have to meet these standards starting from 31 Dec 2013 (new models already need to comply by 31 Dec 2012). In comparison to the Euro V standard, the permitted fine particles (PM) need to be reduced by 66% and the exhaust of NOx needs to be reduced by 80%.[3] However, CO_2 emissions will increase slightly by about 2%.

EU EMISSION STANDARDS FOR HGV (g/kWh, smoke in m−1)

Tier	Date	Test	CO	HC	NOx	PM	Smoke
Euro I	1992, < 85 kW	ECE R-49	4.5	1.1	8.0	0.612	
	1992, > 85 kW		4.5	1.1	8.0	0.36	
Euro II	1996.10		4.0	1.1	7.0	0.25	
	1998.10		4.0	1.1	7.0	0.15	
Euro III	*1999.10, EEVs only*	ESC & ELR	*1.5*	*0.25*	*2.0*	*0.02*	*0.15*
	2000.10	ESC & ELR	2.1	0.66	5.0	0.10 0.13[a]	0.8
Euro IV	2005.10		1.5	0.46	3.5	0.02	0.5
Euro V	2008.10		1.5	0.46	2.0	0.02	0.5
Euro VI	2013.01		1.5	0.13	0.4	0.01	

a – for engines of less than 0.75 dm^3 swept volume per cylinder and a rated power speed of more than 3000 min^{-1}

Table 2: *Source: European Commission*

[3] REGULATION (EC) No 595/2009 of 18 June 2009 on type-approval of motor vehicles and engines with respect to emissions from heavy duty vehicles (Euro VI).

Engine producers are currently working on the challenges to meet these ambitious new standards, e.g. with the help of exhaust treatment.[4] The following table shows several techniques to reduce exhaust and their potential to reduce NOx and PM emissions:

TECHNIQUES TO REDUCE NOX AND PM10 EMISSIONS OF DIESEL ENGINES

Technique	Reduction of
Selective catalytic reduction	NOx emissions up to 90%
Exhaust gas recirculation	NOx emissions up to 30%
Particle filter (closed system)	PM mass up to 90% PM particle number up to 99%
Particle reduction system (open system)	PM mass up to 60%

Table 3: *Source: UBA 2009, Strategien nachhaltiger Güterverkehr*

Based on the existing literature on modernization of the vehicle fleet, the iMONITRAF! scenarios assume that the share of the new Euro VI standard will rise over the next years. In the year 2020, Euro VI HGV will already represent nearly three quarters of the vehicle fleet (73%).

New fuels: the role of biofuels

Biofuels are an important cornerstone of the EU energy-climate policy. At the end of 2008, a mandatory 10% renewable energy target for transport (to be reached until 2020) has been defined. Up to now, the use of biofuels has taken the highest importance for reaching these targets. Biofuels are mostly compatible with existing vehicles and can be blended with fossil fuels. The present EU biofuels policy focuses on the development of second generation biofuels, overcoming market barriers, and the improvement of distribution and storage systems.

However, biofuels have been widely criticized for their negative indirect impacts. One of the most important reasons for this is the failure of the European and national biofuel policies to account for the environmental impact of indirect land use change (ILUC). When agricultural land is converted for biofuel production, land elsewhere will be converted for agriculture, releasing a high amount of CO_2 emissions. Assessing the impact of ILUC and incorporating it in biofuels policy is critically important to ensuring an effective CO_2-reduction.

Stakeholders working in the field of sustainable transport thus support the development of more ambitious “sustainability criteria” for making use of biofuels which include the aspects of indirect land use change as well as biofuels’ impacts on biodiversity and vulnerable communities (Transport and Environment 2008).

New drive-train technologies: electric mobility

With rising CO_2-emissions from transport, the peak-oil problem and a high energy-dependency, European countries are currently pushing new drive-train technologies which are independent from oil. Especially, hopes are pinned on the potential of electric mobility and many incentive programmes have been started to push forward this technology (e.g. the German government has started its platform on electric mobility aiming at putting at least one million electric cars on the road by 2020).

The shift to electric mobility will mostly affect passenger traffic and public transportation as transport demand patterns in this field can be met with electric mobility: most car trips are well

[4] Article „Euro 6 – Herausforderung für Motorenentwickler und Abgas-Experten“: http://www.amz.de/news/newsartikel/euro-6-herausforderung-fuer-motorenentwickler-und-abgas-experten.html?cHash=11471a7a80

within the range of electric vehicles and especially hybrid technologies can use their full potential in urban stop-and-go traffic. This potential has been recognised both on European as well as national levels. The new Transport White Paper (European Commission 2011) gives a high relevance to electric mobility and several national programmes aim at a fast diffusion of this technology (e.g. the German platform for electric mobility with direct funding and incentive instruments). Recommendations for making use of alternative technologies in the Alpine Space are, for example, developed in the frame of the Interreg project CO_2NeutrAlp with guidelines for decision makers and transport professions.[5]According to current scenarios and projections, full electric vehicles as well as plug-in electric vehicles will however have a limited market share between five to 15% in 2020.[6]

In the field of freight transport, the potential of electric mobility is however limited. Some truck manufacturers are currently working on the development of hybrid HGV, which can be used for short-range or urban transports (e.g. for waste collection trucks). Hybrid technologies have however little potential for long-range transit traffic, as little regenerative brake energy is generated. Also, at the moment, no battery technologies are available that could power a transit HGV.

Efficiency improvements with mega-trucks

On EU level, the discussion on megatrucks (also known as gigaliner, EuroCombi, Ecoliner) has been going on for several years. In some Scandinavian countries, megatrucks have been used for several years and tests are going on in the Netherlands and Germany. Proponents of megatrucks argue that they will increase efficiency in the road freight transport.

Several studies have analysed the environmental effects of megatrucks and their impacts on modal shift with the following results (UBA 2007, TRL 2008):

- Due to their additional deadweight, megatrucks can only generate fuel savings if their capacity is fully used.
- A megatruck is much louder on the road than standard HDVs due to its larger number of axles and greater motorization.
- Megatrucks will reduce the competitiveness of combined transport and will lead to a shift to road transport. Especially with regard to high-volume freight, rail currently enjoys an advantage over road transport due to new high-capacity wagons. With a load volume in excess of 140 cubic metres and a maximum payload of 27 tonnes, a rail wagon is clearly superior to standard truck-trailer combinations with their maximum 105 cubic metres and 26 tonne payload. Megatrucks, with their volume of over 150 cubic metres and a payload of up to 40 tonnes – with a total weight of up to 60 tonnes – are much larger than standard truck-trailer combinations.
- Due to their increased volume, megatrucks could reduce the transport costs per load-tonne by 20 to 25 per cent compared to standard HGVs.
- Megatrucks put an additional strain on road infrastructures, especially on bridges. Also, they have a negative effect on safety due to their weight.
- A market-analysis shows that megatrucks would only be specialist vehicles working in "niche" operations and would not replace the 40 tonne articulated vehicle as the standard "workhorse" of the industry. On the basis of all this information, it was estimated that up to 5% to 10% of the tonne-kms carried by articulated vehicles could move to megatrucks of 60 tonnes or more

[5] http://www.co2neutralp.eu/index.phtml?ID1=1715&id=2896&sprachen1=en

[6] For an overview of existing scenarios for electric mobility, refer to: Pfaffenbichler et al. (2009): Pre-feasibility study zur Markteinführung Elektromobilität",

→ *Vehicle efficiency improvements and the link to steering instruments*

Efficiency improvements need to be considered when designing a common steering instrument:

1) Current developments need to be considered in a business-as-usual scenario that serves as basis for defining a target of a cap-and-trade instrument. The use of more efficient vehicles and biofuels will especially be relevant for an emissions trading system based on CO_2-emissions. If the existing potential for CO_2-improvements are not considered in the target, the instrument will lose its effectiveness.

2) Steering instruments can also set incentives to improve diffusion of innovative technologies, e.g. via differentiated prices in a Toll Plus system or a special "bonus" for very efficient innovative technologies.

3) The use of megatrucks could undermine the effectiveness of a common steering instrument and weaken the potentials for transalpine combined transport. This is especially true if the instrument is based on HGV numbers (ACE). Accompanying measures to a steering instrument could thus include an explicit statement to keep the current weight and size limits for HGVs on the Alpine corridors.

3.2 Technological innovations that improve competitiveness of rail

Due to time-consuming cargo-handling between road and rail parts of combined transport and waiting times at the terminals, combined transport currently has a disadvantage with respect to road transport. Several technological improvements aim at reducing the time losses and try to improve the functioning of the overall transport chain.

Innovative wagon and trailer systems for combined transport

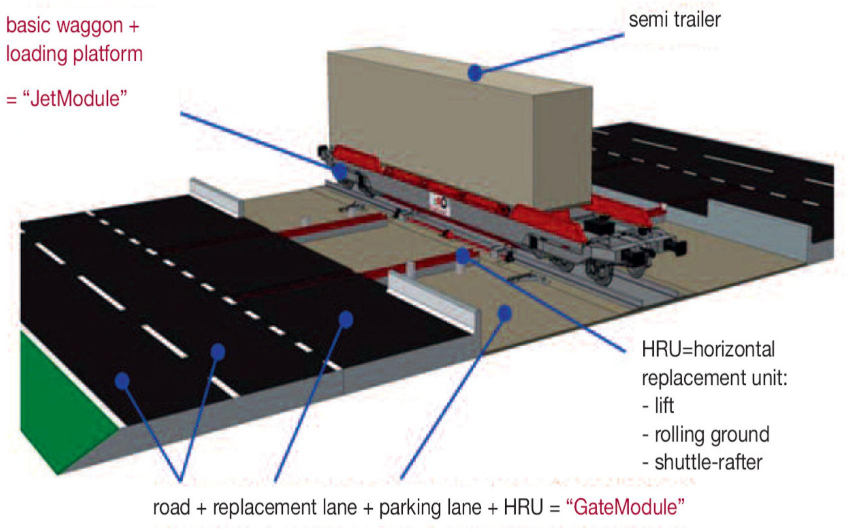
Wagons for combined transport are an integral element of the intermodal transport system. As they have to interact with both railway infrastructures and operating conditions as well as the road transport conditions, they constitute the link between the transport modes.

Several innovative systems aim at a faster, more efficient and automated transhipment between road and rail, making it unnecessary to carry along the towing vehicle as on the rolling motorway. This includes new trans-shipment systems at terminals to reduce handling time as well as new rail-wagons for semi-trailers which allow for an improved trans-shipment (DIOMIS project 2008).[7] All innovative wagon and trailer systems require an implementation at a broad level to reach the necessary economies of scale. Also, it requires the availability of improved information and communication technologies (ICT) to manage the traffic chains and to ensure the connection to the feeder system (see section below).

