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Alpine Space
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MONITRAF

SYNTHESIS REPORT

MONITRAF activities and outcome

Final Version

Produced by:

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in cooperation with:

INFRAS

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CONTENT

EXECUTIVE SUMMARY

The MONITRAF project as platform for the transit regions

Freight traffic and its impacts are a major challenge for the Alpine countries and require an international approach in order to prevent distributional impacts between the different countries. Because the transit regions are especially affected, the regions Tyrol, South Tyrol, Central Switzerland, Ticino, Piemonte, Rhône-Alpes and Valle d'Aosta have started the project MONITRAF aimed at the development of a common and sustainable strategy for transalpine freight traffic. Organised within the INTERREG project framework, MONITRAF runs from 2005 until 2008 and is lead by the Austrian partner Tyrol.

As a major milestone, MONITRAF partners have defined major indicators to describe the traffic development and its impacts and have collected traffic, environmental and socio-economic data to obtained a comparable picture of the situation in the Alpine countries. Such a data base has, up until now, not been available and allows a re-evaluation of the situation regarding freight traffic and its impacts as well as the modelling of common traffic scenarios emphasising the need to implement common policies. Furthermore, project partners have improved the exchange of Best Practices to tackle the problem of transit traffic and have analysed the strategic aspects of transalpine transport policies in the different countries.

The information obtained through MONITRAF activities has enabled the project partners to get a better understanding of freight traffic related impacts and effective measures to reach a sustainable solution for the future with a major shift from road to rail. As a final step within the project, the transit regions have developed recommendations for a set of common measures. To strengthen the common voice of the transit regions, these measures shall obtain political support through a joint resolution signed by official representatives from all MONITRAF regions.

MONITRAF REGIONS

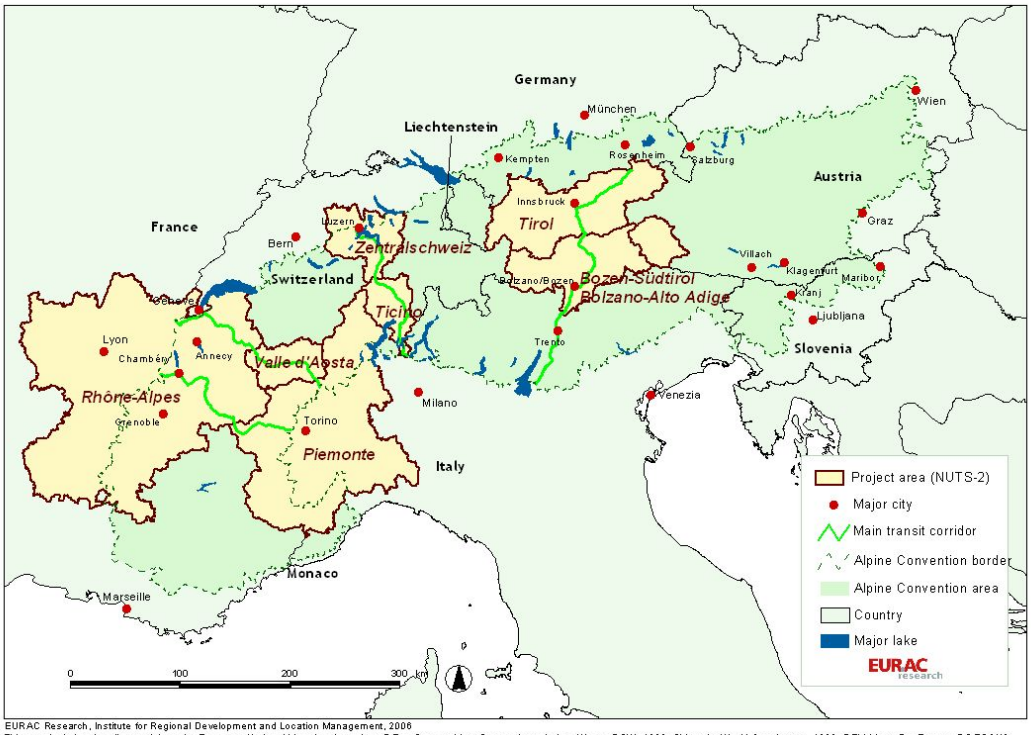
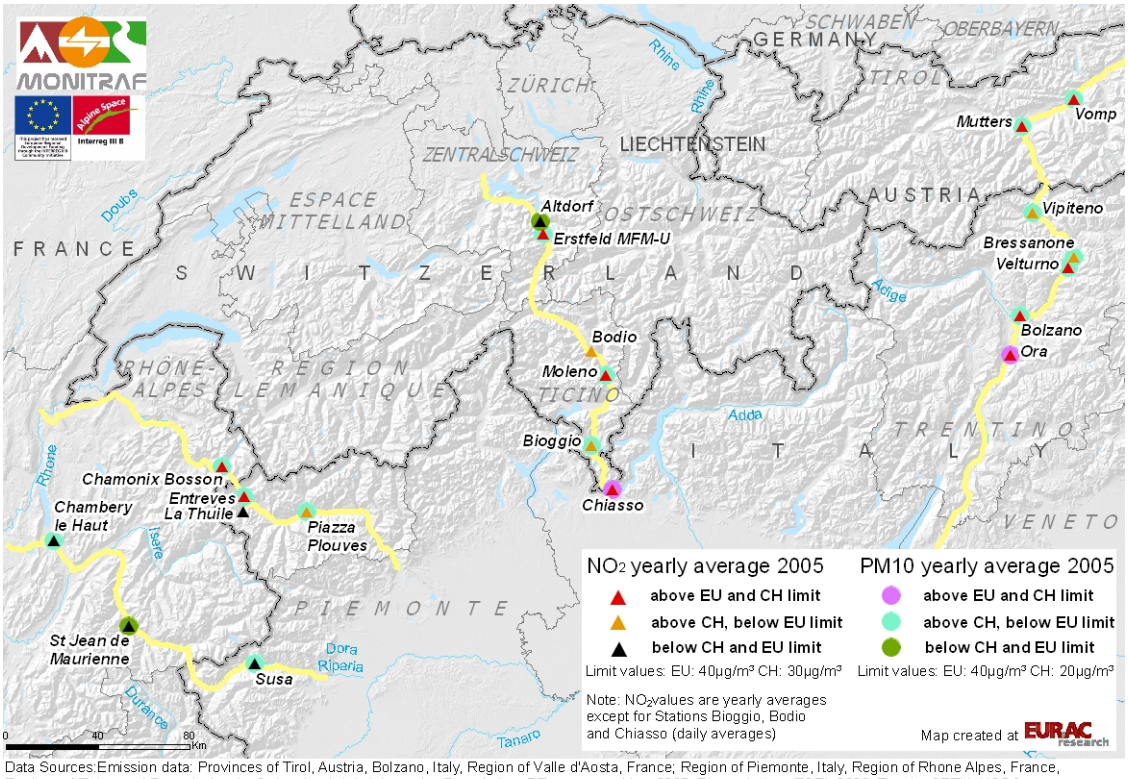


Figure i *From the different regions along the alpine crossings, the regions Tyrol, South Tyrol, Central Switzerland, Ticino, Rhônes-Alpes, Aosta Valley and Piemont are MONITRAF partners. Source: MONITRAF 2007*

High and increasing pressures in transit regions

As sensitive areas, the Alpine transit regions suffer from an increasing volume of traffic and its environmental impacts. In particular, transalpine road freight traffic on the road leads to critical noise and air pollution levels and deteriorates the living conditions for the local population as well as nature and landscape. According to the European Directive 1999/30/EC, the legally defined annual limit value for the protection of human health for NO_2 must be reduced to 40 $\mu g/m^3$ before 2010. For Switzerland, the annual limit value is 30 $\mu g/m^3$ as laid down by the Ordinance on Air Pollution Control (Luftreinhalte-Verordnung). These values are currently exceeded especially at the Brenner, the Gotthard and the Mont Blanc axis. The 24-hour limit value for the protection of human health for particulate matter (PM10) to be met by 2005 is 35 days (EU) and 1 day (CH) respectively. Note that the limit for the EU drops down to 7 days by 2010. In 2005, the limit value has been exceeded at several stations along all the four axes.

EXCEEDANCE OF LIMIT VALUES FOR NO2 AND PM10 AT THE MONITRAF CORRIDORS



Data Sources:Emission data: Provinces of Tirol, Austria, Bolzano, Italy, Region of Valle d'Aosta, France; Region of Piemonte, Italy, Region of Rhone Alpes, France, Regions of Ticino and Zentralschweiz, Switzerland. Admininstrative Boundaries: ©Eurogeographics, 2007; Rivers, Lakes: ESRI, 2000. Terrain: SRTM, USGS.

Figure ii *Exceedance of limit values for NO_2 and PM10 at the MONITRAF corridors. Source: MONITRAF 2007*

In addition the safety problems within tunnels in the transit corridors have become a severe issue, after the fatalities at Mont Blanc, Tauern and Gotthard. These burdens for the population, the environment and the transport users are not in line with the aims of sustainable development. Due to the specific characteristics of Alpine regions (sensitivity of natural resources, narrow valleys with meteorological inversions and topographic slopes, traffic as dominant emission source), the pressures are – compared to other regions – increased. Scientific studies have shown that external costs in sensitive regions are considerably higher than in flat areas. In fact, the external cost in sensitive areas are 2 to 5 times higher than in average. These differences in external costs are, up until now, however inadequately considered in road charges. The existing Eurovignette Directive does not contain the possibility for inclusion of external costs and only allows a 25% mark-up in sensitive regions which is however linked to the building of new infrastructure at the same corridor.

Due to their geographic situation, the different alpine corridors within the MONITRAF regions have faced different developments of traffic volumes in the last decades. Due to their central geographic situation between

North/Central Europe and the Mediterranean countries, transit traffic takes an especially high share in Switzerland (Gotthard) and Austria (Brenner). Traffic forecasts for both freight and passenger traffic show that the pressures will increase in the future even if specific vehicle emissions will be reduced due to new technologies. Traffic volumes will develop with a further expansion of the common European market and social cohesion between EU Member States.

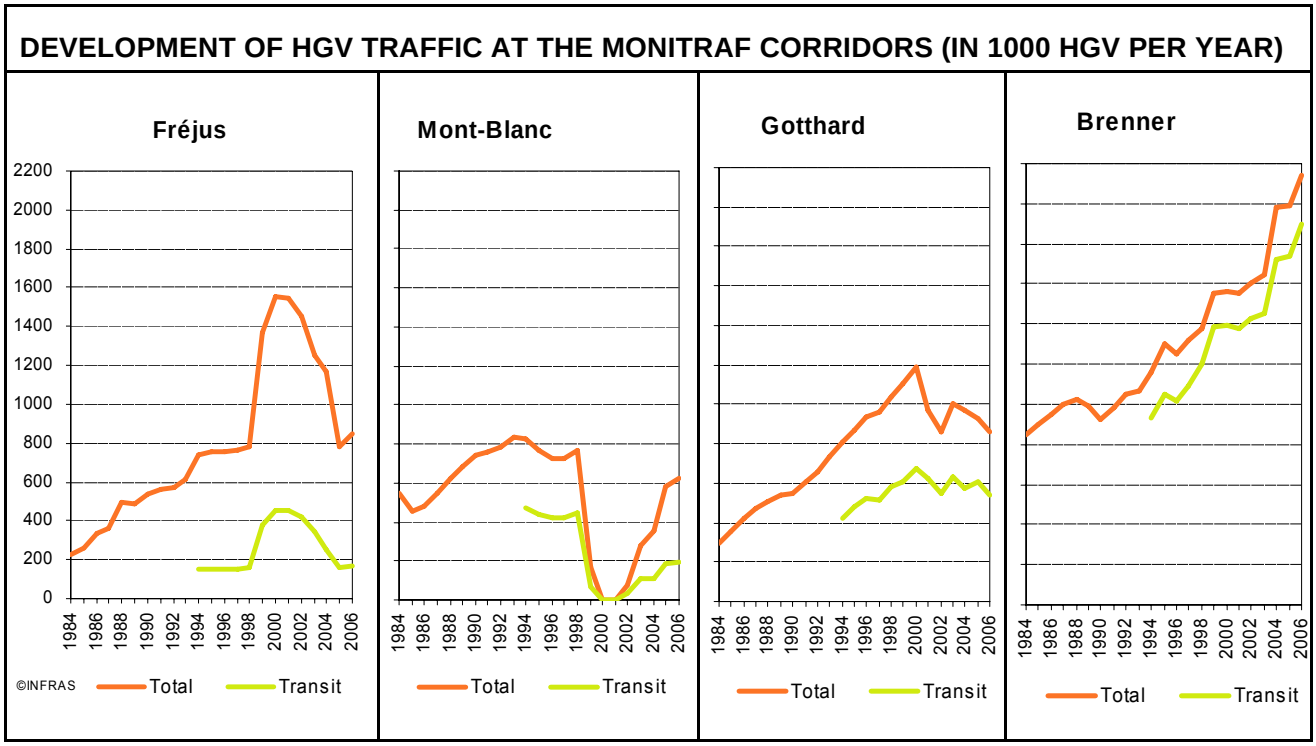


*Figure **iii** Due to a fire catastrophe at the Mont-Blanc in 1999 the tunnel had to be closed for several years. The shift of traffic to the Fréjus can be clearly seen in the graphic. At the Gotthard, a fire in 2001 stopped the traffic for several months. Source: BAV Alpinfo 1985-2006. Transit traffic is defined as in the CAFT surveys and Alpinfo. (Alpinfo data is also used as MONITRAF indicator)*

Many activities but insufficient improvements – the need for a common approach

Transalpine transport policy is an important issue at regional, national and European level. In all countries, Alpine transit traffic has grown over a long period and includes a great number of different measures for steering transalpine traffic towards a sustainable solution. Although the measures are developed on the basis of the same objective, there are considerable differences regarding regional competences, directions of measures and their design.

The Swiss freight transport policy with its explicit modal shift aim and a comprehensive mix of instruments for road and rail is the most advanced policy approach to tackling the increasing volumes of transalpine traffic. However all initiatives are not sufficient to achieve a sustainable improvement of living and environmental conditions along the transit corridors. Additionally, there is a risk that the planned rail infrastructure projects will not lead to a shift from road to rail if they are not accompanied by an effective set of additional measures.

MONITRAF is not intended to question and harmonise the total approach of Alpine policies but rather develop recommendations on specific common approaches which enable a better co-ordination between the regions and an effective reduction on environmental pressures. On the basis of existing experience on Best Practice measures in all Alpine countries, regional action plans as well as the framework set by European legislation, MONITRAF partners have developed four directions of common measures which can be seen as a comprehensive strategy for reducing transalpine freight traffic and its impacts These four main directions supplement each other and will only become effective if implemented altogether:

- Main direction 1 with the common monitoring system builds the basis for all other measures as it delivers the necessary data basis. It will also be crucial for evaluating the effectiveness of MONITRAF measures and for improving the instrument mix.

- Main direction 2 with the regional measures can be seen as "on-top" measures as they are mainly aimed at reducing peaks in regional/local air pollution. A set of night driving bans and bans for high-emissions vehicles as well as flexible implementations of speed limits seems most effective.
- Main direction 3 is the basis for the common modal shift policy. It builds on the total charging of external costs on the side of road traffic. A harmonised toll based on the higher external costs in sensitive regions can prevent cost differences between different alpine passages and sets a financial incentive for a shift to rail. The ongoing process to implement these external costs into the EU Eurovignette should lead to increased tolls at least to a comparable level of existing international agreements (e.g the Overland Transport Agreement between Switzerland and the EU). On the side of the rail, an improvement of service quality and a further development of infrastructure is necessary. Increased usage must then be supported through subsidies to rail.
- Main direction 4 with the Alpine Crossing Exchange can be seen complementary to main direction 3 as it will replace the common "corridor toll" in the long-term (if designed as cap-and-trade system). In the event that the Alpine Crossing Exchange is only used as reservation system for improving traffic management over the Alps, it goes side by side with the other measures.

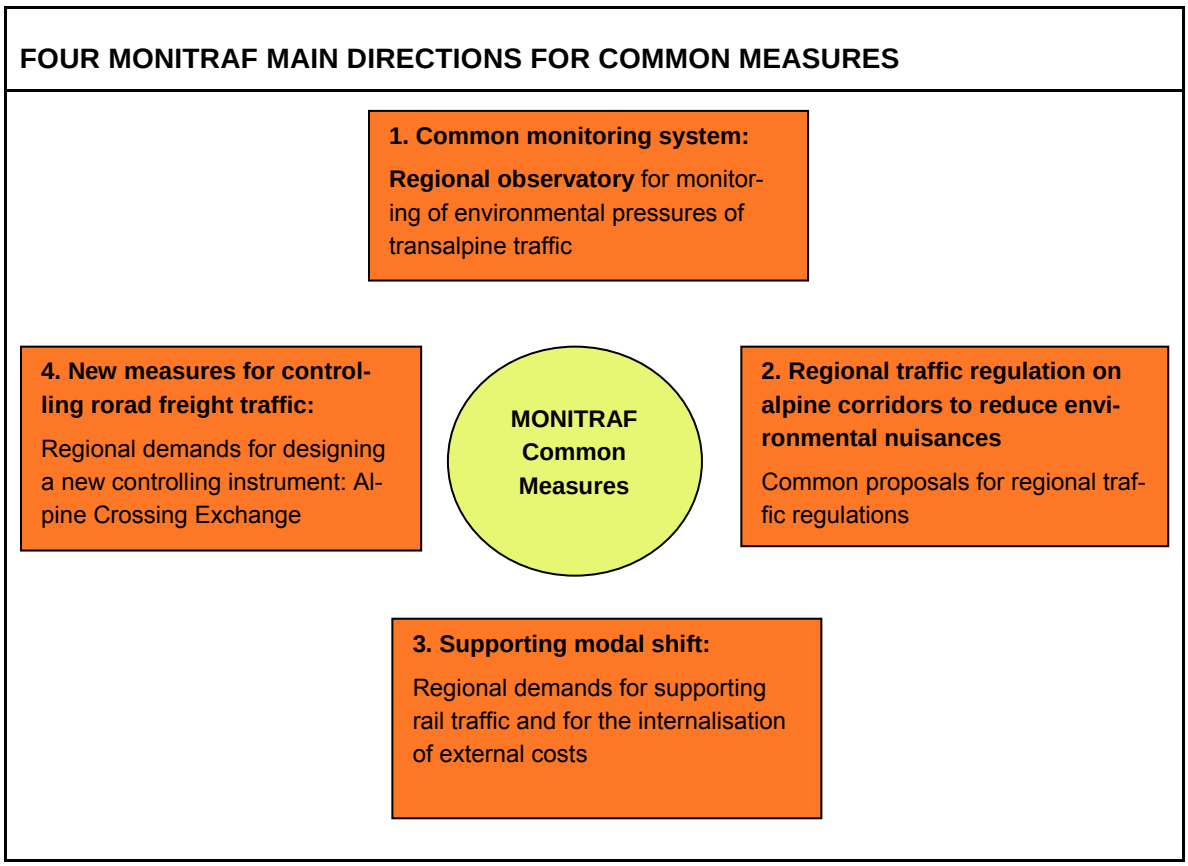


Figure iv *Four main directions for common measures. Source: MONITRAF 2007*

MONITRAF has been cooperating with the INTERREG IIIB Alpine Space project ALPNAP on noise and air pollution along Alpine transit routes. ALPNAP is a network of specialists in mountain meteorology, transport of air pollutants, propagation of noise, and environmental health, who have collected up-to-date science based observation tools, simulation models and impact assessment methods. The output of ALPNAP is summarized in a comprehensive book “Methods to Assess Air Pollution and Traffic Noise in the Alpine Space – A Guide for Authorities and Consulters” and a brochure for the general public. Both publications will be available in January 2008.

1 INTRODUCTION

Background information

Transport and mobility have always been an important issue in the Alpine regions. The Alpine mountains, through their central position in the European geography were in former times seen as a barrier between the Mediterranean and the northern countries. Through the construction of road- and railway infrastructure the Alps became accessible and the cross Alpine trade began to develop and expand. The traffic axes through the Alps are ever since essential for the trade between the North and the South and are important links between economic interdependencies.

The corridors are the basis for economic, social and cultural development in the Alpine space and form the foundation for interexchange with the extra Alpine regions. The Alpine regions, which were formerly placed at the periphery of Europe gained a favourable position through the improved accessibility.

With the increase in motorisation the traffic through the Alps has risen enormously in the last decades. Freight traffic showed especially big increases. In the year 1986 around 65,9 Mio. tons (t) of goods were transported on rail and road on the main eight corridors between Mt. Cenis and Tauern. In the year 2006 it was already 127,9 Mio. t., which means an increase of around 94 % in this last 20 years (BAV Alpinfo 2006). Figure 1 gives an overview of the traffic development for rail and road between 1986 and 2006.

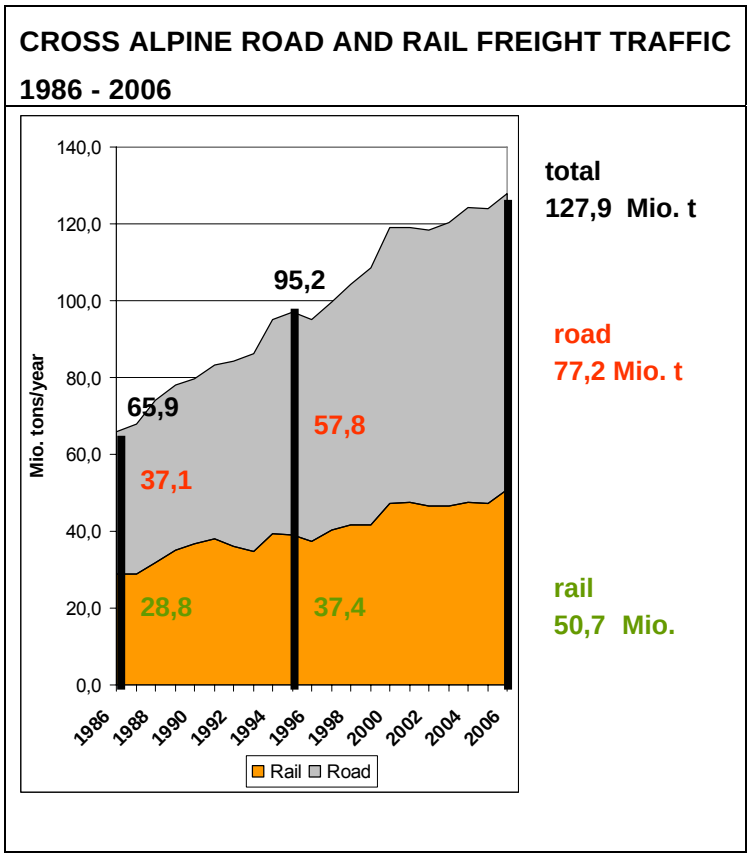


Figure 1 Freight development 1986-2006 across Mt. Cenis, Fréjus, Mont- Blanc, Simplon, Gotthard, San Bernardino, Brenner and Tauern for road and rail transport. Source: BAV Alpinfo 1986 – 2006 (Alpinfo data is also used as MONITRAF indicator)

The uncontrolled growth of traffic along the corridors is increasingly affecting the population, the environment and also the economy in the Alps in a negative way. The impacts of traffic have been analysed and shown in several studies and the complaints of the population of the most affected areas are rising constantly. Traffic axes and traffic no longer bring only benefits to the Alpine regions.

Traffic congestion are the most striking signs of a traffic overload. But also noise and air pollution (due to NO, NO_2, PM10) has already reached a critical stage in Alpine valleys. Limit values have been exceeded at several air quality measuring stations across the Alps. In the last years the air-dust concentrations and gas emissions showed values above health standards.

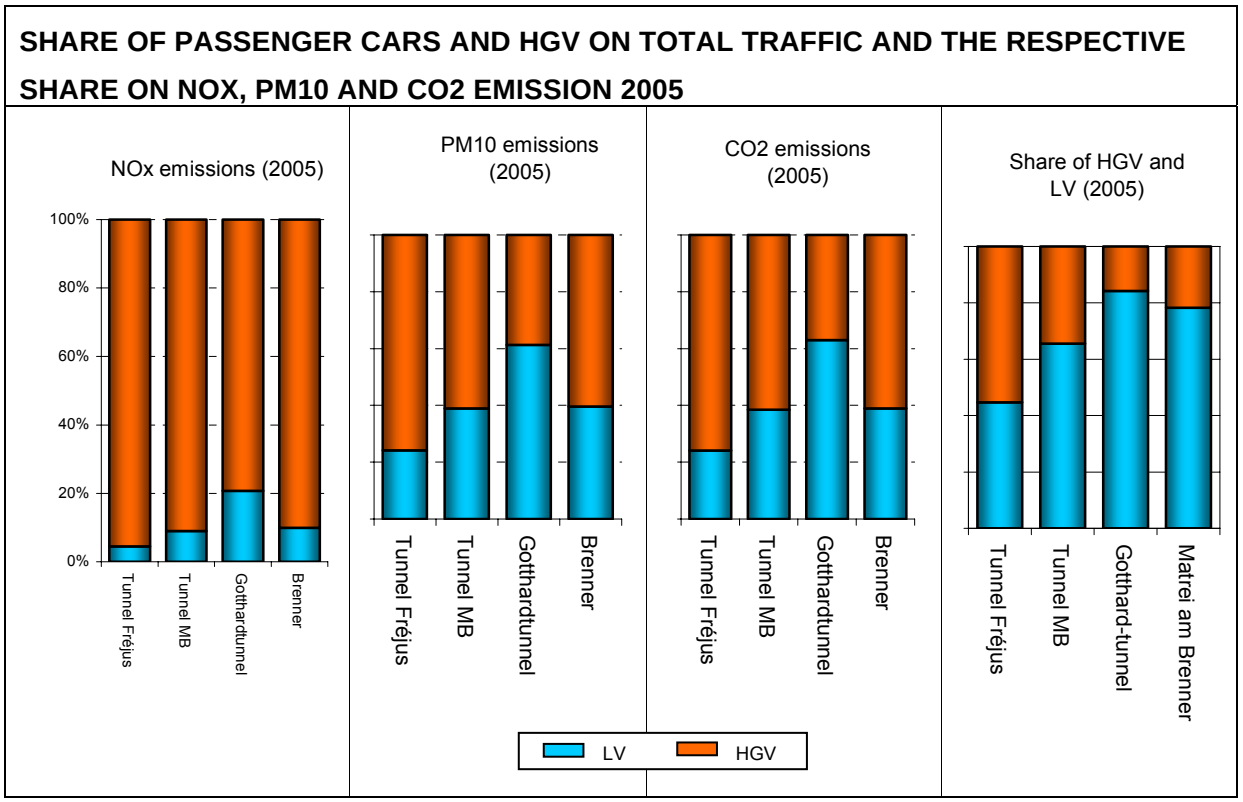


Figure 2 Share of passenger cars and HGV on total traffic emissions and the respective NOx, PM10 and CO2 emissions at the MONITRAF corridors Fréjus, Mont-Blanc, Gotthard and Brenner for the year 2005. Source: MONITRAF 2007

Here the emissions of heavy goods vehicles (HGV) are articulately higher than the emissions of light vehicles (LV). Figure 3 shows the share of HGV and LV on the total traffic emissions of NOx, PM10 and CO_2 at the four MONITRAF corridors. Considering that the portion of HGV traffic on the total traffic lies between 16% (Gotthard) and 55% (Fréjus) the emissions produced by HGV are comparatively high at all corridors. The NOx emissions produced by HGV have a share of 80% at the Gotthard to around 95% at the Fréjus. The PM10 emissions form HGV make 76% at the Fréjus and 38% at the Gotthard. The situation for the CO2 emissions produced by HGV is very similar and shows values between 76% at the Fréjus and 37% at the Gotthard.