Examples for new trailer systems are the Modalohr, Cargobeamer or Railrunner systems. Those systems provide automated solutions without the use of cranes The Cargobeamer system claims a handling of a train with 36 unloading semi-trailers and parallel 36 loading semi-trailers in 15 minutes.[8]

[7] A short overview of innovative technologies in the field of combined transport is given by Müller (2011): Mehr Erfolg mit neuen Techniken, in: Internationales Verkehrswesen (63) 2, p. 38-39.
[8] http://www.cargobeamer.com/files/100312_pr__sentation_cargobeamer_englisch_internet.pdf

Cargo Beamer system



The **Modalohr system** focuses on new low-floor articulated railway wagons, enabling a quick and safe transhipment from road to rail. Horizontal loading of trucks is directly carried out with the roadway tractor without any handling equipment and without requiring any sophisticated terminals.[9]

The bimodal **RailRunner system** focuses on a concept of intermodal trains that are assembled directly from the container-carrying RailRunner highway chassis, using compact specialized rail vehicles called "bogies." The chassis and container are coupled to the bogie. The highway wheels are raised pneumatically, allowing the highway wheels to clear the track, thus transforming the road vehicle to a rail vehicle in a matter of minutes. Train assembly requires no lifting of the shipping container, and is fast, simple and cost-efficient. Handling times can thus be reduced in comparison to traditional intermodal solutions.[10]

[9] http://www.modalohr.com/plaquette/modalohr_gb.pdf
[10] http://www.railrunner.com/

These three examples already show the challenges that come along with using these new trailer systems. They are all based on different concepts and require different terminal infrastructures. It will already be a major challenge to find an operable solution for the Alpine Space. To become fully effective, it will however be necessary that the concept is also used in combined transport along the transport relations.

The regions in the Alpine Space need to use their role as “pilot region” to shape further developments on the European scale. This includes a clear organisational approach on how to promote the supply of new trailer systems. If the supply shall be available with the implementation of a common steering instruments, the planning will have to start before the transport market itself obtains the incentives. Similar to the approach of the reservation system for rail transports and tracks in subsidy systems, this could include an arrangement between public authorities and operators of trailer systems and infrastructures. First experiences of such an approach will be gained on the Gotthard corridor, where the necessary repair work on the Gotthard tunnel will require additional supply of combined transport services.

A higher competitiveness of rail services and combined transport services will also depend on the availability of new infrastructures and train engines that allow a better interoperability between European systems. This also includes the further deployment of the European Train Control System (ETCS).

New technologies to reduce noise emissions and air pollution

The principal source of rail noise is the rail-wheel interaction. This problem concerns both passenger and freight transport but is more acute for freight wagons, especially as freight is often transported during the night. The European Commission has recognised this problem and has introduced noise limits for rolling stock used in the EU.[11] New freight wagons have to be equipped with low-noise brake blocks (such as so-called K-blocks) reducing the noise by about 50%. Especially so-called LL-blocks have a high potential to reduce rail noise and are currently further developed by manufacturers (e.g. within the Dutch “Whispering Train Programme”).

As they do not focus on the source of noise pollution, noise barriers and soundproof windows are seen as short-term solutions only.

[11] COMMISSION DECISION of 23 December 2005 concerning the technical specification for interoperability relating to the subsystem ‘rolling stock - noise’ of the trans-European conventional rail system.

Regarding the improvement of local air quality, the further electrification of rail infrastructures and rolling stock will reduce the emissions from diesel freight engines. The electrification of the rail system can also create synergies with the integration of renewable energies, as the rail power network can be used as extension for the power network.

→ *Innovations in the rail sector and the link to common steering instruments*

The implementation of a common steering instrument will lead to a considerable shift from road to rail. To improve acceptance for a steering instrument and to ensure the efficiency of transalpine transport systems, this requires an improvement of services and quality of rail and intermodal solutions. Thus, the discussion of a common steering instrument should include the following aspects:

1) Especially in the short-term, the implementation of a steering instrument will lead to an increased demand in accompanied combined transport services. As the rolling motorway is a rather inefficient solution, the regions should work towards providing more attractive intermodal solutions.

2) Revenues from a common steering instruments could be used to finance such innovative systems for combined transport and infrastructures.

3) The higher share of rail will lead to an increase of rail noise. It should be guaranteed that only the best-available-technologies are used in additional rail services. Relevant financial needs to equip trains with low-noise brakes and to build additional noise barriers could be derived from the revenues of a steering instrument

3.3 Technological innovations to improve efficiency of the overall transport system

Intelligent transport systems and planning tools for logistic processes

Intelligent Transport Systems (ITS) make use of existing information and communication technologies to improve efficiency and security of the transport system and to improve the competetiveness of combined transport. ITS includes telematics and communications:

- In vehicles: for example with GPS navigation for an improved trip planning and location of congestion and accidents,
- Between vehicles: for example the car-to-car system which makes use of short-range wireless technology and electronically extends the driver's horizon and enables entirely new safety functions. Car-to-car systems also help to improve traffic flow and thus have an impact on efficiency (Car 2 Car Communication Consortium 2007).
- Between vehicles and infrastructures: for example to collect road tolls
- Between infrastructure an vehicles: e.g. to regulate traffic speed and traffic flow

Also, new information technologies can help to improve the competitiveness of combined transport. New planning tools for logistic processes include (European Commission 2008)[12]:

- Easier customer service to reduce administrative costs for booking and coordination.
- On-line monitoring of freight
- (Real-time) Fleet management systems to provide for a more flexible use of HGV fleet.

[12] ICT and e-Business Impact in the Transport and Logistics Services Industry, Study report No. 05/2008

- E-freight: denotes the vision of paperless freight transport processes where an electronic flow of information is linked to the physical flow of goods. Paperless processes could considerably reduce the administrative burden, especially in intermodal transport. E-Freight is the starting point for a further automation of the transportation management process, leading to “intelligent cargo”.

In the Alpine Space, new information and communication technologies are an important cornerstone for an improved competitiveness of combined transport. ITS allow an easier and more flexible trip planning and an improved monitoring of freight. The use of such systems can thus improve the quality of combined transport services.

An ITS system will also be necessary for effectively implementing a common steering instrument, especially a cap-and-trade system. In this respect, an ITS system will be necessary to transparently communicate the costs of permits/allowances and to steer transport users to the most cost-efficient solution.

Overall, these new technologies can be clustered into: i) Improved traffic management (schedule and route planning), ii) better capacity management (e.g. vehicle-to-load matching, platforms to locate empty trucks) and iii) an improvement in overall freight logistics management.

→ Transport management solutions and the link to common steering instruments:

The solutions and potentials that come along with intelligent transport systems need to be considered in the design of a common steering instrument. They will be an important accompanying measure to enable transport stakeholders to deal with the new restrictions from a steering instrument and to improve quality of intermodal services. Most of the solutions have to be pushed forward on a broader geographical scale. However, in the frame of a common steering instrument, the Alpine regions could support the following ideas:

1) Solutions for a better HGV capacity management on regional scale, e.g. a platform for pooling of shipments and for “empty truck” management. This platform could be linked to an online trading platform of an Alpine Crossing Exchange or an Emissions Trading System.

2) Support of improved traffic management solutions in the Alpine Space to enable a higher flexibility of transport operators.

3.4 Overview on technological innovations and their relevance for the iMONITRAF! objectives

All these technological innovations have the potential to lead to a more sustainable transport system. However, it is important to also consider their limitations and trade-offs. All technologies leading to a higher efficiency lead to lower transport costs and thus lead to higher demand. This phenomenon is known as the “rebound effect” and can be easily seen in the case of passenger vehicles where efficiency improvements have partly been overcompensated by an increase in car usage. This clearly shows the necessity to embed technological improvements in a smart policy instrument-mix to prevent such rebound effects.

Also, some technological innovations have impacts on other policy fields. Biofuels are a good example: while they have the potential to lead to a reduction of CO_2-emissions, they have negative impacts on food production as well as biodiversity. Even if some of these trade-offs are not directly relevant for the Alpine Space, they should still be included in an in-depth analysis.

The following table gives an overview of current technological developments and their relevance for the Alpine Space. The last column shows, if these technologies are positive or negative with respect to iMONITRAF objectives.

TECHNOLOGICAL INNOVATIONS – RELEVANCE FOR IMONITRAF! OBJECTIVES

	Relevance for Alpine Space	Air im-provm.	CO_2 emis-sions	Noise impr.	Modal shift	Competi-tiveness rail	Safe ty
Improvement of engines, Euro 6	High relevance as this affects all HGV used within transit traffic	++	-	0	0	0	0
Biofuels	Medium relevance with respect to CO2-emissions		+	0	0	0	0
Electric mobility	Relevance only for passenger/tourist traf-fic. No use for transalpine transit traffic.	+	+	+	0	0	0
Use of Gigaliners	Highly relevant, as they would be used in long-distance/transit traffic..	0	0	-	-	--	-
New brake tech-nologies rail	Highly relevant with modal shift to rail	0	0	+	0	+	0
Innovative trailer systems	Improves competitive-ness of rail	+	+	-/0	+	++	0
Innovative transport man-agement	Improves efficiency of the transport system	+	+	0	0	0	+

Table 4: ++ = very positive impact, + = positive impact, 0 = no impact, - = negative impact, -- = very negative im-pact.

The analysis makes clear that technological innovations have a far-reaching potential to change the transport system in the coming years. These developments need to be considered in the design of new policy instruments so that they reach their desired effects. The following table gives an overview on the relevance of technological developments for the design of cap-and-trade and pricing-systems.