Though it is not only the high traffic numbers and the modal split which result in a strong impact on the environment and the population. A number of effects influences the specific burden of the Alpine regions.

The Alpine arch – a sensitive area

High mountains incised by steep valleys, like in the Alpine arch are very sensitive ecosystems. The fast changing altitudes and temperatures, the different light levels and average rainfall on a small scale make the Alpine moun-

tains very vulnerable for exterior influences. Traffic and also other emitters have a higher impact on the mountainous environment than on flat terrain. Several studies have shown that the air pollution concentration produced by one emission unit is two to three times higher in Alpine valleys than in lowland (Thudium 2005). The topography has a further negative impact on the noise situation in Alpine valleys which is known by the so called “amphitheatre effect”. Moreover, the risk of accidents is higher due to longer braking distance on steep roads and the fatal effects of accidents in tunnels. All this makes the Alpine regions an extremly sensitive area.

However, on a European level a definition for sensitive areas and a distinction between insensitive regions has not yet been made. Within the framework of the EU FP6 project GRACE a pragmatic definition for sensitive regions is chosen as basis for the calculation of external costs which seems appropriate for the objectives of MONITRAF (Lieb et al. 2006). According to this sensitive areas can be described as areas where the environmental pressures are in general higher than in insensitive regions, the same level of pressures leads to higher damages than in insensitive regions and the environmental pressures endanger unique natural resources or cultural heritages. Consequently, the increasing transit freight traffic has enormous impacts on the sensitive and densely populated Alpine valleys.

These specific circumstances and the knowledge that HGV and personal traffic will further increase in the future (prognoses by the Europäische Komission 2006; ProgTrans AG &Rapp Trans AG 2004) require immediate and aligned action.

MONITRAF – Objectives and structure

All affected countries have taken measures to reduce the negative impacts of freight traffic for the population and environment. Most of these measures concentrated on single corridors or were limited to single regions. A holistic and transnational approach was largley missing and thus the implemented measures could not become fully effective. Traffic limiting actions were overtaken by the traffic increasing circumstances like the fast economical growth, the rise of international networks, transport prices, international division of labour and production costs. Moreover, a lack of concerted action created traffic shifts from one corridor to an other.

With the implementation of the Alpine space INTERREG IIIB project MONITRAF in 2005 it was the first time that the affected regions started to cooperate and work on a common approach to reduce the negative effects of transalpine traffic. The four main Alpine corridors Fréjus, Mont-Blanc, Gotthard and Brenner formed the project area and seven regions from the Austrian, Italian, Swiss and French alps, each situated along the northern or southern side of the corridors joined the project. During the project runtime of 3 ½ years the MONITRAF regions exchanged information and data, identified and analysed the impact of interalpine and transalpine road freight traffic and grew and extended networks. The main objective, the development of comprehensive and collective measures against the negative effects of road freight traffic was leading though the project. The elaborated measures should not result in the shift of traffic from one corridor to another and should increase the quality of life in the sensitive Alpine regions. Figure 4 shows the project regions Rhône-Alpes, Piemonte, Valle d'Aosta, Ticino, Central Switzerland, South Tyrol and Tyrol and the relevant transalpine corridors.

MONITRAF REGIONS

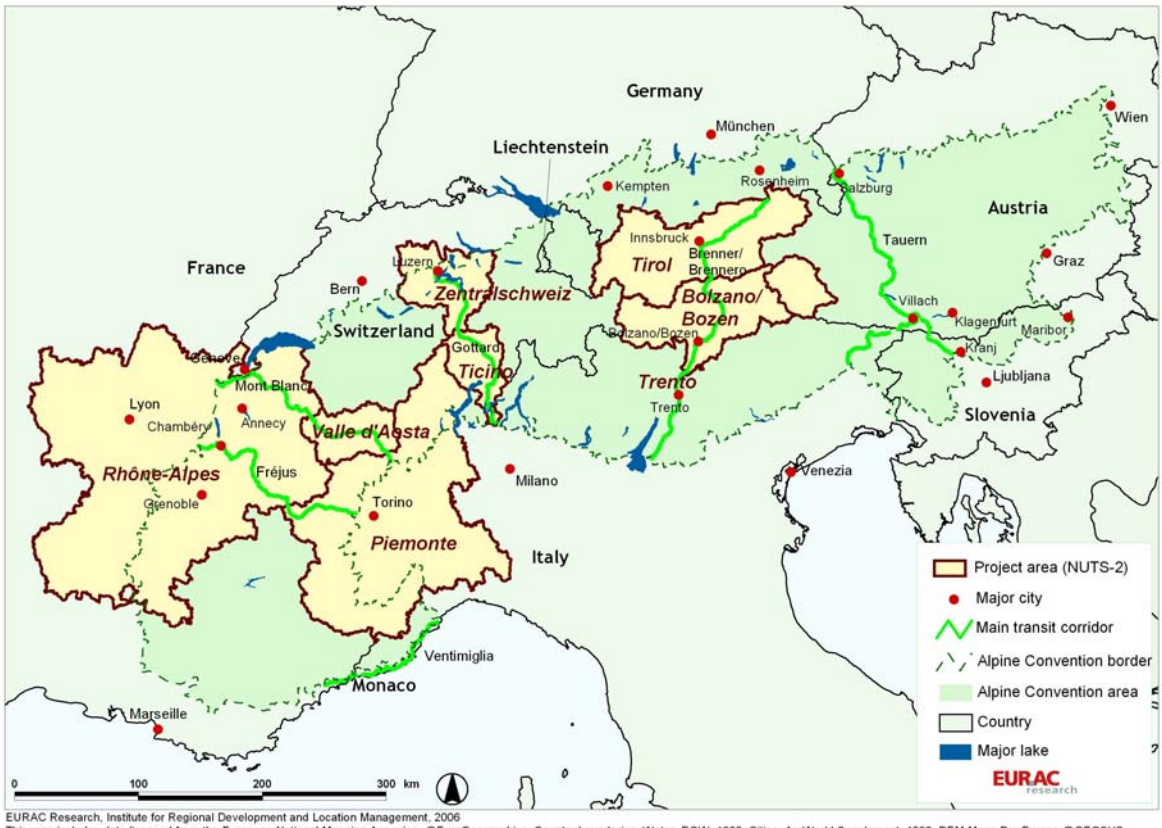


Figure 4 The MONITRAF regions Rhône-Alpes, Piemonte, Valley d'Aosta, Ticino, Central Switzerland, South Tyrol and Tyrol. Besides the MONITRAF corridors Fréjus, Mont-Blanc, Gotthard and Brenner the transit axes Ventigmilia and Tauern are marked in the map. Source: MONITRAF 2007

The project elaboration was divided in different work packages which were treated partially parallel or consecutive. Each region was responsible for one work package. The overall project management was in the hands of the region Tyrol. The European Academy EURAC Research, Institute for Regional Development and Location Management joined the project as the eighth partner and was responsible for public relations. In the initial stage of the project the first networks between the regional administrations were established. This well functioning network was the basis for further cooperation.

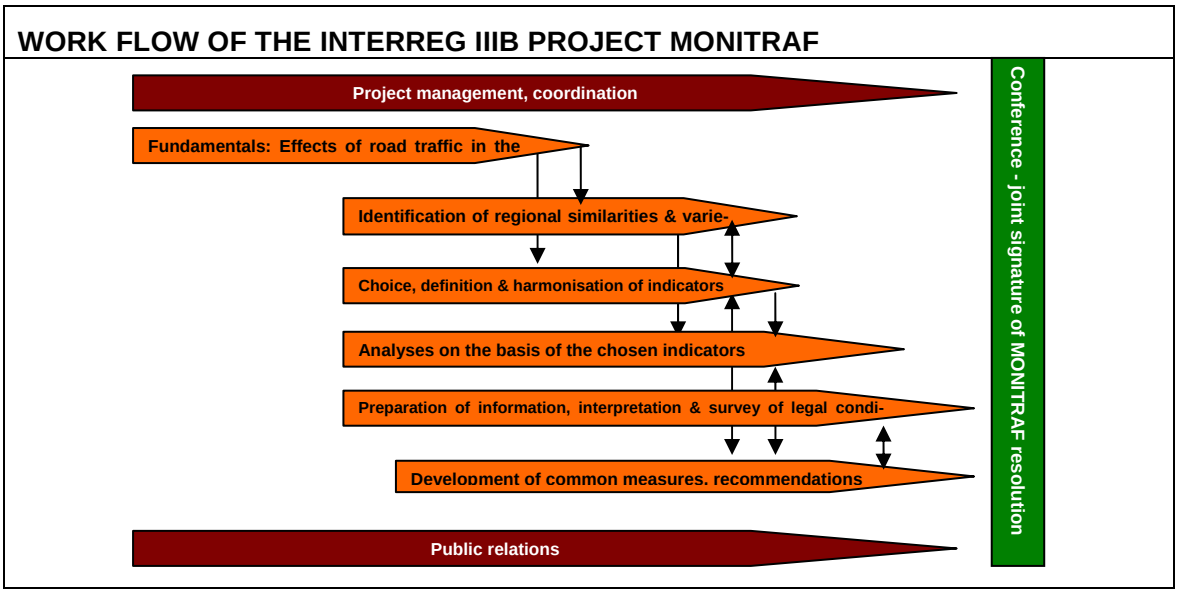


Figure 5 The project was conducted in various stages and was divided in different work packages. Always one project partner was responsible for the management and the implementation of one work packages. The procedure of the work packages was consecutive and partially parallel. Source: MONITRAF 2007

Traffic is a very complex system and the development of effective measures is only possible if a comprehensive picture on the impacts of traffic is known. Thus in the beginning, the influences of traffic on air and noise quality, economy, tourism, public health and the extra Alpine conditions were analysed. These first results gave a wider perspective on the problem and were the basis of the follow-up work. Moreover, some already known phenomena could be stressed and tested by the surveys. As a second step, past and present trends within the different regions were identified and compared. Herewith similarities and disparities could be displayed.

The analysis and choice of common and harmonised indicators was one of the next big steps within MONITRAF. Indicators are important to demonstrate the impact of traffic on different fields and support the monitoring of the development. On the basis of carefully selected indicators the effects of certain measures can be assessed. MONITRAF developed an indicator set by means of a sustainable system and elaborated comprehensive analyses. Emission modelling for two different scenarios, a business as usual and a target scenario were part of these surveys.

In the next phases the legal frameworks and the different competences in the regions were processed. An easy to use database with important regional regulations, laws and also the most relevant EU directives was organised. In addition, the database contains studies on the effectiveness of measures, action plans and specific regional surveys. The tool can be continuously updated and can support regional administrations in their decision making process.

The final module of MONITRAF concentrated on the development of a set of common measures. The measures are in tune with the regional characterisitcs and support a common approach against the negative impacts of transalpine traffic. In no case should the measures lead to a shift of traffic to other corridors or cause other unwanted distributional effects. The set gives measures which can be implemented by the regions but also includes measures which are addressed to different levels, like the national states or the EU. Figure 5 gives a short overview on the different work steps and the management of the MONITRAF project. The interaction and the exchange between the work packages was essential for the success of the project.

Moreover MONITRAF has been cooperating with the scientific project ALPNAP on air and noise pollution along the main Alpine corridors. ALPNAP is a network of experts in the fields of Alpine meteorology, air pollution, noise, and health effects. Most ALPNAP partners are universities and research centres. Both project were funded by the EU within the INTERREG IIIB Alpine Space programme.

2 TRAFFIC AND TRAFFIC RELATED EFFECTS IN THE ALPINE AREAS

MONITRAF started with five studies on the interactions between environment, economy and social frameworks. These first analyses were the basis for the follow up work and pointed out some important phenomena of freight traffic and its impacts in the Alpine regions. The results of these surveys were presented at the international MONITRAF conference in Luzern in the year 2005 and were also released in the publication "Traffic across the Alps". For detailed information please refer to the mentioned publication. The following chapter will give some extractions of these findings and analyses.

2.1 The Alpine bow as barrier for north-south/east-west trade

The Alpine regions situated among the main economic areas in the heart of Europe have always been and are still an obstacle for the trade between the north and south as well as for regions in the west and east. The Mediterranean countries are linked to central and eastern Europe through Italy, which in the North is fully framed by the Alps. The Alpine mountain ridge, due to its steepness gives only some possibilities to pass. Therefore the transport infrastructure and hence also the transalpine traffic flow concentrates on a few main corridors. (SWOMM, 2005-06).

A closer look to the destinations of the cross Alpine road freight gives a clearer picture on the situation. Besides some minor exceptions from south-eastern destinations, almost all source traffic from the south comes from Italy. Germany and France clearly dominate the destination traffic from Italy with each a share of almost a third of the whole transalpine freight traffic between Fréjus and Brenner. Switzerland is following in big distance with 8% as well as Great Britain with 6% and the eastern European countries with 6% together. Austria, the BeNeLux countries and Scandinavia only play a minor role for the destination traffic from Italy (Ickert 2006).

Correspondingly the development of the outer Alpine metropolitan areas e.g. in Southern Germany or Northern Italy has a major impact on transalpine traffic development. In the year 2004 solely between Bavaria or Baden-Württemberg (South Germany) respectively and Italy Northeast or Italy Northwest respectively 715.000 journeys across the alps were carried out (Köll 2005).

The economic development in the European regions, the increasing complexity of production processes and the freight traffic development are closely linked together. Freight transport across the Alpine bow has an outstanding role not only for the Alpine but also European economy. Economic development and the growth of freight traffic are often put on equal footing. Nevertheless in the last few years the growth of freight traffic has overtaken the economic growth.

2.2 Traffic development in the present and past (routes, modal split) – factors of influence

The share of road and rail freight traffic on Alpine corridors

The development of the cross Alpine freight traffic shows a continuous increase for road and rail. The freight volume along the eight main corridors between Mont-Blanc and Tauern almost doubled in the last 20 years which corresponds to an yearly average increase of +3,4%. The road freight traffic shows a slightly bigger increase than the rail freight traffic. Though the share of rail freight traffic in the Alpine space is relatively high compared to other European regions and does not reflect the general European trend.

The freight traffic development and the modal split are very diverse at the different corridors. At the French- Italian Alpine crossings the transport volume has stagnated since the tunnel accident at the Mont-Blanc. In the last years a decrease for rail can be seen. The modal share at the French-Italian corridors has reduced to levels below the situation in 1986. With a share of 69% the Swiss Alpine corridors have by far the highest modal split. In Austria the share of the freight traffic remained almost the same at around 30% for the last 20 years. The increase for the road freight however was significant.

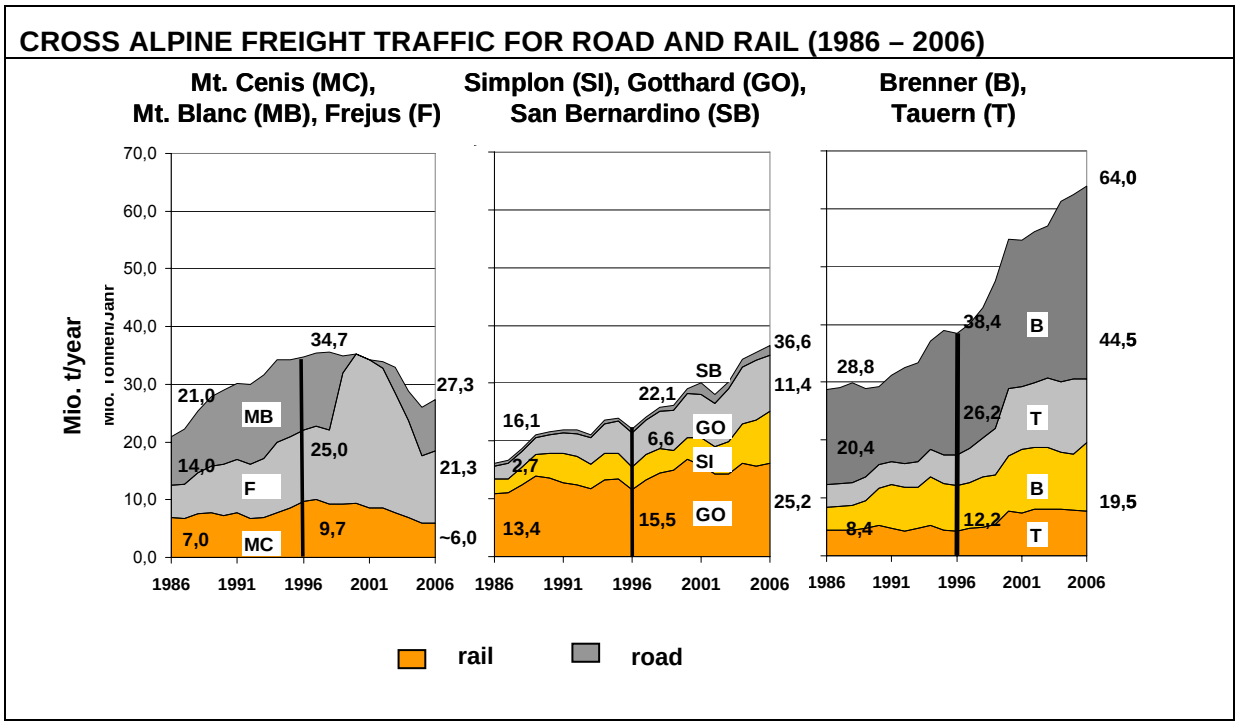


Figure 6 *Freight development along the Mt. Cenis, Fréjus, Mont- Blanc, Simplon, Gotthard, San Bernardino, Brenner and Tauern for road and rail. For this evaluation the eight main corridors of the Alpine arc were taken into consideration in order to show the shifts between the corridors. Source: BAV Alpinfo 1986 – 2006 (Alpinfo data is also used as MONITRAF indicators)*

Road freight traffic

In the year 2006, 70,6 Mio. t were transported on the roads between Mt-Cenis/Fréjus and the Brenner. This transported freight volume expressed itself in 4,9 Mio heavy vehicles (> 3,5 t) over the Alpine arc between Mt-Cenis/Fréjus and the Brenner. The main burden on road freight traffic was taken by the Brenner with about 2 Mio. HGV in the year 2006 and 34.3 Mio transported tonnes. The Gotthard and the Fréjus corridor were following with a share of the HGV of around 17% of all HGV vehicle between Mt-Cenis/Fréjus and the Brenner in 2006 (BAV Alpinfo 2006)

Figure 7 shows the development of haulage and the transported tonnes over the four MONITRAF corridors Brenner, Gotthard, Mont-Blanc and Fréjus. In general a continuous increase of HGV until the year 1999 can be recognised in the inner Alpine arc. Due to a fatal accident at the Mont-Blanc in 1999 the tunnel had to be closed. Fréjus absorbed most of the traffic which previously used the Mont-Blanc, whereas the Gotthard-pass was not so much affected by the closure of the tunnel. Further accident at the Gotthard in 2001 and at the Fréjus corridor in the year 2005 resulted in the closure of the tunnels for several month.

In Switzerland a slight decrease of HGV haulages can be recognised after 2000. On the one hand this has to be seen in context with the increase of the maximum capacity allowed for HGV from 28t to 34t and than later to 40t. The transported tonnes over the Gotthard corridor show a continuous increase. On the other hand the introduction of the distant related heavy vehicle fee (LSVA) result in a decrease of "empty runs" at the Gotthard.

DEVELOPMENT OF HGV TRAFFIC AT THE MONITRAF CORRIDORS IN MIO. T AND IN 1000 HGV PER YEAR (1990 – 2006)

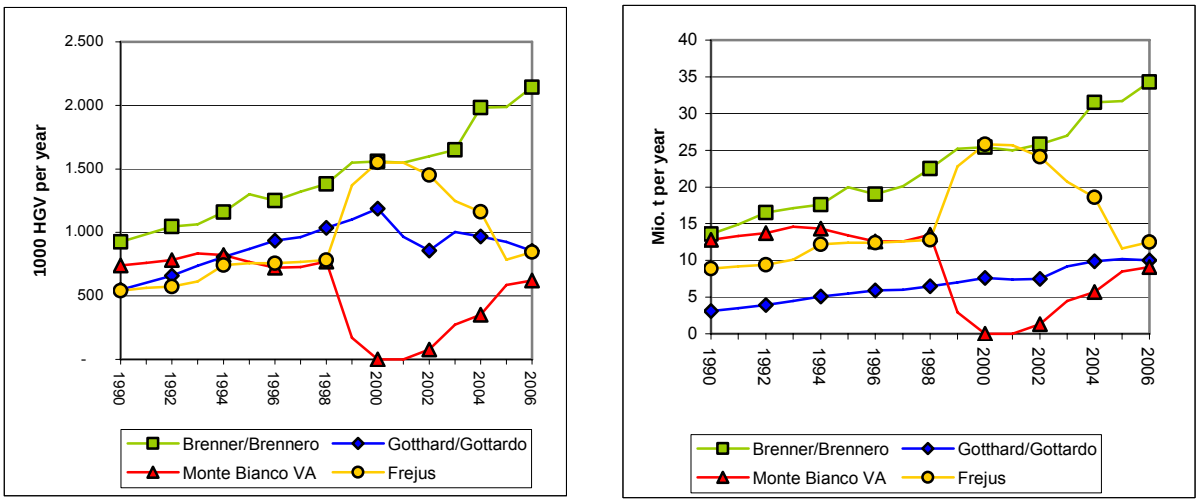


Figure 7 Development of the road freight traffic in 1000 HGV/year (left diagram) and in Mio. tons per year (right diagramm) of road freight transport. Source: BAV Alpinfo 1990 – 2006 (Alpinfo data is also used as MONITRAF indicators)

Regarding the determined journey distances and the catchment areas of the single corridor differences were ascertained by MONITRAF (Köll 2005). The development of the catchment area between 1994 to 2004 at the Brenner corridor shows an extend to northwest and northeast as well as along the Italian Mediterranean coastline. The average rout distance for a HGV increased during the same period around +22% (1994: 950 km, 2004: 1.160km). The comparison with the route network of the Gotthard corridor shows besides a distinctive smaller catchment area also more direct rout courses. In the year 2004 the average journey distance amounted to around 720km which is 38% lower than the Brenner value. The route network across the Frejus (1994-1999) appear to curve around Switzerland even stronger than at the Brenner. The average journey distances were in 1999 only a little bit shorter than at the Brenner (1.055 km).

Figure 8 gives an overview on the route network and the catchment areas of the corridors Mont-Blanc, Gotthard and Brenner.

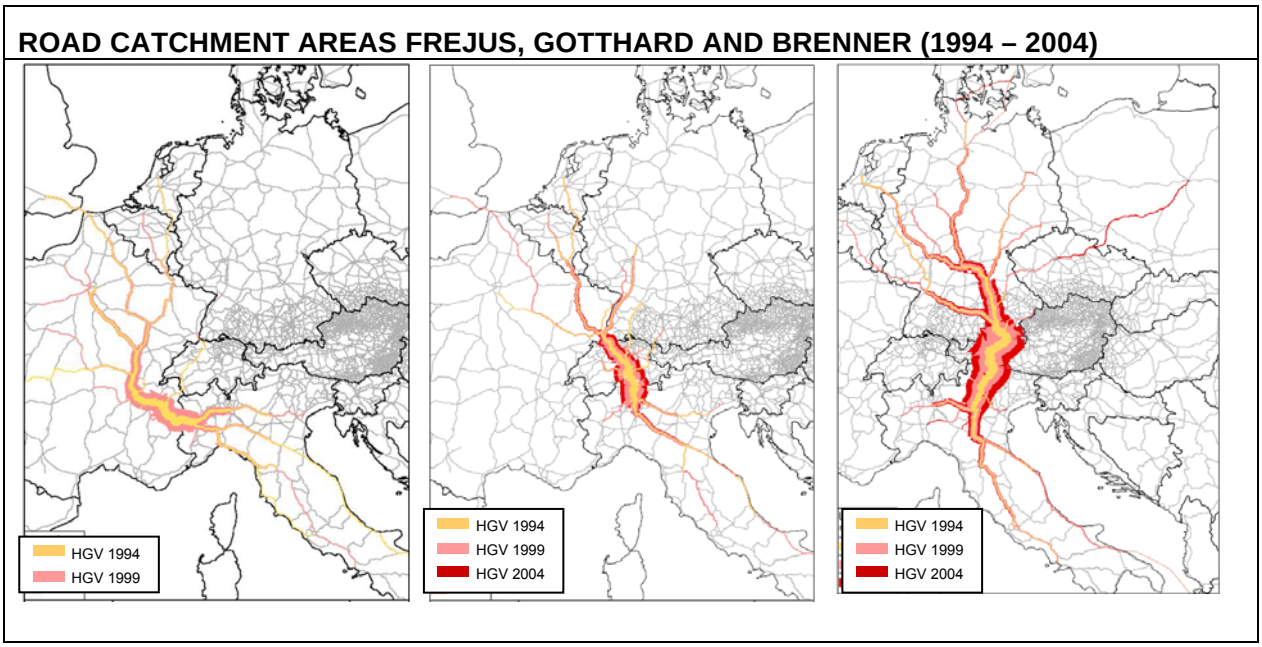


Figure 8 The road route network, the catchment areas and the average journey length were calculated on the basis of the CAFT data which are available for the years 1994, 1999 and 2004. At the time of the evaluation the CAFT data of France for the year 2004 was not available for the MONITRAF project. Source: Köll 2005 (within MONITRAF)

Simulations on the traffic flux can be based on different criteria like for example the journey costs, time, safety, reliability or route length. MONITRAF analyses regarding the route choice between the Swiss and Austrian corridors were based on the journey length and confirmed that in many cases it was not the shortest route that was chosen. If only the length of the route is taken as the main criteria for the analyses and only Brenner or Gotthard are available as alternative routes, then around 680.000 journeys/year would have an at least 60 km shorter alternative over the Gotthard. Thereof 562.500 are running over the Brenner. An alternative route over the Brenner which is at least 60 km shorter exist for around 65.000 journeys/year. (Köll 2005)

In a second simulation the journeys were divided into three categories. The first category shows all journeys which were done on the shortest ± 60km route (best way). The second category gives all journeys which would have at least one equivalent alternative (equivalent alternative) and the last category shows all journeys which would have an, at least 60 km, shorter alternative.