TECHNOLOGICAL INNOVATIONS: IMPACTS ON STEERING INSTRUMENTS

	Relevance for cap-and-trade instruments	Relevance for pricing mechanism
Improvement of engines, Euro 6	If the instrument aims at an improvement of local air quality, the new Euro standards need to be considered in setting the target.	Pricing system needs to be adjusted when Euro 6 comes into force.
Biofuels	The deployment of biofuels and the relevant reduction in CO2-emissions needs to be considered in the baseline of an emission-based cap-and-trade system. No relevance for a system based on trips.	The negative effects of biofuels need to be included in the calculation of fee.
Electric mobility	Only relevant for passenger transport. In the short and medium term no relevance for target-based instruments.	Pricing system needs to consider these new technologies, e.g. with a special price group for these vehicles (e.g. local HGV in the construction business).
Use of Gigaliners	Highly relevant for a target-based system based on traffic numbers. The measure could lose its impact with a considerable capacity increase per truck.	Depends on the pricing system. In a performance-based system which considers the weight of the vehicles, the mechanisms would stay the same with megatrucks.
New brake technologies rail	Can be seen as accompanying measure for a target-based steering instrument to prevent negative impacts of modal shift concerning noise.	Only indirect relevance, to cushion negative noise effects of modal shift.
Innovative trailer systems	Accompanying measure for a target-based system to provide adequate alternative transport solutions for freight.	Only indirect relevance, to ensure efficient freight transport
Intelligent Transport systems and logistic planning tools	Accompanying measure for a target-based system to provide adequate alternative transport solutions for freight.	Only indirect relevance, to ensure efficient freight transport

Table 5:

4 Innovative steering instruments – the Alpine Regions' main field of action

4.1 Methodology

The following chapter analyses different innovative policy instruments which have the potential to become a common measure in the iMONITRAF! strategy. In a first step, the measures and their impact mechanisms are described on the basis of existing literature references. This includes an identification of the main design features/mechanisms which determine the outcome of the instrument. Also, the scope of application of the instrument is discussed – is it only applicable to freight transport or can it be used in an integrated way to include passenger transport?

Especially for the steering instruments with a cap-and-trade mechanism, the target definition is a crucial design feature as it determines the effectiveness of the instrument. Thus, the description of steering instruments will include a discussion on how the target can be defined (e.g. a dynamic target path or a modular target system). The latest study of the Suivi de Zurich process (ALBATRAS 2011) has made clear that the definition of these targets (called "thresholds" in ALBATRAS study) plays a crucial role for the effectiveness of steering instruments. As the different Alpine regions have their individual policy frameworks and objectives, the definition of a common target system will require an innovative approach.

In a second step, the potential impacts of the measures in the iMONITRAF! regions will be evaluated.

- Environmental impacts: Potential environmental effects of the measure and their contribution to meet specific environmental targets (national, European standards) and the contribution to meet the environmental and traffic targets as defined in the iMONITRAF! DPSIR-system.[13]

  For the evaluation of environmental impacts of a common steering instrument, two scenarios are analysed with the DPSIR system and illustrated in a special brochure for policy-makers.
- Socio-economic impacts: A broad steering instrument that affects overall European transport flows will have different impacts in different parts of the transit corridors. The analysis will include impacts on the regional economies, regional transports and the corresponding impacts on the population.

4.2 Chances and risks for the Alpine regions

A common steering instrument has the potential to improve the traffic management in the Alpine Space and to limit negative impacts on the environment and health. The target-based systems Alpine Crossing Exchange and Emissions Trading System define an absolute limit for transport volumes and/or its impacts. A pricing mechanism will improve modal shift through the price incentive. Steering instruments thus clearly support the iMONITRAF! objectives and should be a crucial part of the iMONITRAF! strategy.

New steering instruments, however, also bring along some risks for the Alpine regions. This requires an in-depth look at socio-economic impacts in the iMONITRAF! regions. Independently

[13] The Driver-Pressure-State-Impact-Response system (DPSIR-system) has been developed by UNEP and EEA and is used in the iMONITRAF! project as an evaluation and communication framework. It includes the targets with highest political relevance in a common framework to allow a comparable picture across regions and over time.

from the specific design of a steering instrument, the following mechanisms need to be considered:

- All steering instruments will lead to an increase of transport prices which raises the prices of both intermediary and consumer goods. This mechanism will lead to an overproportional economic impact in the mountain regions due to longer transport distances and higher transport-intensities of their economies.
- The instruments also have impacts on the regional transport sector. Here, however, the three instruments have to be differentiated. An overproportional burden for the regional transport sector only occurs, if the instrument does not take into account the transport distance. In addition, it needs to be considered that the regional transport sector with small and medium enterprices may face an overproprotional administrative burden.
- The steering instruments will lead to an increased demand for combined transport services. In the short term, this demand will focus on the rolling motorway. To provide the necessary capacities, this will require the provision of new rail infrastructures, terminals and trans-shipment centres. This will lead to new business opportunities in the regions – but also to new sources of environmental pressures (especially noise and land-use).

The following table summarizes the major chances and risks, considering the existing pressures and political frameworks on the different iMONITRAF! corridors:

STEERING INSTRUMENTS: CHANCES AND RISKS FOR THE ALPINE REGIONS

	Chances	Risks
Brenner corridor	– Reduction of environmental pressures due to lower transport volumes – Improved road safety – Higher demand for rail services will serve as driver for construction of BBT – Tirol: Steering instrument can be used as backstop-solution if sector driving ban is not approved by EU.	– Impacts on regional economies (especially South Tyrol on southern side of the corridor) – Impacts on the regional transport sector
Gotthard corridor	– Reaching the modal shift aim as defined by the Swiss constitution – Improvement of road safety – Better use of new GBT rail capacities	– Impacts on regional economies and transport sector (see above). – Traffic shifts from other corridors (to road and rail) as existing differences in transport prices will become lower.
Fréjus and Mont-Blanc corridors	– Improved traffic management between the two corridors. – Reduction of environmental impacts and improved safety. – Driver for construction of Lyon-Torino basetunnel.	– Impacts on regional economies and transport sector (see above), especially in Italian regions.
Tarvisio	– Reduction of environmental impacts and improved safety.	– Impacts on regional economies and transport sector (see above), especially in Italian regions.

Table 6:

Detailed regional impacts of steering instruments have not yet been analysed for all regions and all instruments. A Swiss study on regional impacts of an Alpine Crossing Exchange (Infras et al.

2011) gives a general feeling on role and vulnerability of regional transports. It has assessed the importance of local and regional transport for a common steering instrument:

- Local transport is the transport in the direct surrounding of the Alpine crossing, with a distance of about 40 km north and south of the crossing (as already defined in Ecoplan et al. 2007). In Switzerland, this local transport currently amounts to 11'500 HGV/year (about 1% of the overall transit volume).
- Short-distance transport of about 150 to 200 km has only limited possibilities to switch from road to rail and should thus be treated in a differentiated way. In Switzerland, these short-distance transports amount to less than 5% of alpine crossing transport volumes.

The analysis made clear that from the overall inland freight transport in Switzerland (with a distance of max. 290 km), short-distance freight transport only takes a rather small share. The following figure shows that only about 18% of all Swiss inland freight transport has a shorter distance than 150 km. Transport distances below 100 km only amount to 7%.

DISTRIBUTION OF SWISS INLAND FREIGHT TRANSPORT (< 290 KM)

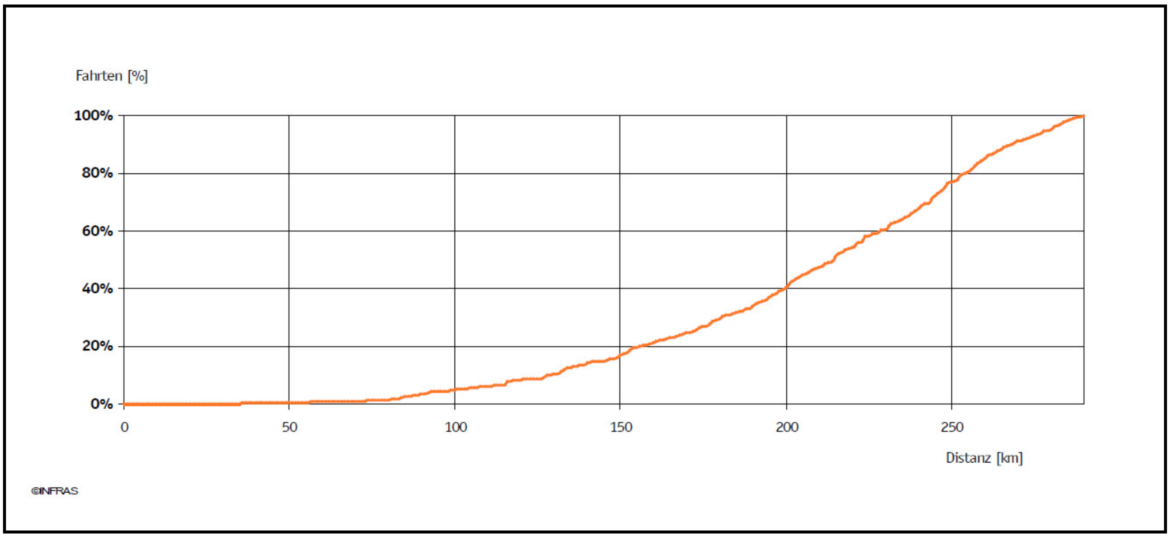


Figure 4 *Source: Infras et al. 2011*

The results of the Swiss study are presented in more detail in chapter 4.4.2 on the Alpine Crossing Exchange. A comprehensive study for the whole Alpine arc is currently developed in the frame of the "Suivi de Zurich" process, considering impacts on the regional transport sector and the overall regional economy. This study builds on the existing report on traffic impacts of different steering instruments (ALBATRAS 2011) and will be presented at the beginning of 2012.

All existing information on the regional impacts of the steering instruments is summarized in the following paragraphs. Even if detailed results are not yet available for all regions, the analysis provides enough information to develop approaches on how to deal with the economic impacts in the Alpine regions as well as recommendations for the iMONITRAF strategy at the end of this chapter.

4.3 Innovative pricing instruments – design features and impacts

General mechanism

The missing market prices for external effects lead to an overexploitation of environmental resources and to an inefficient factor allocation. This situation has led to the realisation that a "laissez-fair" approach is not feasible in the case that negative external effects occur and that governmental intervention is necessary to correct external effects.

An environmental tax or charge which is based on the external effects can lead to a more efficient situation, as it sets a price incentive for emission reduction activities. Such environmental taxes or charges are not new and are currently used in several European countries (CO_2 taxes, ecotax, water charges, etc.).

However in the field of transport, taxes and charges have up to now focused on the financing of infrastructures and have not included external effects of transportation. The Swiss HGV fee is up to now the only pricing mechanism which explicitly includes external effects to set an incentive for modal shift and to reduce road transport volumes. With the revision of the Eurovignette Directive, also the European Union enables the inclusion of external costs into road pricing mechanisms for freight transport. However, it allows only the inclusion of external costs on local air quality and noise as well as a differentiation into peak and off-peak hours to better manage congestion. The inclusion of these external costs is however not mandatory (European Commission (2011c).

A broad use of pricing mechanisms based on external costs of transport could thus be seen as new measure. In order to meet the criteria of the polluter-pays-principle, a pricing mechanism needs to be differentiated according to different types of vehicles and their specific emissions.