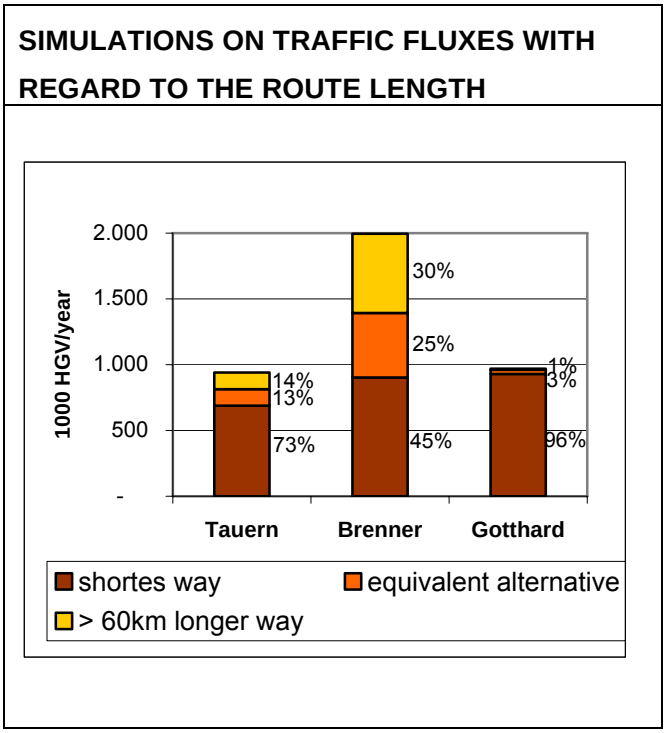


Figure 9 gives the results of the MONITRAF simulation on the traffic fluxes which has been developed on the basis of the CAFT data from the year 2004.

It is remarkable that at the Gotthard almost all journeys fall into the category best way. In comparison at the Brenner pass 55% of all HGV journeys would have a significant shorter (> 60km) or equivalent (within the threshold of 60km) route choice. This conclusion is valid irrespective to the threshold value of 60km or 120km and also if the criteria is 10% of the journey length. The analyses gives information on the length of the route but does not consider other criteria like price, time and effort. The main reasons for the route choice Brenner can be found in the good topography (lowest Alpine pass, no tunnel) and thus the possibility to transport hazardous goods, the low toll prices and the low fuel tax as well as the possibility to cross the boarder with no waiting times and less traffic congestion on the access roads to the corridor.

Figure 9 Route choice at the Alpine corridors Tauern, Brenner and Gotthard for HGV for the year 2004 divided into the categories shortest way, equivalent alternative and > 60km longer way. Source: Köll 2006 (within MONITRAF)

This evaluation demonstrates that the traffic policies and the surrounding conditions in the single countries have a major affect on the route choice. The measures evaluated within MONITRAF should not result in the shift of the traffic burden from one corridor to another. The objective of MONITRAF though is to achieve common relief from the impacts of freight traffic along all four corridors.

2.3 The specific vulnerability of the Alpine regions

Air quality and noise situation

In the narrow Alpine valleys the share of land use occupied by traffic infrastructure is relatively high – mainly along the larger Alpine valleys. Since most of the settlement area also concentrates along the main Alpine valleys, the exposure of the population to the negative affects of traffic is significant.

The most striking impacts of traffic on the environment and the population are noise and air pollution. MONITRAF evaluated the air quality and noise situation along the four main alpine corridors and analysed the correlation between concentration and emission as well as the specific Alpine climate situation with regards to the special conditions of each region.

For the evaluation of the air pollution (NOx, NO2 and PM10) only measuring stations close to the motorway (5-6m) in the upper and central part of the valley were taken into account. For the stations where the NOx concentration is dominated by road traffic the relation value between concentration and emission on an annual and monthly basis as a value for the mean dispersion/diffusion conditions was used. In this way it became possible to compare the sensitivity of the different Alpine valleys not only amongst each other but also to the flatter country. Figure 10 gives the results of this evaluation and shows that in the Alpine valleys of the MONITRAF-project one emission-unit creates a 2-3 fold higher air pollution concentration than in the flatter country near Basel. Yet it must

be taken into account that the region near Basel is by no means 'flat country' when compared to other European regions, and that close to Muttenz there is significant pollution from other sources (Thudium 2005).

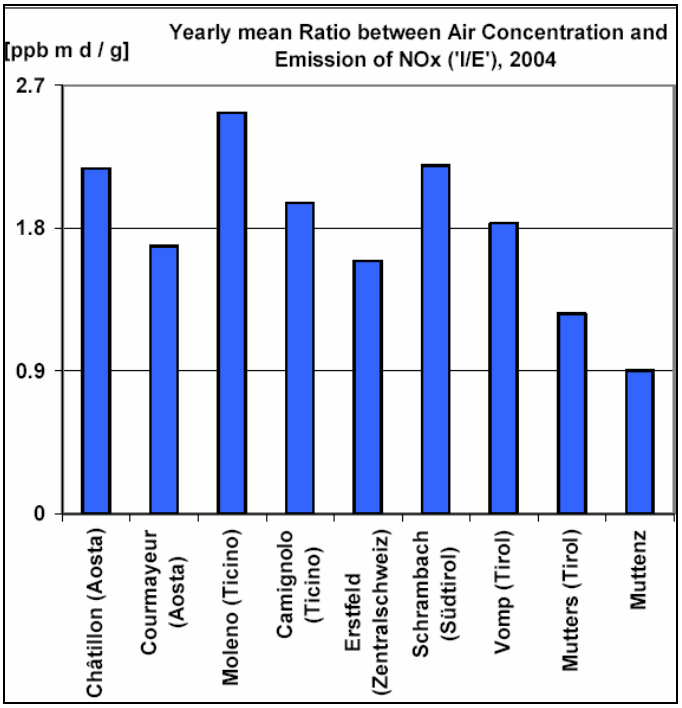


Figure 10 Relation (here ratio) between concentration and emission of NOx (I/E) at the measuring points close to the highways in the MONITRAF-regions and at the measuring point Muttenz (near Basel), Swiss flat country. Source: Thudium 2005 (within MONITRAF)

The fundamental climatic aspects which influence the diffusion of NOx emission are the temperature profile and the wind conditions. From existing temperature profiles, inversions close to ground in the year 2004 were estimated. The frequency of inversions shown in Figure 11 gives an annual average of 30-40% and in one case even 50% and are therefore substantial. The influence of inversion on the NOx immission was found to be significant. In general more inversion happened in winter-time but with big regional disparities. The comparison between Figure 10 and Figure 11 show very clearly that in Moleno which has a high frequency of inversions the ratio between air concentration and emission is correspondingly high.

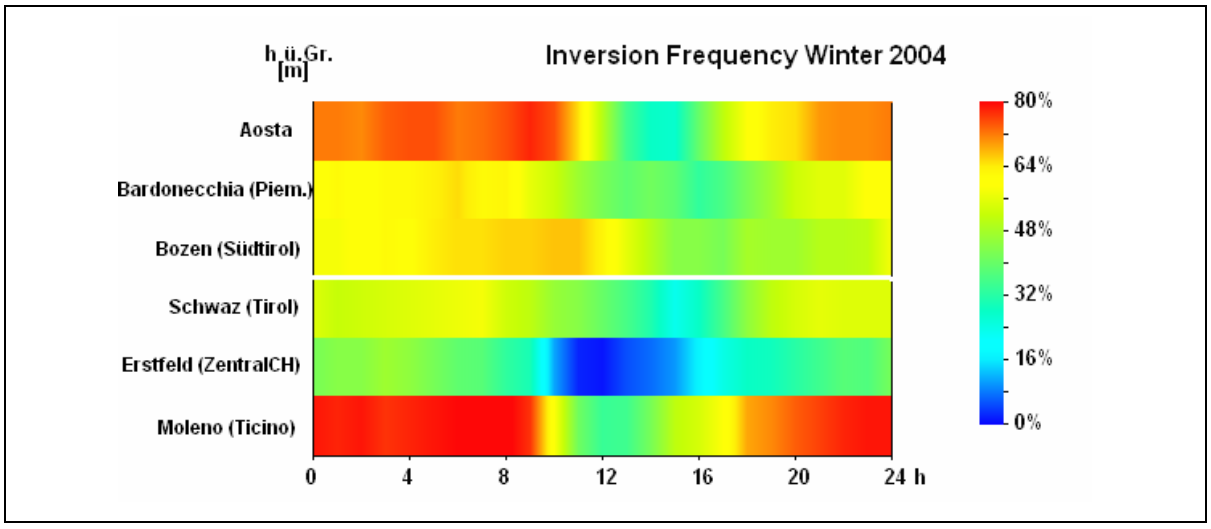


Figure 11 Frequency of inversion in the six MONITRAF-regions in winter 2004. In crucial winter season the inversion frequencies range between the minimum at Erstfeld (Central Switzerland) and the maximum at Moleno (Ticino), analog to the I/E ratio in Figure 10 .Source: Thudium 2005 (within MONITRAF)

Inversion layers also cause an increased propagation of noise. In case of an inverse temperature situation the sound propagation is being reflected towards the ground again which results in a higher noise level close to the ground. The noise situation further away from the road is also very much influenced by the amphitheater effect. Which means that acoustic noise is being carried further and to higher locations in Alpine valleys than in the flat. In general the noise situation in the MONITRAF regions can be seen as very unfavourable and the protection of the populations is rather difficult, since no obvious quiet side exists.

A main problem for the noise evaluation within MONITRAF was the lack of available and continuous data. Note that the partner project ALPNAP did further and very detailed surveys on the air pollution and noise situation in selected Alpine valleys.

3 THE INDICATOR FRAMEWORK OF MONITRAF

Common indicators for assessing a sustainable development in the MONITRAF regions

In the Alpine regions, social structures and the environment are closely connected to transport systems. Only an efficient transport system may guarantee good functioning of daily life and of the economies in the Alpine regions. However – as the information in the previous chapters has shown – the huge growth of road traffic in the last years has overburdened the existing transport systems and infrastructures and has led to unwanted effects for society (inequity, effects on human health, difficult cohesion of the EC) and the environment (air pollution, emission of greenhouse gases, noise, habitat loss, etc.). Also, the overburdening of the traffic system reduces its positive economic influence through congestion, an increase in mobility barriers, higher accidents numbers and increased service costs.

Thus, political activities in the Alpine region have focused on the re-organisation and further development of transport systems under the principle of sustainability. Bringing the transport system to a sustainable development path includes a balancing between the economic, environmental and social dimension of freight transport which makes sure that the positive effects of freight transport can clearly compensate some remaining negative aspects.

Currently, no overall accepted approach for measuring the sustainability of transport systems is available. One way to understand the territorial and social systems is the use of indicators which represent one useful instrument to obtain knowledge on the three dimensions of sustainable transport systems and their interaction. In order to assess the level of sustainability of the current transport system and to evaluate future developments, an important objective of MONITRAF has been the definition of common indicators giving evidence on the three dimensions of a sustainable transport system.

The choice of common indicators

Currently, information on a large amount of indicators is collected in the different Alpine countries and MONITRAF regions from which an initial set of indicators has been selected for measuring sustainable development. In order to present an appropriate picture of the current situation and to serve as basis for the development of common policy measures, the indicators should meet the following basic needs:

- To cover environmental and traffic but also social and economical aspects,
- scientific accuracy and validity,
- political acceptability and effectiveness in relation to the defined policy objectives,
- technical feasibility, also including the costs for gathering the data
- enabling a harmonised use/data gathering in all MONITRAF regions in order to obtain comparable information.

Within the process of defining the indicator set for MONITRAF, it became evident that a scientific approach did not lead to the desired outcome as the project partners had to draw information from existing sources. However, it was clear that the indicators should not only focus on traffic development and its environmental impacts but should also include socio-economic aspects to cover all dimensions of sustainability. In discussing the options on several MONITRAF workshops, a set of common indicators turned out to be adequate (see Figure 12).

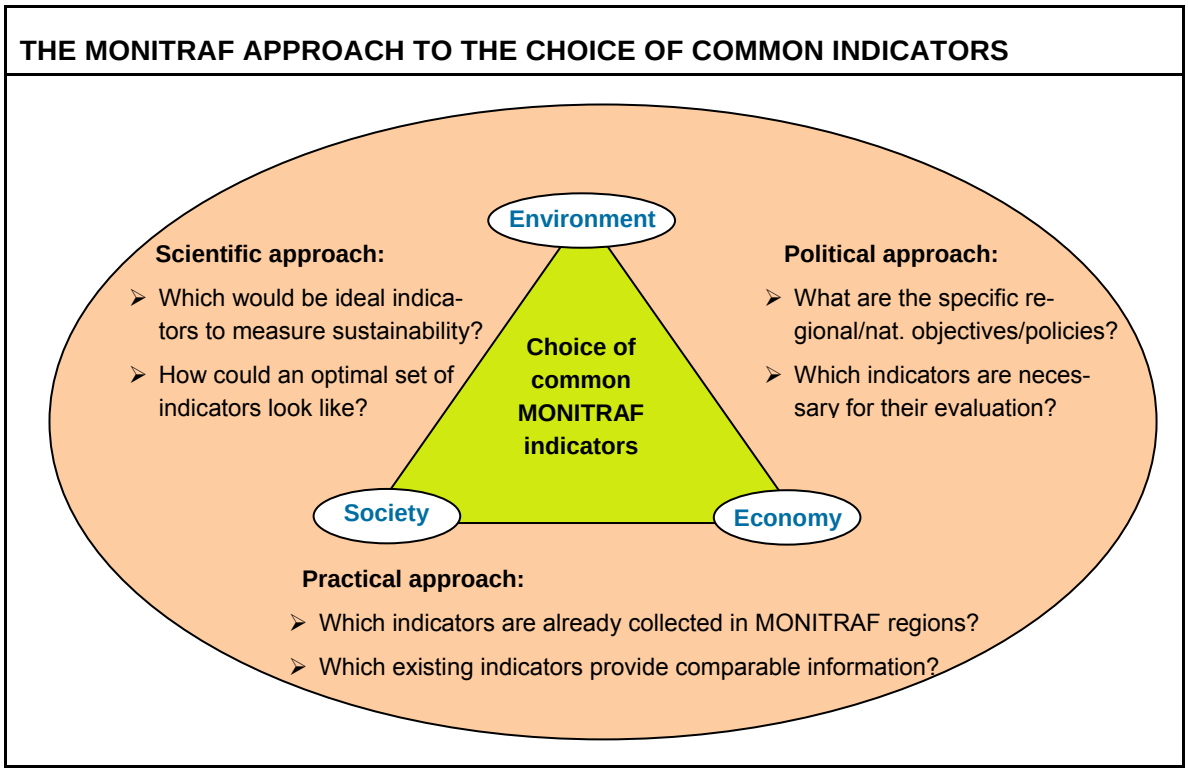


Figure 12 The MONITRAF approach for the choice of common measures. Source: MONITRAF 2007

Data collection and harmonisation: success and difficulties

An extensive set of common MONITRAF indicators was already proposed in the first year of the MONITRAF project. However, when starting to collect data for these indicators, MONITRAF project partners were faced with several difficulties:

- **Different methodologies and definitions:** The MONITRAF regions use differing methodologies and definitions which reduce comparability or make it even impossible. For example, a heavy good vehicle in Switzerland is defined as vehicle for goods transport with weight over 3.5 tonnes while it is defined as a vehicle with more than two axles in Austria. Concerning the monitoring of ambient air pollution concentration, different monitoring approaches and monitoring protocols (e.g. position of the monitoring station, time of taking a sample, etc.) are used.
- **Different levels of data availability:** The MONITRAF regions have different policies and provide different statistical information on socio-economic indicators. Some regions collect data on NUTS 3 level, other regions go more into details and provide data on NUTS 4 and 5 levels. Comparison can only be carried out on the lowest common level. Other data turned out to be incomplete or was not available for the time period considered. Finally, some data is collected by national and by regional authorities in a different manner resulting in ambiguous figures. In some cases, MONITRAF was unable to go into deep analysis to understand the differences.
- **Different accessibility of data:** In some regions, the data looked for may indeed be collected but may not be available for the public (e.g. on an online platform). In some regions, authorities were even rather reluctant to provide the necessary data.

Due to these first problems in the data collection, the list of indicators has been further adjusted during the project that implied some deviation from the initial and "ideal" set of indicators. For most of the 25 final indicators (see table 1), a comparable picture could be obtained including data from the majority of the regions. Only for the health indicator, information was only scarcely available. This indicator is however kept in the list to signalise that the health impacts of traffic in the Alps need further investigation.

With the data collection in the MONITRAF regions, a common and comparable data basis for a comprehensive set of indicators is probably provided for the first time for the Alpine regions in Austria, Switzerland, Italy and France. The provision of this comparable picture for the three dimensions of sustainability – environment, society, economy – may be considered a main success of the MONITRAF project and may be seen as a first important step towards the establishment of a common monitoring system.

MONITRAF SET OF COMMON INDICATORS			
No	**Indicator**	**Main category**	**Data and definition**
1/2	Traffic volume all vehicles and heavy goods vehicles	Traffic	Yearly average of mean daily traffic (HGV and total vehicles minus HGV)
3	Composition of vehicle fleet	Traffic	Yearly percentage of HGV Euro 4 and higher
4	Modal split freight transport	Traffic	Proportion between freight transport on road and freight transport on rail
5	Yearly transalpine total tonnage	Traffic	Total yearly tonnage transported via the main Alpine crossing of each corridor for road and rail
6	Air pollution concentration NO_2, max. hourly values	Environment	Number of hours per year with a NO_2 concentration of more than 200 µg/m³
7	Air pollution concentration NO_2, max. daily values	Environment	Number of days per year with a NO_2 concentration daily average of more than 80 µg/m³
8	Air pollution concentration NO2, annual average	Environment	Annual average of NO_2 concentration
9	Air pollution concentration PM10, annual average	Environment	Annual average of Particulate Matter (PM10)
10	Air pollution concentration PM10, max. daily values	Environment	Number of days with a PM10 concentration of more than 50 µg/m³
11	Noise indicator	Environment, Quality of life	Lden (noise indicator for overall annoyance) and Lnight (noise indicator for annoyance during the night period).
12	Health indicator	Quality of life	Cardiovascular and respiratory morbidity
13	Transport accidents	Quality of life	Yearly number of road accidents with fatalities and injuries per per km on the motorway of the corridor
14	Investments in noise protection infrastructure	Quality of life	Coverage of noise protection infrastructure divided into road (motorway) and railway along the defined corridor (only motorway and railway line)
15	Investments in transport infrastructure	Infrastructure	Yearly investments (new investments and maintenance) in transport infrastructures for motorway and main railway line on the corridor, only material costs and without personal costs
16	Toll prices	Pricing and regulation	Toll prices (min. and max. tariff) per km on the motorway and on the tunnel in the project corridor for light vehicles and HGV and vignette (only for light vehicles)
17	Fuel prices	Pricing and regulation	Yearly average of fuel prices (what the final consumer pays) on regional level (NUTS 2) and for the state distinguished between diesel and petrol
18	GDP per inhabitant	Economy	Value of the economic performance resulting from productive activities in a period of reference, calculated for NUTS 3 level and NUTS 2 level
19	Population	Society	Inhabitants in the selected municipalities (NUTS 5) along the corridors and in the regions (NUTS 2 and NUTS 3)

MONITRAF SET OF COMMON INDICATORS			
No	**Indicator**	**Main category**	**Data and definition**
20	Unemployment rate	Society	Proportion between unemployed people and the labour force on municipality level (NUTS 5), regional level (NUTS 3) and for comparison NUTS 2 level and national level (state).
21	Number of employees in transport sector	Economy	Number of employed persons in the transport sector (NACE / NOGA) for NUTS 3 level and NUTS 2 level
22	Number of tourist beds	Economy	Number of tourist beds in commercial and non commercial accommodation
23	Overnight stays	Economy	Number of overnight stays in commercial and non commercial accommodation per month
24	Migration balance	Society	Difference in terms of surplus or deficit between the number of registrations (immigration) and cancellations (emigration), related to the number of inhabitants, per year, for the selected municipalities (NUTS 5) along the corridors and on level NUTS 3 and NUTS 2
25	Birth balance	Society	Difference in terms of surplus or deficit between the number of births and the number of deaths, related to the number of inhabitants, per year, for the selected municipalities (NUTS 5) along the corridors and on level NUTS 3 and NUTS 2

Table 1

4 CURRENT STATE AND FUTURE DEVELOPMENT

4.1 Today's situation: the performance in the MONITRAF corridors

Traffic development along the MONITRAF corridors and modal shift between road and rail

Within MONITRAF traffic data for several counting stations a long the four main corridors were collected. Figure 13 shows the development of the yearly average of daily mean value along the corridors. The Brenner and the Mont-Blanc corridor show a constant traffic increase at almost all counting stations. At the Fréjus and the Gotthard axes the development differs from counting station to counting station and partially minor traffic decreases could be registered.

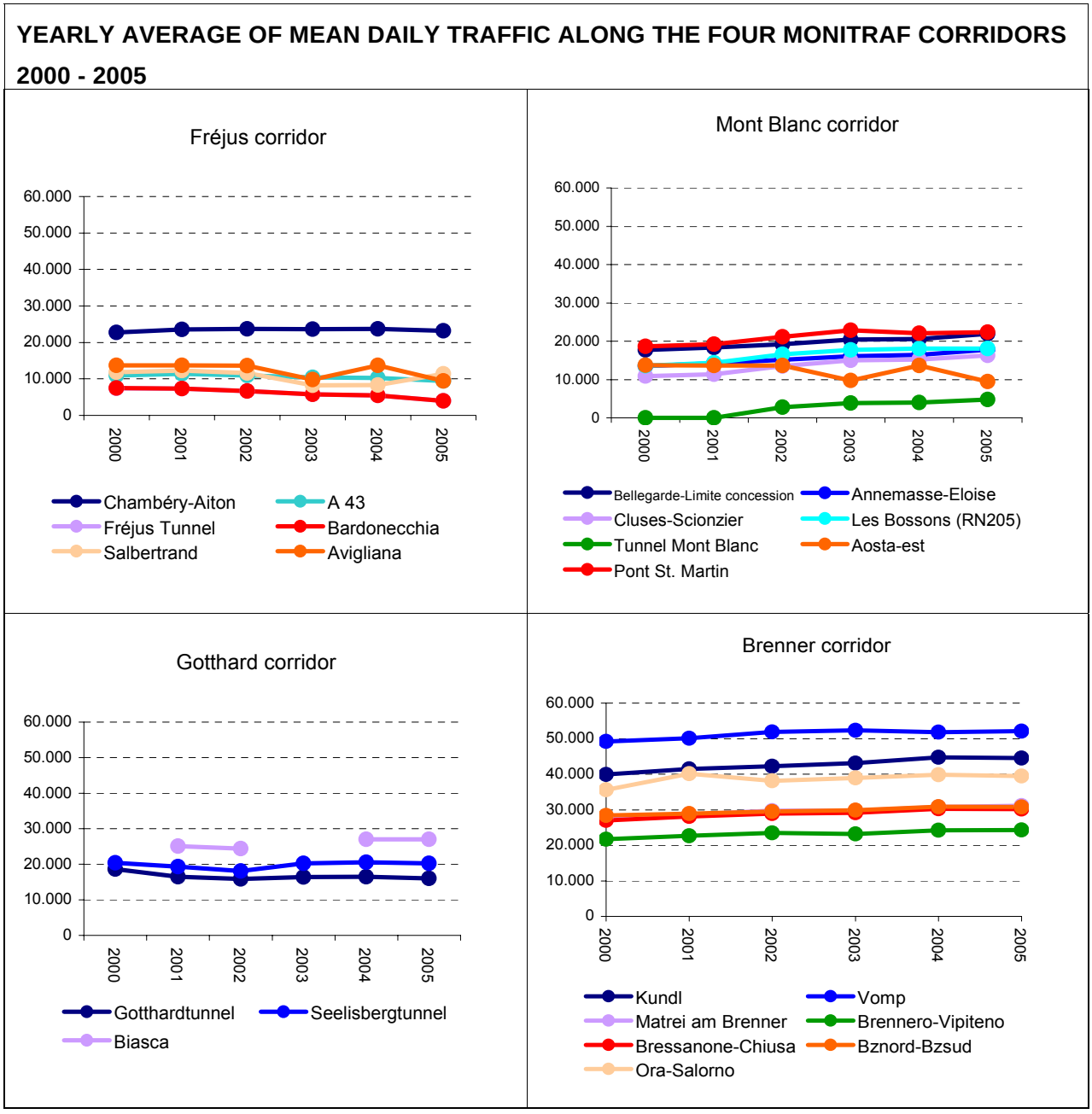


Figure 13 Yearly average of total traffic volume at counting stations along the MONITRAF corridors for the years 2000 – 2005. Source: MONITRAF 2007

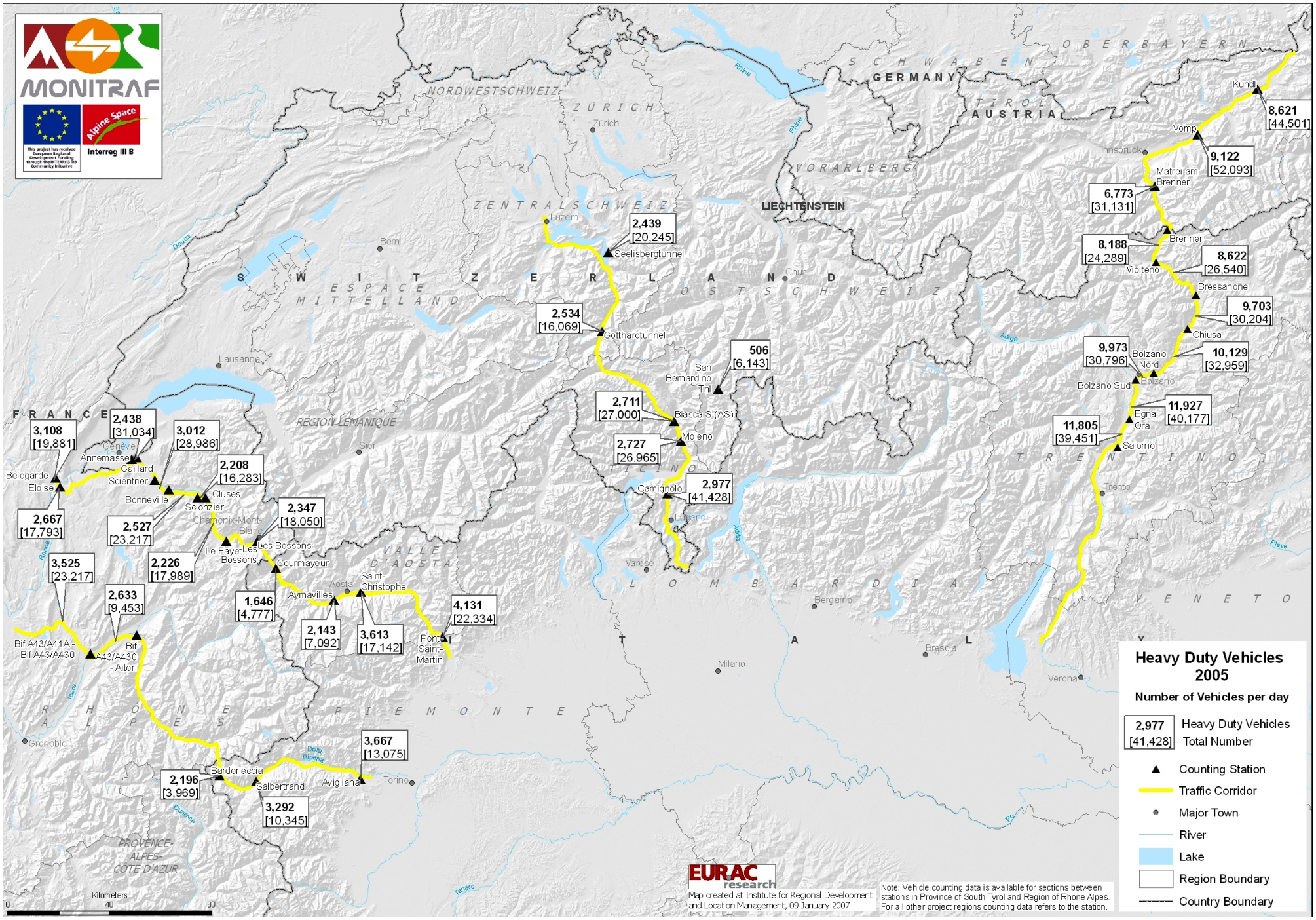


Figure 14 Number of vehicles per day at different counting stations along the four MONITRAF corridors for the year 2005. Source MONITRAF 2007

In figure 13 the counting stations for which traffic data was collected within MONITRAF are mapped. The figure gives information on the total traffic flux and the HGV traffic at the counting points.