Making full use of the new possibilities of the revised Eurovignette Directive needs to be seen as first step. Furthermore, the regions can work towards a more differentiated pricing system, allowing for a full internalisation of all external costs.

Design of a Toll Plus system

The idea of a Toll Plus system is mostly developed in France and is closely linked to the current discussions on EU-level to improve the Eurovignette Directive. It is based on two characteristics, the internalization of external costs as well as the implementation of the polluter-pays-principle (ALBATRAS 2011). An improved pricing system should have the possibility to charge a mark-up in sensitive areas and to allow for further differentiation of tolls. Currently, the mark-up factor for sensitive areas in the Eurovignette Directive is only 25% of average tolls. Analyses of external costs however show that external costs in sensitive areas are twice as high as in flat areas (Lieb et al. 2006). An improved pricing system could also include a stronger spread between different Euroclasses to set a clear incentive for using the most efficient HGV.

A harmonized approach with a common pricing system for all iMONITRAF! regions would reduce the existing price differences between the different corridors and would thus help to prevent detour traffic and to lead to a more efficient transport system.[14]

The French Toll+ concept is based on existing toll modulations on French motorways that have been used since the 1990s, mostly in the field of passenger transport to smooth traffic in the peak-hours. The more detailed analysis of a Toll+ concept within the Suivi de Zurich process

[14] For an analysis of today's pricing systems and the corresponding detour traffic see the relevant reports that have been developed in the MONITRAF project (WP 10 Common measures and synthesis report).

builds on the ideas developed in France and proposed the following **structure** for differentiation (ALBATRAS 2011):

- A differentiation according to the weight of the vehicle or the number of axles to determine the overall level of the toll.
- A differentiation according to environmental impacts of vehicles, for example based on Euroclasses.
- A differentiation between peak and off-peak hours to set incentives for a more balanced capacity usage of infrastructures.

While the definition of an overall number of HGV or an overall limit for emissions is the crucial threshold for target-oriented instruments (cap-and-trade), the effectiveness of a pricing system crucially depends on the level of the toll. Concerning the **level** of the toll, the French concept (MEDAD 2008) proposes an orientation on the existing Swiss HGV fee (the LSVA) with an adjustment path until 2020.

As the iMONITRAF! regions face different situations with respect to infrastructure availability, a common implementation of a Toll+ system would require some options for fine-tuning:

- A differentiation according to peak and off-peak hours needs to consider the interaction with night-driving bans. This is especially relevant for freight traffic. If traffic cannot switch to off-peak hours during the night, due to the night driving ban, the differentiation cannot be used. In this respect, the application of strict night driving bans needs to be discussed.
- When designing the Toll+ system, the infrastructure availability needs to be considered. If there are few or no possibilities to switch from road to rail, a lower rate or a longer adjustment pathway might be necessary to prevent disproportionate burdens.

A pricing system could also include an innovative approach to using the revenue. From a regional viewpoint, it would be important to use the revenue within the target system, so that it leads to a multiplicator effect. This could include the following options:

- Cross-financing between road and rail: The revenue from pricing of Alpine roads could be used to further develop rail infrastructures. This mechanism is already applied in Switzerland for financing the new base tunnels.
- Financing of a regional fund: Some of the revenue could be used to feed a regional development fund. This fund could finance innovative projects for regional development and cooperation, e.g. in the field of tourism. The regional fund could also be used to compensate the population in the Alpine Space.

Regional impacts of a Toll+ system

The regional impacts of a Toll+ system crucially depend on the design of the system concerning level of the tolls and their structure. The recent study of the Suivi de Zurich derives the toll level from the discussion of the cap-and-trade instruments. The resulting price per kilometer lies between the price of an Alpine Crossing Exchange and an Emissions Trading System and amounts to **0,29 €/km** (ALBATRAS 2011). This toll is implemented in addition to existing policy instruments (as in the 2004 base case). Due to the distance-based approach, the overall toll prices vary per corridor.

- On the **Brenner** corridor with one of the longest distances in the Alpine Space territory, the price amounts to **125 €/trip**.

- On the **Gotthard**, the price would be **78 €/trip**
- On the **Mont-Blanc** it would be **73 €/trip** and
- On the **Fréjus**, it would be **89 €/trip**.

Traffic impacts

The proposed toll level of the Toll+ concept lies below the current toll level of the Swiss HGV fee. The price incentive which arises in the concept of the ALBATRAS study can thus be seen as a “conservative” estimate and resulting impacts need to be cross-checked with experiences of the Swiss HGV fee. ALBATRAS (2011) has analysed the impacts of a Toll+ concept concerning: i) traffic switches between Alpine crossings, ii) traffic switches from road to rail, and iii) avoidance of traffic. In the 2020 scenario, the Toll+ system leads to a decrease in total transalpine road freight transport volumes of around 15% compared to the business-as-usual case. The changes on the different corridors are depicted in the following figure:

IMPACTS OF A TOLL+ CONCEPT ON ROAD AND RAIL (2020, %-CHANGES)

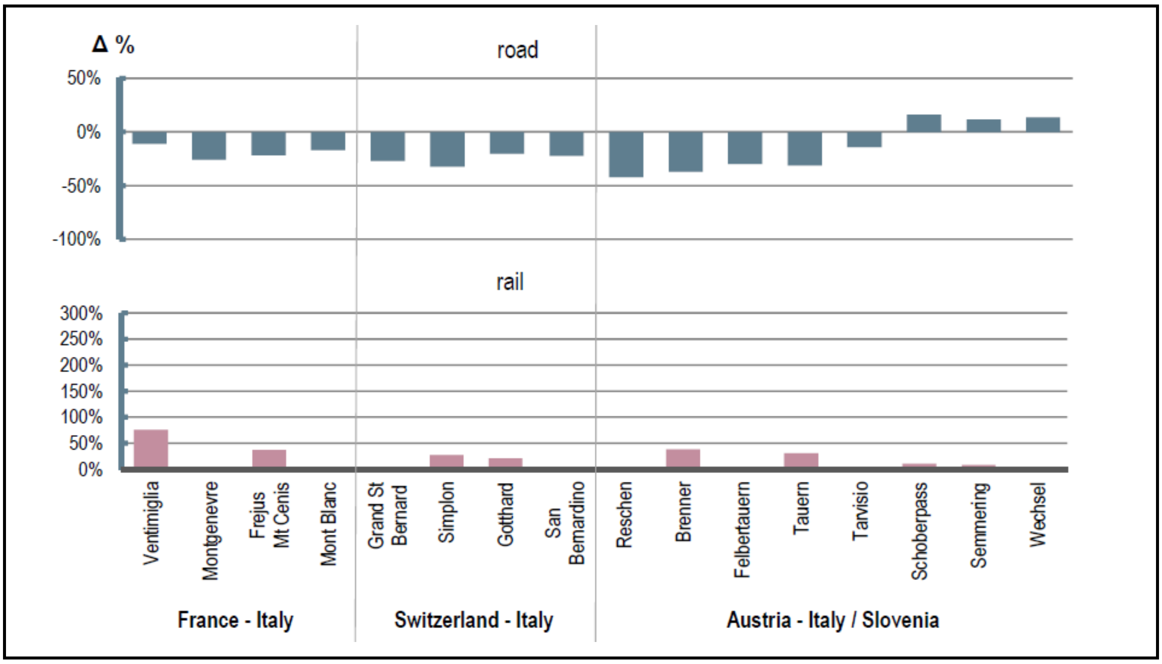


Figure 5 *All changes are depicted in comparison to the 2020 Business-as-usual scenario, source: ALBATRAS 2011, p. 184.*

Overall, the scenario would lead to a reduction of modal split of road from 62% to 53%, with a decrease of total transalpine HGV trips from 12.4 Mio./year to 10.6 Mio./year. The common application of this Toll+ concept leads to a traffic shift from Austrian/Italian and French/Italian corridors to the Swiss/Italian corridors. This can be seen in the figure above where especially the Brenner corridor sees a much higher reduction of road transport than the Gotthard corridor.[15]

[15] Detailed results can be found in the ALBATRAS report on p. 183. In the described Toll + scenario, transalpine freight volumes develop as follows: On corridors between A and I/Slo, road freight volumes are reduced by 14 Mio.tons/a. 11 Mio. t/a are shifted towards A – I/Slo rail corridors. On the CH – I corridors, road freight volumes are reduced by 4 Mio. t/a. 8 Mio. t/a are shifted towards CH - I rail corridors. On the F-I corridors, road freight volumes are reduced by 5 Mio. t/a and 6 Mio. t/a are shifted towards F/I rail corridors.

A differentiation of the toll according to Euroclasses and day times has not been modelled in ALBATRAS. It can be expected, that a differentiation according to Euroclasses would set an incentive to switch to the most efficient HGV. The reduction of environmental pressures would thus be overproportional to the reduction of road traffic volumes.

The ALBATRAS results seem to be in-line with experiences with the Swiss HGV fee. The Swiss HGV fee has been introduced together with an increase in weight limits, so that to different effects have to be isolated. An evaluation of the transport and economic impacts shows that the effect of the higher weight limits is overcompensated by the price mechanism (Ecoplan and Infras 2007). Until 2005, the HGV fee has led to a 23.5% reduction of vehicle kilometres compared to a business-as-usual scenario (overall transport volume). As the ALBATRAS study uses a lower toll level but does not have any effect on weight limits, the 15% reduction of the road transport volumes of the ALBATRAS scenario seems reasonable.

Overall, the experiences in Switzerland and the scenario analysis of a Toll+ concept make clear that an ambitious road pricing system has a high potential to reduce road transport volumes. However, it needs to be considered that the reduction is always illustrated in comparison to a business-as-usual scenario (including further growth), so that the reduction in comparison to existing road transport volumes is much lower.

Regional socio-economic impacts

The regional impacts of the proposed Toll+ concept have not yet been studied in detail. An evaluation of the regional impacts of the Swiss HGV fee can however give a first indication (Ecoplan and Infras 2008). The regional economic impacts depend on transport distances, transport volumes and the transport-intensity of the regional economy. The analyses shows that there are both mountain regions and other regions with an overproportional burden per employee. However, the mountain regions on average face a higher burden than the other regions (177 CHF per employee in mountain regions compared to 137 CHF per employee in the rest of Switzerland).

In Switzerland, this overproportional burden for mountain areas is compensated with a financial transfer to the mountain regions from the revenue. A similar approach could be used for a common Toll+ system.

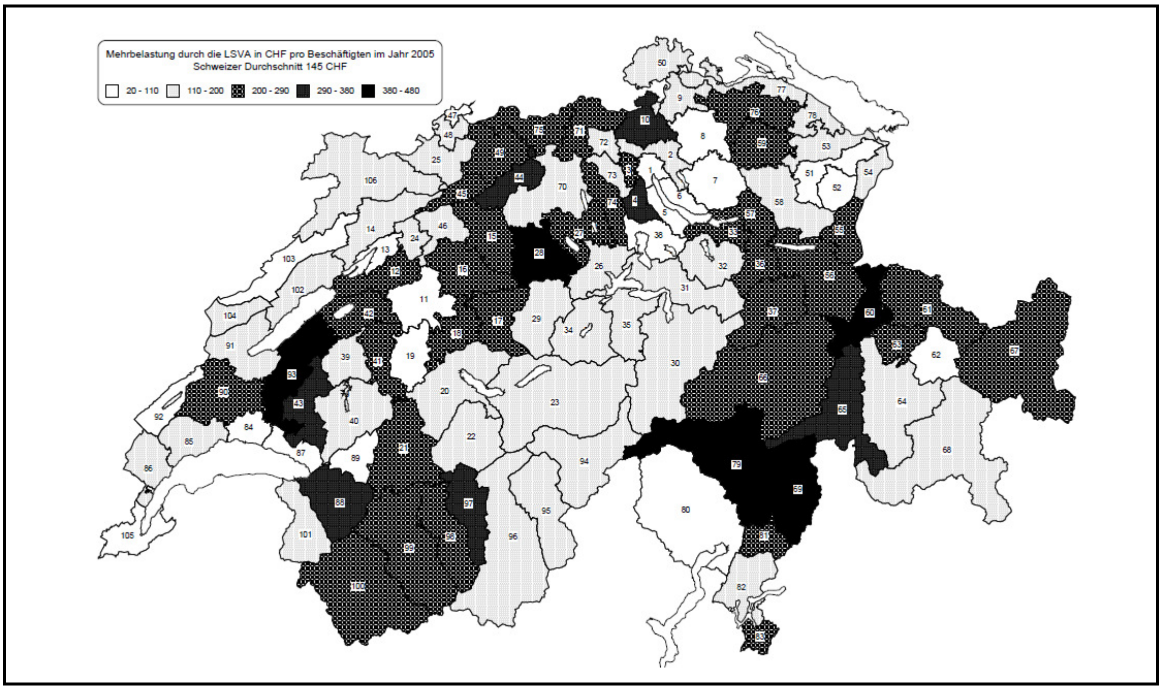


Figure 6 *The regional impact is illustrated in form of additional burden per employee. On average, the Swiss HGV fee has led to an additional burden of 145 CHF in 2005. In the mountain regions, the average additional burden amounts to 177 CHF whereas the rest of Switzerland only faces a burden of 137 CHF. Source: Ecoplan and Infras, 2007.*

4.4 Innovative target-oriented measures

4.4.1 Mechanisms and discussion of targets

The effectiveness of pricing mechanisms can often not be guaranteed: even if they lead to a full internalisation of external costs, it is possible that emissions are not reduced in an amount to effectively prevent environmental damages. Especially if abatement costs in the relevant sector are high, polluters would rather pay the tax or charge than reduce their emissions.

This problem can be prevented in a target-oriented approach which limits emissions or the relevant activities to a given amount. An emissions trading system with a cap-and-trade approach is the typical example: the overall available amount of allowances (the cap) is defined and the allowances are distributed to polluters. The polluters are allowed to trade their allowances in order to reduce overall abatement costs: if the abatement costs of a polluter are below the market price of allowances, he will sell allowances until his abatement costs increase to the level of the market price. If the abatement costs are above the market price, the polluter will however prefer to buy emission allowances and can thus continue his emitting activities.

Such target oriented-measures are a rather new instrument in the fields of environmental and transport policies. The EU emissions trading system for stationary sources (power companies and energy-intensive industries) and the aviation sector (from 2012) is probably the most successful cap-and-trade system. In the field of transport, the Austrian ecopoint system which has been in force from 1993 to 2003 is another example. The ecopoint system was the first instrument for effectively limiting the numbers of HGV and their environmental impacts to a predefined limit (Herry/Infras/Prognos 1997).

The first question for implementing a cap-and-trade instrument is **the relevant target** that the instrument should focus on:

- Reduction of road traffic volumes and modal shift from road to rail as well as an efficient distribution of traffic volumes.
- Reduction of environmental pressures with focus on specific pollutants or an index – based on the environmental capacities of the sensitive Alpine Space.
- Financing of new infrastructures.

The different Alpine regions and countries today put different priorities on these targets. As basis for a common instrument it will thus be necessary to first discuss the possibility to establish a common target or to integrate the different targets in a common steering instrument.

4.4.2 Alpine Crossing Exchange – Market –based instrument on the basis of HGV numbers

Design of the Alpine Crossing Exchange

The Alpine Crossing Exchange (ACE) is a market-based instrument to manage transalpine road traffic. The measure has been developed in Switzerland and is an element of the Swiss modal shift policy. The Alpine Crossing Exchange can guarantee the reduction of transalpine road journeys to a specific target as it sets a cap on road transportation. The cap-and-trade approach is a system of tradable Alpine Crossing Allowances with the main objective to reach a pre-defined traffic target in an efficient way. According to the current Swiss proposal, the Alpine Crossing Allowances will be distributed via an auctioning mechanism and can then be traded on a trading platform/stock exchange. The option leads to a scarcity price for road transport and thus to an increase of transport prices and an incentive to switch from road to rail. It would also be possible to distribute the allowances for free, e.g. based on historical transport numbers or on the basis of applications.

A common implementation of the ACE in the Alpine Space would lead to an overall limitation of transalpine road transport. Distributional impacts that would come along with a unilateral implementation of an ACE are prevented, additional transport beyond the pre-defined target would have to shift to rail.

The effectiveness of an ACE and its impacts crucially depend on the target (called “threshold” in the ALBATRAS study of the Suivi de Zurich process). There are different approaches to define the target/threshold:

- Technical approaches oriented at environmental capacities: This approach defined the overall target/threshold on the basis of environmental capacities of the Alpine Space. Which traffic volumes are acceptable to prevent negative impacts on human health and the sensitive ecosystems?
- Technical approaches oriented at infrastructure capacities: This approach is based on existing and planned infrastructure capacities on road and rail. The capacity of the road infrastructure is limited through number of lanes, speed and the distance between vehicles. Rail capacities depend on prioritization between freight and passenger transport as well as supply of combined transport services.
- Political approach: The political approach often presents a compromise between the different technical approaches and the acceptance of stakeholders. In many cases, the political approach has used a “stabilisation scenario” which freezes traffic volumes or emissions at a specific base-year.

The only absolute target in the field of transport has been defined in Switzerland, with the modal shift aim of 650'000 transalpine HGV per year after the opening of the Gotthard base tunnel. For an ACE, the other regions or countries would need to define similar caps on the basis of their political objectives. Up to now, the discussion in the iMONITRAF! project has followed a flexible system with different approaches for the corridors;

- The Swiss target of 650'000 HGV per year is defined on the basis of the political modal shift objective.
- In Tirol, the need for action is derived from environmental targets and the capacities of infrastructures.
- A common target for the French/Italian corridors Fréjus and Mont-Blanc has been fixed along the political approach, with a stabilization on the level of 1990.

The ALBATRAS study (2011) has also defined several threshold scenarios, include a restrictive and a tolerant scenario for both 2020 and 2030. It assumes that all regions, in the long run until 2030, reach the same reduction, with the Swiss modal shift objective as basis. However, the French-Italian and Austrian-Italian corridors take on a less ambitious reduction pathway, with only half the reduction objective until 2020. The ALBATRAS thresholds are illustrated in the following tables. As ALBATRAS focuses on all corridors in the respective countries, we need to break down the numbers to iMONITRAF! corridors in order to compare the ALBATRAS thresholds with the proposed iMONITRAF! targets.

PROPOSED THRESHOLDS FOR AN ACE IN 2020 AND 2030 (HGV/YEAR)

		CH – I corridors	F-I corridors	A – I/Slo corridors
2020	ALBATRAS tolerant	900'000 HGV	2.1 Mio HGV (all corridors) 0.96 Mio. HGV (Fréjus and Mont Blanc)	4,5 Mio HGV (all corridors) 1.08 Mio. HGV (Brenner)
	ALBATRAS restrictive	650'000 HGV	1.9 Mio. HGV (all corridors) 0.87 Mio. HGV (Fréjus and Mont Blanc)	4 Mio. HGV (all corridors) 0.96 Mio. HGV (Brenner)
	iMONITRAF! proposal	650'000 HGV	1.24 Mio. HGV (Fréjus and Mont Blanc)	1.0 Mio. HGV (Brenner)
2030	ALBATRAS tolerant	900'000 HGV	1.6 Mio HGV (all corridors) 0.74 Mio. HGV (Fréjus and Mont Blanc)	3.5 Mio HGV (all corridors) 0.84 Mio. HGV (Brenner)
	ALBATRAS restrictive	650'000 HGV	1.1 Mio. HGV (all corridors) 0.5 Mio. HGV (Fréjus and Mont Blanc)	2.5 Mio. HGV (all corridors) 0.6 Mio. HGV (Brenner)

Table 7: *The thresholds are broken down from national targets to corridor targets according the shares of the ALBATRAS study, p. 260*

The comparison shows, that the ALBATRAS thresholds are in general more ambitious than the currently discussed iMONITRAF! targets. This is due to the fact that they are derived from the Swiss reduction aim. The results from the ALBATRAS study thus need to be seen as an upper bound and would need to be verified for less ambitious but politically feasible targets.

Regional impacts of an Alpine Crossing Exchange

The impacts of an Alpine Crossing Exchange have been analysed in detail for the Swiss situation, including an in-depth analysis of regional impacts (INFRAS et al. 2011). The ALBATRAS study includes an analysis of traffic impacts of the ACE scenarios.

Traffic impacts

The traffic impacts of an ACE for the Alpine Arch C have been analysed for the ALBATRAS scenarios with a traffic model. The different thresholds per country and the different frameworks to switch from road to rail (prices, capacities) lead to different prices for an Alpine Crossing Permit. For the restrictive scenario, the price for an Alpine crossing on the Swiss-Italian corridors would amount to 160 €/trip in 2020. Due to the less ambitious reduction pathways, the prices would be lower on the other corridors, with 94 €/trip on the Austrian-Italian corridors and 126 €/trip on the French-Italian corridors.

The introduction of an ACE with the restrictive thresholds would lead to a reduction of transalpine road freight transport of about 17% compared to the business-as-usual scenario. Due to the higher prices, the reductions on the Swiss-Italian corridors are much higher than on the other corridors, as shown in the following figure.