MODAL SPLIT: SHARE OF RAIL-TRANSPORTED TONNAGE

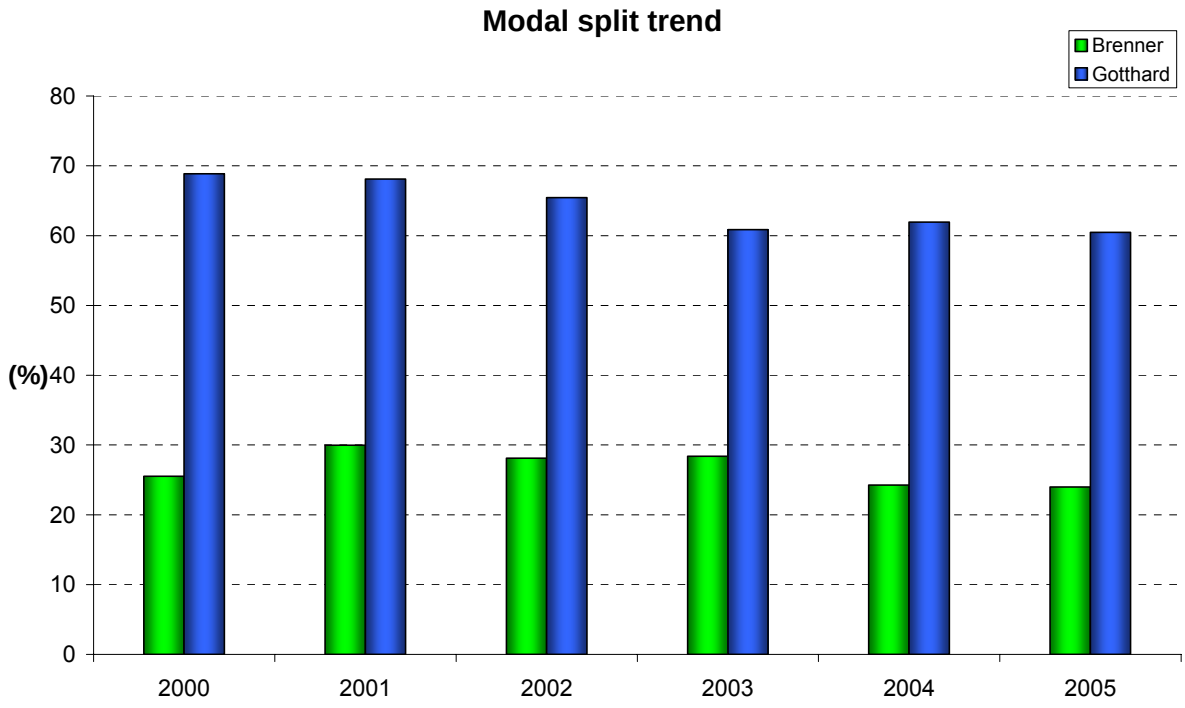


Figure 15 The share of the freight volume transported on the rail way system. Source: MONITRAF 2007

On the Gotthard and Brenner corridor, a rail link is available. Although, transport policies in Austria and Switzerland have worked towards a shift from road to rail traffic, Figure 15 shows that the road solution is still dominant over the rail alternative. At the Brenner corridor, not even a third of all goods are transported by rail. At the Gotthard corridor, rail way system plays a more important role. In 2005 almost 60% of all goods were transported by rail.

Even with new railway infrastructures a sufficient shift from road to rail can only be achieved with an accompanying set of effective measures.

The environmental situation: air pollution and noise in the Alpine corridors

Air pollution emission evaluation

Based on the traffic number data and emission factors (BUWAL 2004), MONITRAF carried out some evaluation for NOx, PM10 and CO_2. The following diagram shows the emissions per km of heavy duty vehicles on stretches of the MONITRAF axis in 2005.

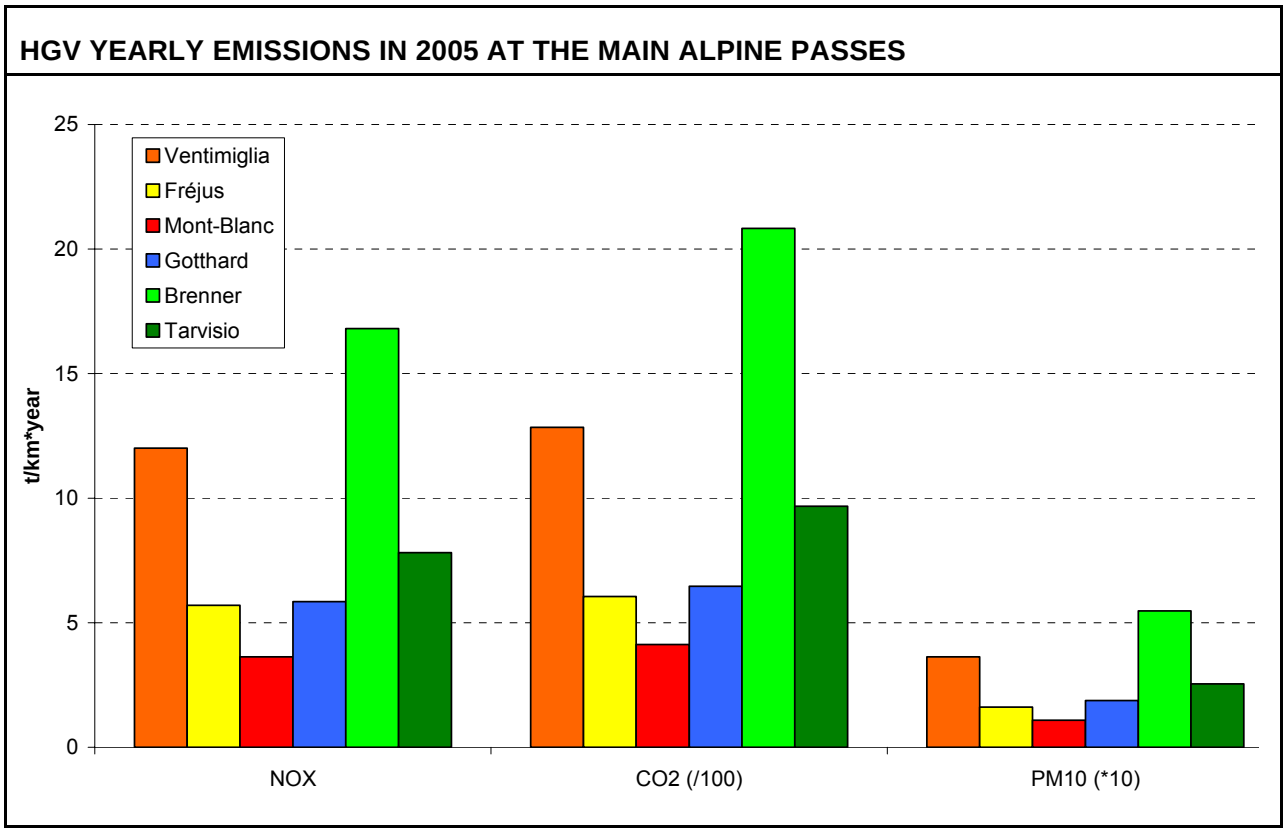


Figure 16 Yearly emission of HGV on the main Alpine corridors evaluated for the year 2005. Source: MONITRAF 2007

Air pollution concentrations

- Under the current situation, the legally defined limit values for NO_2 and PM10 cannot be met at all locations in the MONITRAF regions as information from the selected monitoring stations shows. Note that the limit values are not the same in Switzerland as in the EU today, but the EU will lower its values from 2010 onwards.
- In 2005, the yearly average of PM10 concentration exceeded the EU limit values at Ora in Italy (Brenner), and for the CH limit value at Erstfeld and Moleno in Switzerland (both Gotthard) as can be seen from the upper diagram. The lower diagram shows that the limit value for the maximum number of days with more than 50 $\mu g/m^3$ is exceeded at several stations including Brenner, Gotthard and Fréjus. However, the EU-limit values for the year 2010 have been exceeded at almost all monitoring stations.
- For NO_2, the exceedance of yearly average values is even more problematic, the limit values are exceeded at ten locations including Brenner, Gotthard, Mont Blanc. The differences between the stations and between the four corridors may be explained by different traffic numbers, by the share of heavy duty vehicles but also by local topography and meteorology and by the distance of the measuring stations to the motorway.

For a description of the limit values, the reader may be referred to Council Directive 1999/30/EC (EC 1999) and the Swiss Federal Ordinance on Air Pollution Control (Swiss Confederation 1985).

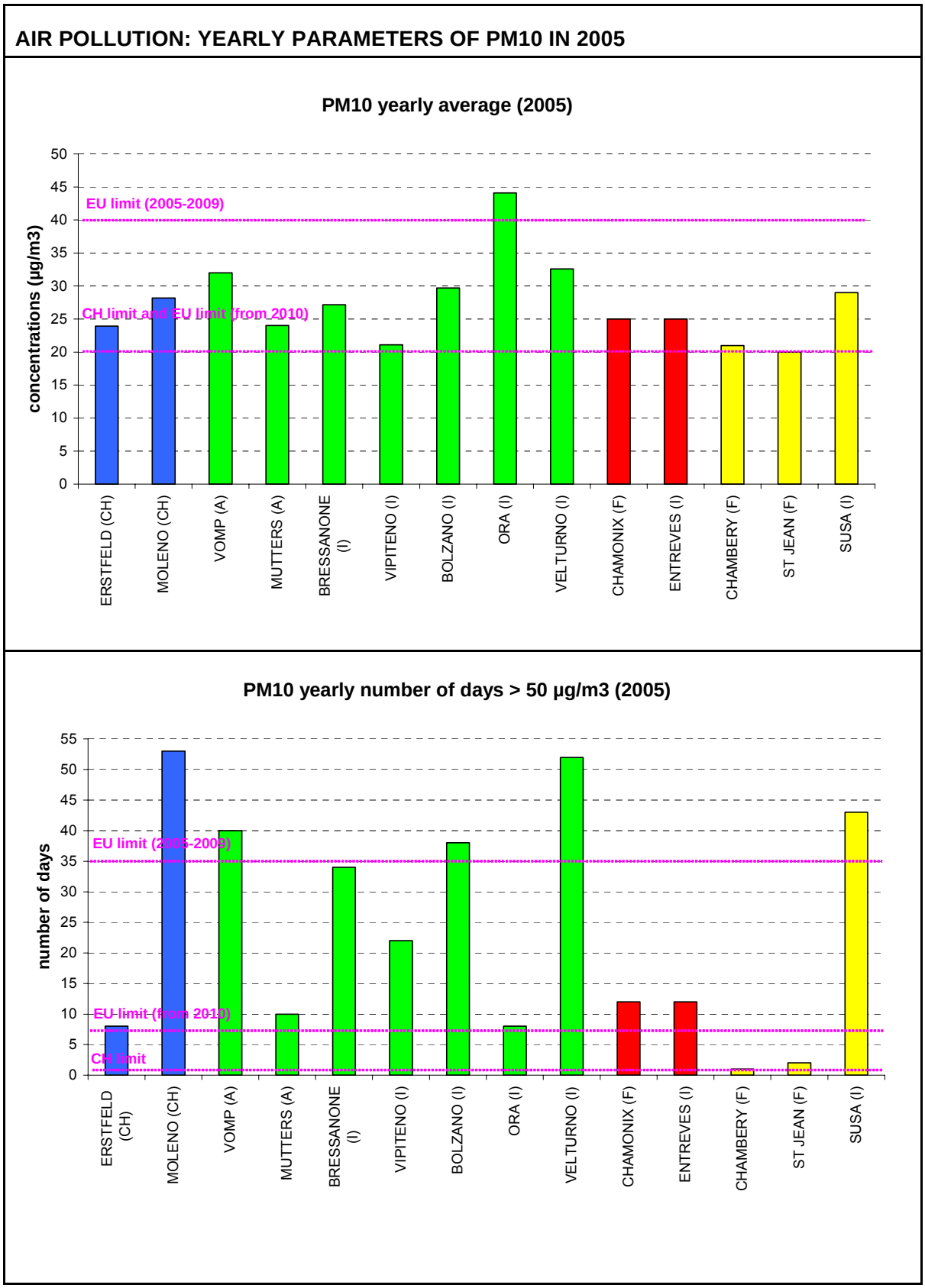


Figure 17 Yearly average of PM10 and the number of days exceeding the PM10 limit value of 50µg/m³ for the year 2005 at the main measuring station at the MONITRAF corridors. Source: MONITRAF 2007