IMPACTS OF AN ACE ON ROAD AND RAIL (2020, %-CHANGES)

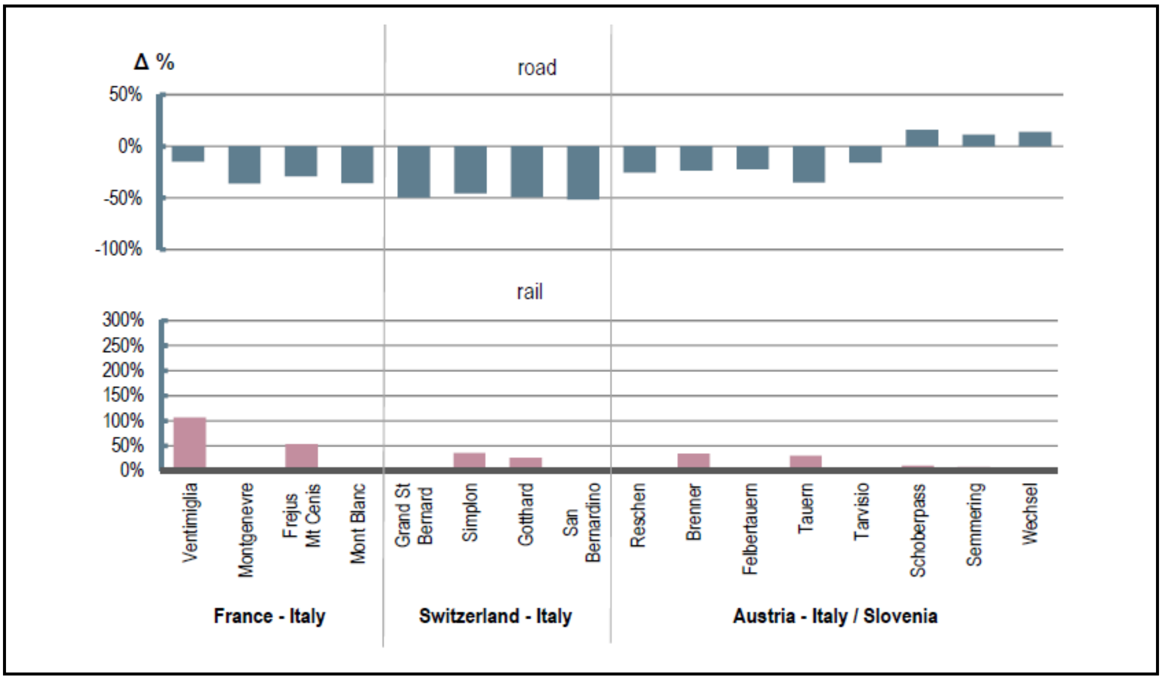


Figure 7 *All changes are depicted in comparison to the 2020 Business-as-usual scenario, source: ALBATRAS 2011, p. 146.*

Nearly all reduced road traffic volumes are shifted from road to rail (27 Mio.t from 27.3 Mio. t/a). Only 0.1% of transports are shifted to other corridors outside the Alpine Arch C or are not transported any more. Due to the limited rail capacities on the French-Italian corridors, some of the traffic volume between France and Italy is shifted to the Swiss-Italian and Austrian-Italian corridors (ALBATRAS 2011).

The environmental impacts of an ACE have not yet been analysed in detail. As the ACE does not include a differentiation according to environmental criteria, it can be assumed that environmental pressures will be reduces in-line with the road transport volumes (all other things being equal).

An evaluation with the iMONITRAF! DPSIR-system can be found in the special brochure for policy-makers.

Regional socio-economic impacts

A study for the Swiss Alpine regions gives a first impression on regional impacts of an ACE (Infras et al. 2011). The study uses similar prices for an Alpine Crossing Permit than the ALBATRAS study (as it is based on the same transport model), so that results should be comparable.

The regional impact study has analysed both the effects on the regional transport sector (direct impact channel) and the effect on the broader regional economy (indirect impact channel due to passing on of higher transport costs). In all regions, the impacts on the transport sector and the regional manufacturing sector are surprisingly low. The overall regional impact lies below 1% of value added in all regions. However, the over-proportional burden for the regional transport sector can clearly be seen. While the average impact in Switzerland amounts to 0.2% of valued added of the transport sector, the economic loss comes up to about 2% in Ticino and 6% in the region Tre Valli (Infras et al. 2011).

REGIONAL IMPACTS OF AN ALPINE CROSSING EXCHANGE IN CH

	Overall economic impact		Economic impact in the transport sector		Economic impact in the manufacturing industry	
	In Mio. CHF	In % of GVA	In Mio. CHF	In % of GVA	In Mio. CHF	In % of GVA
CH total	137.7	0.03%	38.6	0.21%	99.1	0.02%
Ticino	50.8	0.22%	14.2	1.87%	36.6	0.16%
Tre Valli	6.4	0.59%	2.5	6.04%	4.0	0.36%
Grisons (Graubünden)	5.8	0.05%	2.1	0.42%	3.8	0.03%
Valais	4.7	0.03%	1.3	0.20%	3.4	0.02%
Uri	2.0	0.11%	0.7	0.83%	1.3	0.07%

Table 8: *GVA: gross value added; Source: Infras et al. 2011*

Several options have been analysed for the Swiss regions to prevent an additional burden from an Alpine Crossing Exchange. Some options are linked to the design mechanism of an ACE (concerning allocation, disposal of certificates and definition of the relevant trading entities). Other options focus on the provision of rail alternatives for short-distance and regional transport or compensatory approaches. The main possibilities are summarized in the following table:

APPROACHES FOR LOCAL AND REGIONAL TRANSPORT IN AN ACE

	How does the mechanism work?	**Advantages, disadvantages?**
Preferential treatment allocation (e.g. free allocation)	The certificates (Alpine Crossing Units) can either be handed out for free or via an auction. It is currently proposed to use an auction mechanism, i.e. transport actors would have to buy the certificates. → Local/regional transport could get a preferential treatment with a free allocation.	Advantages: Regional/local transport would be included in the system but would face no additional costs; Disadvantages: Increase of administrative complexity;
Differentiated prices in an ACE	The current concept proposes to different "currencies" for an ACE. The basis currency is the Alpine Crossing Unit which needs to be exchanged into an Alpine Crossing Permit. → With this mechanism, it is possible to establish differentiated prices. E.g. while long-distance transport has to hand in 10 units for one crossing, regional and local transport could obtain a better exchange rate.	Advantages: Regional/local transport would be included. With a differentiation of transport distance, an overproportional burden can be prevented. Disadvantage: Additional complexity with exchange of units it an Alpine Crossing Permit
Complete exemption from ACE	Short-distance and regional transport only amounts to a small share of trans-Alpine transport. The overall impacts are not influence by this share. → An easy solution would be a complete exemption from the ACE. This could be based on existing experiences in Switzerland with exemptions for short-distance transport in the Gotthard dosing system.	Advantage: Very easy mechanism. Disadvantage: Local and regional transport would not be integrated in the target system. A small uncertainty towards reaching the aims would remain.
Provision of specific rail infrastructures	Currently, regional and local transport has no possibility to switch to rail as there are no services. → A possibility would be the implementation of a short-distance rolling motorway.	Advantage: Modal shift incentive would be extended to regional and local transport: Disadvantage: Overall efficiency of such a system seems questionable.
Compensation	Different mechanisms could provide a compensation for the over-proportional regional burden. The compensation could go to i) the transport system, ii) to the local economy, iii) to the region.	Advantage: Regional/local transport would be fully included in an ACE. Disadvantage: Net impacts are difficult to assess.

Table 9: *Source: Infras et al. 2011*

It becomes clear that all approaches to avoid a burden for regional and local transport have advantages and disadvantages. Regarding the first estimates on the absolute amount of the regional burden, a compensatory mechanism seems not necessary. As the provision of new rail services requires high investments and seems questionable from the efficiency point of view, this approach should also obtain a low priority. A complete exemption for regional transport does not seem feasible from a strategical point of view if the Alpine regions call for the implementation of an ACE. Overall, a mechanism within the design of an ACE seems reasonable (e.g. a differentiation of prices with different exchange rates from ACE units to allowances, preferential treatment in allocation)..

4.4.3 Emissions Trading System – Market –based instrument on the basis of environmental targets

Design of an Emissions Trading system

Contrary to the ACE, an Emissions Trading System is based on one or several environmental targets. A good reference is the Austrian Ecopoint system (1992 to 2004) which had the objective of a 60% reduction of NOx emissions. The environmental target can be based on one environmental indicator (e.g. NOx or CO_2 emissions) or could consist of several indicators in form of an index. An ETS will thus differentiate an Alpine Crossing on the basis of environmental aspects: an HGV with high emissions has to hand in more allowances than a modern and efficient vehicle. Also, an emission based approach might make it necessary to consider the different distances of the Alpine crossings.

The design mechanism based on environmental indicators sets a direct incentive for hauliers to use the most efficient transport fleet. The improvement of the vehicles fleet is thus the most important mitigation option, in contrary to the ACE with the modal shift as most important reaction. Depending on the environmental target, an ETS cannot guarantee that traffic targets are met. Theoretically, it would be possible that an environmental target is reached with the help of technological improvements.

It might be interesting to discuss a two-level approach which also includes a traffic-target in an ETS. Such a mechanism with a limit for traffic growth had also been integrated in the Ecopoint system to prevent that traffic numbers increase by more than a pre-defined proportion.

A specific proposal for an emissions trading system has been developed in Austria. An existing analysis proposed a mixed environmental indicator on the basis of CO_2, NOx and PM10 (Gobiet et al. 2006). It might also be possible that an emissions trading system for transalpine freight transport would be linked to the existing EU emissions trading system for stationary sources and aviation. This would however imply, that the ETS focuses on CO_2-emissions. The idea of a CO_2-based emissions trading system has been taken up in the ALBATRAS study, which defines the mechanism of on Alpine Emissions Trading System.

As an emissions trading system follows the same mechanism as an Alpine Crossing Exchange, the effectiveness of the system also depends on the definition of the target (threshold). The reduction target is defined in comparison to a given base year: Along the mechanism of the international climate change agreements, it would be possible to focus on CO_2 and to reduce emissions by a specific amount in comparison to 1990. The reduction target could be based on the following frameworks:

- European level: The European Union has defined a 20% reduction target for greenhouse gas emissions until 2020 (compared to 1990). If other industrialized countries contribute in a future international agreement, the EU would increase this target to a 30% reduction. For the first time, the Transport White Paper defines a specific reduction target for the transport sector, with a 20% reduction of CO_2-emissions until 2030 (compared to 2008).
- National level: The thresholds could also be based on national reduction targets.
- Regional level: It would also be possible to define a specific reduction target for the Alpine Space. As the sensitive mountain regions will face overproportional impacts from climate change, it could be argued that these regions should go ahead in reducing CO_2 emissions and to motivate other regions.

The ALBATRAS study has taken a pragmatic approach, with the definition of a tolerant and a restrictive scenario. The tolerant scenario is based on a reduction target of minus 10% until

2020, and a reduction of 20% reduction until 2020. This tolerant scenario is thus in line with the targets of the EU Transport White Paper. The restrictive target foresees a reduction of 20% until 2020 and of 40% until 2030.

As CO_2-emissions depend on the trip distance, the mechanism as defined in ALBATRAS includes a distance-based differentiation. The price of a certificate is presented as costs per kilometer, leading to higher costs of a permit at the corridors with a longer distance in the Alpine region (as defined by the Alpine Convention).

Regional impacts of an Emissions Trading System

The regional impacts of an Emissions Trading System are similar to the impacts of an Alpine Crossing Exchange and a Toll+ system. In comparison to the thresholds / targets of the Alpine Crossing Exchange, the reduction targets for a CO_2-based Emissions Trading System are much less ambitious. This is reflected in the existing results.

Traffic impacts

In the restrictive scenario, the reduction target leads to **a price of 0.23 Euro/km**, in the tolerant scenario the price signal is lower with 0.11 Euro/km. Due to the different distances in the Alpine areas, the crossing on a corridor with a longer distance in the Alpine Space would be more expensive than a crossing with a shorter distance. The mechanism of traffic shifts is similar than the shifts described for a Toll+ system.

In the restrictive scenario, the total transalpine road freight volume is reduced by around 12% as compared to the business-as-usual scenario. Similar to the Alpine Crossing Exchange, this reduction is mainly due to a shift from road to rail, the reduction of transport is again only 0.1% of the volume. Again, traffic is shifted from Austrian-Italian and French-Italian corridors towards the Swiss-Italian corridors. This is especially due to the short distance of the Gotthard corridor and to the availability of the new rail infrastructures.

The environmental impacts of an ETS are also analysed with the help of the iMONITRAF! DPSIR-approach and illustrated in the special brochure.

Regional socio-economic impacts

The regional impacts of an Alpine emissions trading system have not yet been analysed in detail. However, two main aspects have to be considered:

- In comparison to the Alpine Crossing Exchange, an Emissions Trading System would consider the different transport distances. Regional transport would thus have to pay the same amount per km than all other transports and would not face an overproportional burden.
- The currently proposed reduction pathway would lead to lower prices than an Alpine Crossing Exchange. For example, the certificates would be much less expensive on the Swiss-Italian corridors, with 62 Euros for a transit at the Gotthard as compared with the 160 Euro per trip with an Alpine Crossing Exchange.

It can thus be assumed that the Alpine regions would not face a high burden from an Emissions Trading System. It still needs to be assessed in detail, if there is a need for designing a special mechanism for regional transports or a compensation.

4.5 Consolidating the regional viewpoint on steering instruments

Overview: a critical appraisal from a regional viewpoint

The analysis of the three different approaches for steering instruments has shown several advantages and disadvantage of the different approaches which need to be carefully weighed against each other. The following table summarizes the main results of the analysis with the SWOT (strength-weaknesses-opportunities-threats) approach.

SWOT ANALYSIS FROM A REGIONAL VIEWPOINT

	Toll Plus	**Alpine Crossing Exchange**	**Emissions Trading System**
Strenghts	Can build on existing pricing systems and is generally accepted by the EU. Implements the polluter-pays-principle in the Alpine Space. Could also be used for passenger transport.	Traffic targets can directly be met due to the target-oriented approach. The trading mechanism provides a high degree of flexibility for hauliers. The scarcity price ensures that the reduction target is met in an efficient way. Possible to link to a sectoral driving ban.	Environmental targets can be reached in an efficient way. An ETS leads to a very modern and efficient vehicle fleet. An ETS puts less pressure on extending rail capacities than an ACE. No overproportional burdens for regional transport
Weaknesses	A pricing system cannot guarantee that traffic targets or environmental targets are effectively met. The modal shift effect depends on capacities and prices of rail services. Some of the revenue necessary for cross-financing of new rail infrastructures.	Requires an extension of rail capacities, especially, rolling motorway capacities. Possible crowding out of passenger transport, as freight will use additional rail capacities. Completely new concept that will be difficult to link to other European instruments. Legal feasibility on EU level unclear.	Cannot guarantee that traffic targets or modal shift targets are met. Theoretically, the improvement of the environmental situation could be reached by technological change alone. Requires an extension of rail capacities.
Opportunities	A harmonized pricing system will lead to a more efficient transport system in the Alpine Space. A differentiation according to Euroclasses supports best-available-technology approach.	Supports the discussion on new base tunnels. It supports the usage of new rail capacities. Dynamic improvements of Alpine regions: the ACE would reduce unnecessary transports and sets incentives to reduce transport intensity.	An improvement of air quality can open new chances for Alpine regions. Such a mechanism fits with the European principles and especially with the new White Paper on transport.
Threats	Depending on the design mechanism and the level of tolls, it might be possible that transalpine traffic volumes grow further. Overproportional economic burden for Alpine regions. Some of the revenue can be used to compensate the relevant regions.	Regional hauliers and short-distance transport will face an over-proportional burden if the allowances are not differentiated. It is necessary to find a suitable design mechanism to prevent an over-proportional burden for regional transport. The increase of transport prices might harm regional economies. Increase of rail noise.	An ETS might lead to an increase of transport prices with negative impacts on regional economics. Depending on the design mechanism, it might be possible that transalpine traffic volumes grow further.

Table 10:

Common target system

The analysis has made clear that the definition of a common target system is the crucial step towards implementing a common steering instrument. Which rationale should become the basis of a steering instrument and what is the basis for the need for action?

Specific targets for the transalpine freight transport can be derived via different rationales – considering transport, environmental and safety mechanisms:

- **Modal shift rationale:** This logic focuses on the fact that the modal shift potential crucially depends on the transport distance. In general, it is assumed that transports with a distance below 300 km are difficult to shift to rail. In sensitive areas like the Alpine Space, this distance can be lower, especially if specific infrastructures are provided.
- **Capacity driven approach:** Under this logic, it is assumed that available and future rail capacities are used to their maximum capacity.
- **Environmental approach:** Under this rationale, the transport system has to be optimised to meet environmental targets (for local and/or global pressures). This can imply a reduction of road transport volumes.
- **Safety:** This approach focuses on an improved road safety. Transport volumes have to be aligned to guarantee minimum distances between vehicles which are appropriate under the relevant speed limits and slopes.
- **Base year approach:** Uses a pragmatic mechanism to reduce a specific environmental pressure or traffic volumes to a given base year. It is often used to define CO_2-targets.

Currently, the Alpine regions focus on different rationales that are determined by the political landscape, the location of the region (along transit corridors, at the end of corridors), challenges in other policy fields but also the availability of transport infrastructures. In the frame of the iMONITRAF! DPSIR-approach, some regions have been able to develop specific traffic targets for their regions which can be used as basis for a common steering instrument. Other regions derive their need for action from an ambitious environmental target. Thus, in a first step towards the common approach, a mixed-target system seems to be a feasible approach.

	Target	**Rationale**
Swiss corridors	650’000 HGV/year	Modal shift rationale: all transports with a distance above 300 km shall be shifted to rail.
Brenner corridor	An HGV target will be derived via transport, environmental and safety targets.	• Full capacity utilisation of the rail infrastructure established and in construction, • Additional shift of at least 30% of long distance traffic (>300km) from road to rail (based on EU White Paper 2011) • Compliance with regional and (inter)national environmental targets (EU Directive on Air quality 2008/50/EC and IG-Luft, EU Noise Directive 2002/49/EC) • Safety distances that allow for harmonic traffic fluxes.
Mont-Blanc and Fréjus corridor	1’270’000 HGV/year	Base year approach: Traffic volumes should be reduced to the base year 1990. Common target for both corridors as they are closely interlinked.
Tarvisio corridor	1’460’000 HGV/year	Base year approach: Traffic volumes should be reduced by 20% based on the year 2000.

Table 11:

Defining a priority for a steering instrument

Based on the common target-system, the regions will have to define a priority for a common steering instrument. Discussions in the project team made clear, that the Toll Plus system offers only limited additional potential as a steering instrument: in Switzerland, the full external costs are already internalised with the HGV fee (LSVA); in Tirol, the revised version of the Eurovignette Directive offers no additional possibilities to increase HGV tolls; and in France, an HGV fee will be implemented from 2013.

Thus, the priority should be put on a cap-and-trade instrument which offers an effective potential for steering of freight transport. The specific design of the instrument depends on the target system and could – in a first step – also follow a mixed approach as the cap and allowances could be linked to either traffic or environmental indicators.

Solutions to prevent overproportional regional impacts

The regions have recognised that an Alpine Crossing Exchange leads to an overproportional economic impact in their region. However, they see the need that regional transport is included in a common steering instrument. A complete exemption is thus not feasible. If an ACE is chosen as priority instrument, the regions have to develop a specific mechanism to prevent an overproportional burden. Several potential mechanisms have already been developed in recent studies that could be fine-tuned with support from the regions (see propositions in Table 9).

To define the relevant parameter that should benefit from a specific mechanism for regional transport, the regions suggest to draw back to the regulations of existing instruments, e.g. the sectoral driving ban in Tirol or the specific regulation for short-distance transport of the dosing system at the Gotthard tunnel.

Use of revenue for accompanying measures

The proposition from the Alpine Regions should also include a proposal on how to use the revenue of a common steering instrument. The analysis of technological innovations has made clear that there is a great potential to provide more efficient intermodal services that enable the necessary modal shift. The diffusion of such innovative intermodal solutions however requires high investments into infrastructures, appropriate trailers and the necessary information/communication platforms.

The Alpine regions should clearly support the call for accompanying measures for improved rail services and acknowledge that some of the revenue from a common steering instrument is used to cover the relevant financial needs.

5 Innovative institutional/organisational approaches

Innovative approaches in the fields of institutions and organisations are necessary to set the relevant framework for implementing common measures but also to use the windows of opportunity that might come along with an effective modal shift policy and a reduction of environmental burdens.

New co operations, networks and the re-definition of stakeholder roles can be initiated on the cross-Alpine level, the transalpine level and the regional level. These three levels are further illustrated in this chapter. For the iMONITRAF! strategy it will be important to define specific actions supporting these developments.

Cross-Alpine approaches

The iMONITRAF! network itself is an innovative approach as it follows an integrated philosophy, bringing together the technical and political spheres as well as transport and environmental expertise. It aims to establish the Alpine regions as a stronger institution within the European policy framework, to allow for a stronger lobbying of regional interests on the national and European scales.

The iMONITRAF! network has the objective to implement the cornerstones of the MONITRAF resolution. For this task, the network faces some major challenges for which it will be necessary to find innovative solutions. An analysis of Best Practice measures made clear that a harmonisation and transfer of these measures will not be sufficient to effectively reduce the environmental burdens in the Alpine Space arising from freight and passenger transport. It will be necessary to develop a common steering instrument. The illustration of potential steering instruments has shown that their success crucially depends on the definition of the underlying targets/thresholds. The network thus faces the challenge to find a **common rationale** as basis for a common steering instrument:

- A common rationale has to consider the different political objectives in the iMONITRAF regions. The discussion up to now has shown that it difficult to find a common denominator which can be defined as a common target.
- The common rationale needs to be defined on the basis of regional analysis. The activities under the iMONITRAF! monitoring system will support the discussion and allow a framework to test first propositions on a common rationale.
- For a common approach, it might also be necessary to accept the different approaches and to find a solution on how to merge them in a common target system and a step-wise approach.

In order to continue the political and technical network of iMONITRAF! it will also be necessary to find innovative solutions on how to continue network beyond the project duration. A proposal on how to institutionalise the network is currently developed within WP 4 (political networking) of iMONITRAF). Possible solutions might be an integration with the Network of Alpine Regions, the Alpine Convention or a broader European Macro Region. To find new funding opportunities for a future iMONITRAF! project office, it would also be interesting to discuss new cooperation structures, e.g. with the railway sector as great beneficiary of the iMONITRAF! activities. Also, it would be interesting to link the iMONITRAF! activities to the revenues of a common steering instrument.

Furthermore, establishing a better link to the Suivi de Zurich process with national ministers will be important to support the cross-Alpine approach.

The cross-Alpine approach might also include new ideas **on better integration of different stakeholders** and in defining new roles:

- Rail operators could be integrated more closely in the discussion, as they have a self-interest in all modal shift policies and should be interested in shaping the political framework.
- Public-private partnerships could be used for operating road and rail infrastructures. These operators could also held responsible for meeting environmental targets and for the administration of a trading platform for cap-and-trade systems. Public-private partnerships however need to be linked to a good regulation: they should not be used to generate profit for individual companies but much more to profit the Alpine Space regions.

Trans-Alpine approaches

For an effective implementation of common measures, it will also be necessary to strengthen the cooperation between the regions along the main transit corridors (trans-Alpine approach). While a slightly different finetuning and implementation of measures on the different corridors seems reasonable and even necessary, the approach along one corridor needs to be harmonised to reach the full impact of common measures.

A good example on how to work towards a better cooperation along the transit-corridors is the Brenner Corridor Platform (BCP) which has already been analysed in the iMONITRAF! Best Practice Guide (Lückge et al. 2010). The BCP includes stakeholders from all regions along the Brenner motorway, but also from the road and rail sector. It has been initialized by the European Commission and thus includes representatives from the European level. The BCP establishes a network of "short information channels" between the different actors and thus improves its operability. Other good examples are initiatives on corridor level to improve interoperability and capacities (e.g. on the Rotterdam-Genua corridor or the Rotterdam-Milano corridor).

It might be interesting to transfer this corridor concept to other transit corridors, e.g. as working groups or "subchapters" to the iMONITRAF! network.

The corridor approach will also be important for using the windows of opportunity that arise from implementing the proposed strategy. The reduction of transalpine road transport and the corresponding environmental burdens will lead to different opportunities on the different corridors. These opportunities also depend on the availability of construction of infrastructures, with different timelines on the iMONITRAF corridors.

It will thus be important to find individual approaches and strategies on how to deal with these new opportunities. The reduction of environmental pressures improves the attractiveness of the region, for both inhabitants and investors. The provision of new rail infrastructures can in addition improve the accessibility of the region, e.g. for tourists. To profit from these developments, it might be necessary to develop a new "regional identity" with a re-defined role of public and private stakeholders.

A first approach into this direction has been taken in the Gotthard region, with the project "San Gottardo". The project was initialised with a "Future conference", to discuss the regional development under the new framework conditions. Up to now, the resulting activities are however very limited and focus on a common tourism strategy. It would be interesting to further develop this approach and to include further sectors and stakeholders.

For a new regional identity, it might also be interesting to merge the current close-to-nature image of the Alpine Space with its ambition to become a laboratory for innovation and sustainable development.

Regional approaches

The challenge of using the opportunities from an effective reduction of road transport also requires new approaches on the regional level. It seems especially important to find solutions to take along existing inhabitants and business and to integrate them in a new approach. This requires a more participatory process on the regional level.

The Andermatt project in Central Switzerland is a good example for the necessity of such an integrated and participatory approach. While the project can be seen as Best Practice example on how to use the accessibility of the mountain regions, it runs the risk to completely transform the local structures and roles.

Innovative participatory approaches like future conferences (Zukunftswerkstatt) to allow a better civil society dialogue or a special funding mechanisms to promote ideas from the region could be some first steps.

6 Summary and recommendations for the iMONITRAF! strategy

Summary – The role and potential of innovative approaches in the Alpine Space

As sensitive area and with a high pressure from the existing transport system, the Alpine Space has a great need to make use of innovative approaches. With their existing policy frameworks and cooperation, the Alpine regions could become a “laboratory” for innovation, with a clear focus on the principle of best-available technology and the use of new steering instruments and institutional approaches.

The overview of the different **spheres of innovation** and the role of the regions within these spheres makes clear that innovative steering instruments are the most important field of action for the regions. With these steering instruments, they obtain a possibility to trigger the desired technological innovations and to limit overall pressures from the transport system.

The analysis of **the three potential steering instruments** under discussion (Toll+, Alpine Crossing Exchange (ACE) and an Emissions Trading System (ETS)) illustrates the strengths and weaknesses of these concepts. It becomes clear that all instruments have a great potential to reduce transalpine road freight transport and to improve modal shift. The Alpine Crossing Exchange in this respect has the “strongest” mechanisms as it sets a direct limit for transalpine lorry trips. The impact channels of a Toll+ system and an Emissions Trading System are less direct, they also depend on technological developments and mitigation costs in the transport sector.

Existing regional impact studies show, that especially the Alpine Crossing Exchange leads to an overproportional burden for the Alpine regions. In absolute terms, this burden is however manageable and could be prevented with a special treatment of regional transport or a compensation.

The analysis of steering instruments makes clear that the definition of targets/thresholds is the crucial factor for the effectiveness and selection of steering instruments. The choice of a steering instrument depends on the target system. If the main objective is the internalisation of external costs and the implementation of the polluter-pays-principle, a Toll+ system would be the best choice. With environmental targets as main objective, an emissions trading system would be the priority and the Alpine Crossing Exchange is compatible with an overall reduction or modal shift target. As first step for the further discussion, the discussion of the proposed mixed-target system should be the main focus.

The implementation of a common strategy will also provide **new windows of opportunity for regional development.** The analysis of steering instruments has made clear, that they have the potential to considerably reduce road freight transport, negative environmental impacts would be reduced respectively. For an innovative approach, it will be important that regions find new approaches on how to make use of these chances. This could include the development of a new image to improve the attractiveness of the Alpine regions for the population and investors and how to develop new tourism opportunities.

Recommendations for the common iMONITRAF! strategy and action plan

This report on innovative approaches supplements the analysis and recommendations of the iMONITRAF! Best Practice Guide that has been developed for the first Transport Forum in

2010. Together with the information from the common monitoring network and the DPSIR approach, these reports build the analytical basis for the iMONITRAF! strategy and action plan.

The analysis of this report has outlined some major elements that should be tackled in the common iMONITRAF! strategy – with a proposition for specific actions.

Propositions for a common steering instrument:

- The political discussion of a common target-system is the first important step towards the implementation of a steering instrument. Based on the existing frameworks in the region, the proposed mixed target-system seems politically feasible.
- The target-system determines the rationale of a common steering-instrument. If the regions aim for a cap-and-trade approach, the priority for an ACE or an ETS will be derived from the target-system.
- From a strategic point of view, the regions should not aim at a complete exemption of regional transport from a common steering-instrument. The problem of the over-proportional burden for regional transports is mainly relevant in the framework of an ACE. Several mechanisms have already been proposed that could be used in an ACE to prevent over-proportional regional impacts.
- The Action Plan should include very specific proposals on how the regions can contribute towards the implementation of a steering instrument. In a first step, it will be crucial to link the regional discussion to the discussion of the Suivi de Zurich group and to establish a common working group. As next step, or in parallel, the regions can lobby for a new steering instrument with other stakeholders and authorities on national level.
- As soon as possible, the discussion should also be brought to the European level. With the EU White Paper, the EU Commission has sketched its vision for a future EU transport system. Policy instruments to internalise external effects of transport play an important role in this vision. If the regions support a cap-and-trade instrument, the potentials will soon have to be discussed on European level.

Common propositions on technological change

The analysis has made clear that the regions have little potential to directly influence the deployment of innovative technologies. However, they need to consider existing dynamics and potentials in their proposals. Thus, the strategy should include a clear statement on technologies that are supported by the regions and –even more important – on developments that are seen as contradictory:

- Regarding vehicles, the regions should support the deployment of best-available-technologies, including new engines, sustainable biofuels and alternative powertrain solutions on the basis of renewable energies. Their potential to reduce local and global emissions needs to be considered when designing the target-system for a common steering instrument.
- The use of gigaliners is however contradictory to the iMONITRAF! objectives and would undermine the effectiveness of a common steering instrument. Thus, the regions should include a clear call against the use of gigaliners on the Alpine transit corridors.
- The functioning of a steering instrument will highly depend on the availability of high-quality rail and intermodal services. The regions should include a clear statement on this necessity in their strategy and propose a use of revenues from a steering instrument to develop these services.

Innovative approaches for the regional cooperation

The iMONITRAF Action Plan requires both a further cooperation of the iMONITRAF! network and a stronger cooperation along the corridors. The discussion of the common strategy should thus also include a specific proposal for institutionalising the existing network. Currently, several ideas are evaluated in iMONITRAF! WP 4 that will be presented and discussed at the next Transport Forum.

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