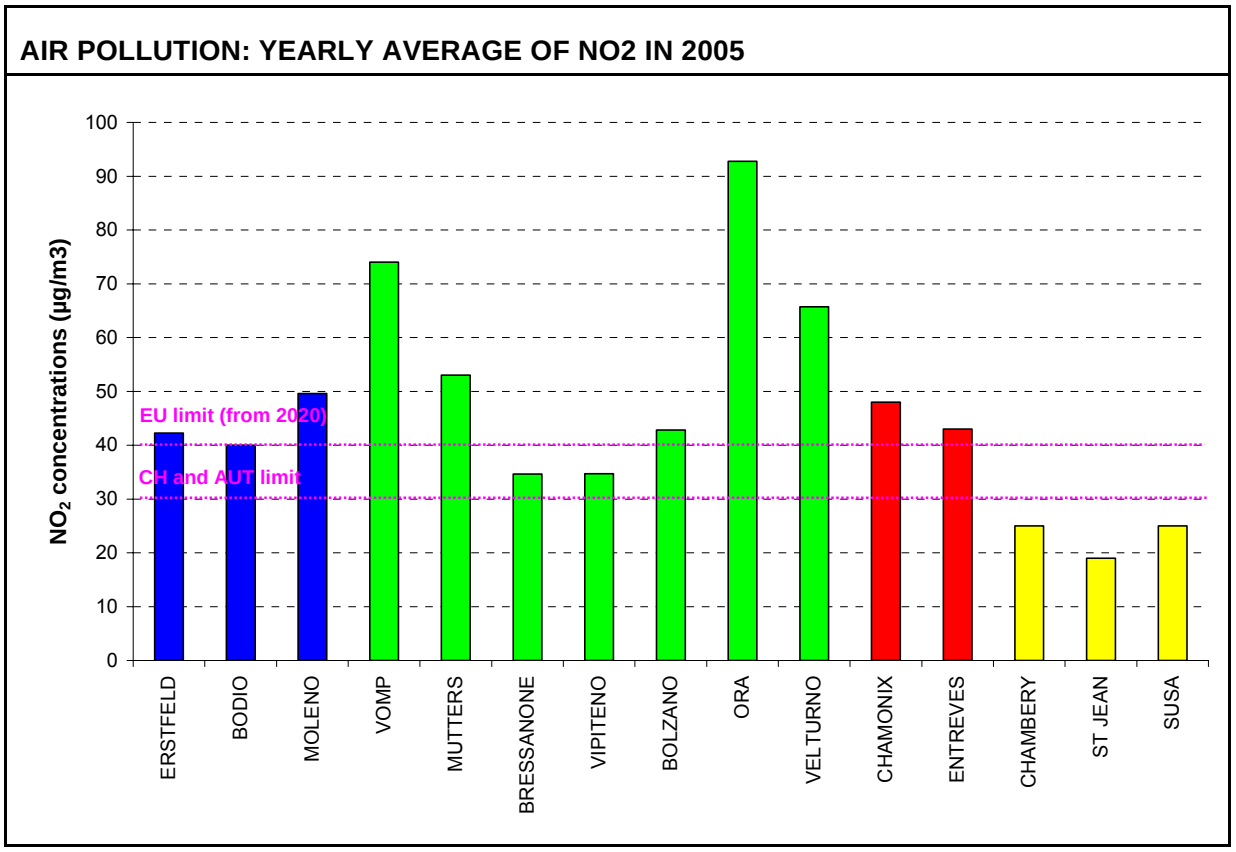
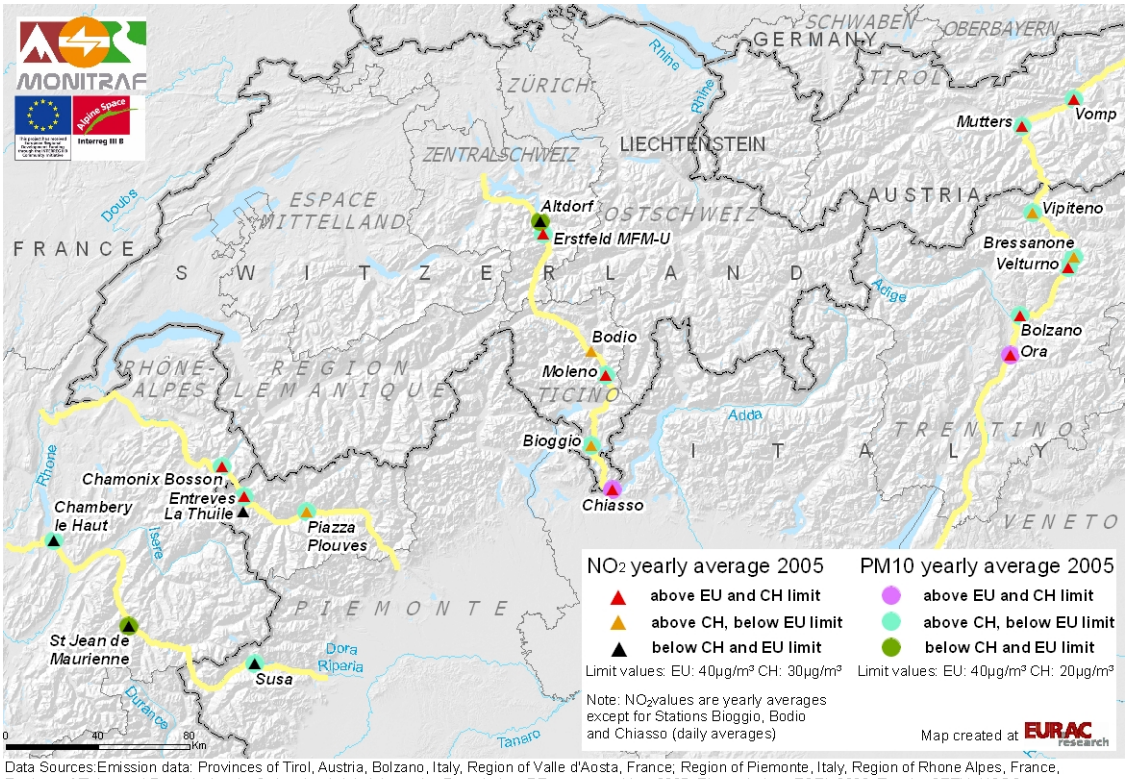


Figure 18 Note that for Tyrol for NO_2 in 2005 the limit value (according to the IG-law) was 30 µg/m³ including a 10 µg/m³ tolerance margin. The margin will be reduced by 5 µg/m³ in the year 2010. In 2012 no tolerance margin will be accepted and the limit value of 30 µg/m³ must be reached. Source: MONITRAF 2007

The following figure visualises the exceedance of threshold values. It can be seen that the situation deteriorates from west to east. It can be seen that the situation is especially critical at the Brenner corridor where the NO_2 and PM10 values either exceed the limit values or lie just below.

EXCEEDANCE OF LIMIT VALUES FOR NO2 AND PM10 AT THE MONITRAF CORRIDORS



Data Sources:Emission data: Provinces of Tirol, Austria, Bolzano, Italy, Region of Valle d'Aosta, France; Region of Piemonte, Italy, Region of Rhone Alpes, France, Regions of Ticino and Zentralschweiz, Switzerland. Admininstrative Boundaries: ©Eurogeographics, 2007; Rivers, Lakes: ESRI, 2000. Terrain: SRTM, USGS.

Figure 19 Exceedance of limit values for NO_2 and Pm10 at the main measuring stations at the MONITRAF corridors. Source: MONITRAF 2007

Noise

Two indicators are measured along Gotthard and Mont Blanc: The weighted level L_{den} and the level at night hours L_n. For the definition of the levels, the reader may be referred to EU (2002).

- Noise levels (L_n) during night hours for the Mont Blanc highway vary from 58 dB(A) to 60 dB(A) in Courmayeur La Palud, where the microphone is set 17 m from the road, and from 66 to 70 dB(A) in Courmayeur Vilette, where the microphone is set 6 m from the road (see Figure 5). Note that on an average the L_n are 5- 7 dB(A) lower than the L_{den} levels.
- Noise levels along the Gotthard axis are measured 6 m away from the highway. The L_n reaches 73 dB(A) during night hours in Erstfeld and 70–73 dB(A) in Moleno for L_n.

Further noise data and analysis are published by the Swiss "Monitoring of the Flanking Measures" (BAFU 2007) and by Terza Relazione sullo Stato dell'Ambiente in Valle d'Aosta – ARPA Valle d'Aosta 2006.

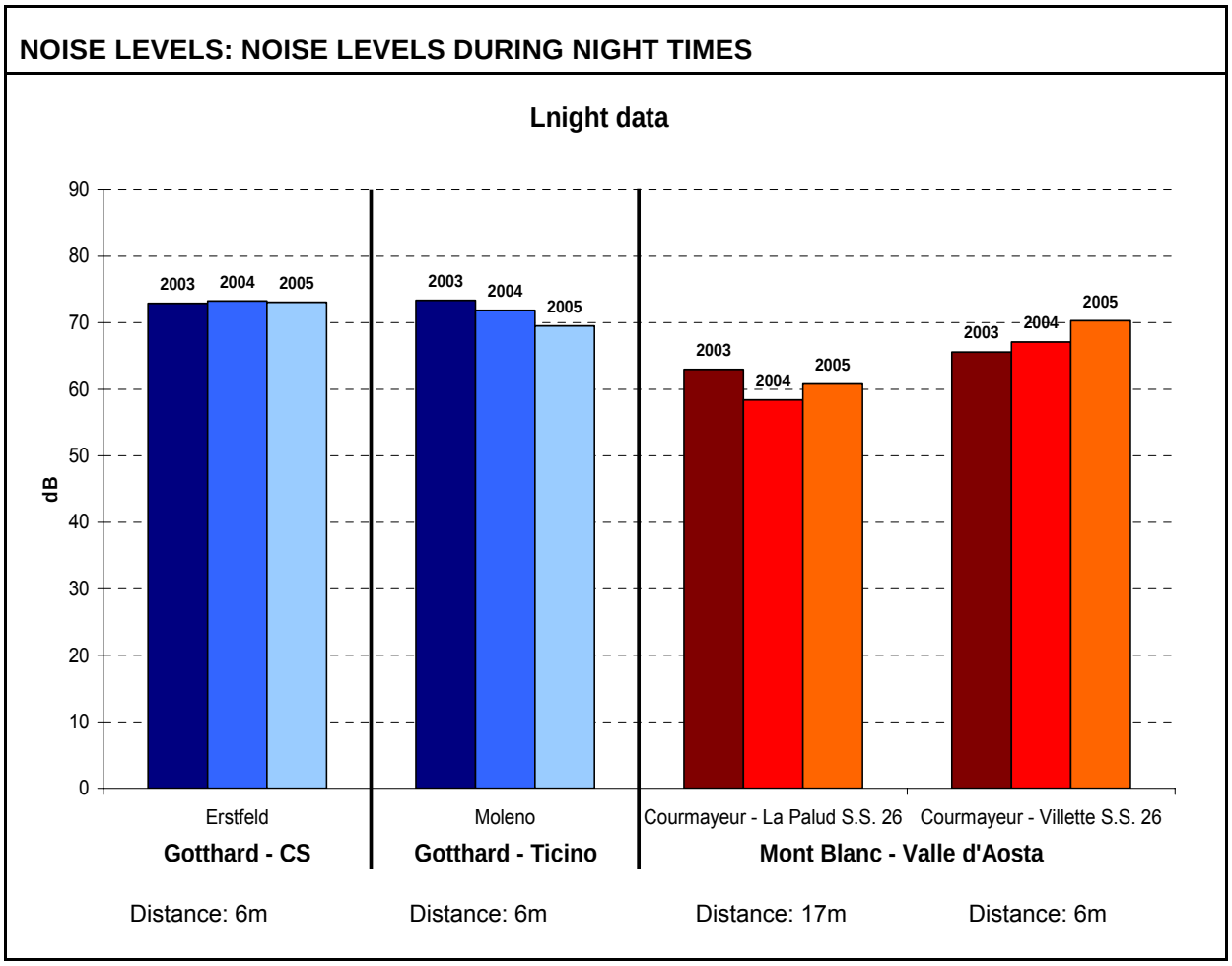


Figure 20 The distance of the microphone from the road is indicated for each station (note that the increase of the distance from 6 m to 17 m may result in a decrease of the noise levels of 4 dB to 5 dB). Source: MONITRAF 2007

4.2 Future development: How does the situation change with the introduction of new measures?

In order to show the potential impact of common measures, MONITRAF partners have modelled future emission scenarios. The scenarios are based on a number of assumptions and thus include a high amount of uncertainty. However, they indicate the impacts of future traffic development, the role of technological development and positive effects of new measures. As a first step, a **business-as-usual scenario (BAU)** has been developed on the basis of the situation in 2005. This business-as-usual scenario is build on existing forecasts for freight traffic (e.g. Federal Council of Switzerland 2007, study for the base tunnel Lyon-Torino (LTF – Etude de trafic Fret – Résultats Phase 1 - septembre 2006). For the Fréjus corridor an increase of traffic until 2025 by 47% is assumed, for the Mt. Blanc by 62%, for the Gotthard by 17% and for the Brenner by 74%. Concerning technological development, also a business-as-usual development is assumed with an equal share of Euro 5 and Euro 6 vehicles in 2025.

For the **best available technique scenario (BAT)**, both a target-oriented as well as a best available technology approach have been used. Concerning targets, it is assumed that new measures – as recommended by MONITRAF – can lead to a stabilisation of freight traffic until 2025, referring to the values of 2005. On the technology side, it is assumed that technological development is accelerated so that the total vehicle fleet would consist of Euro 6 vehicles.

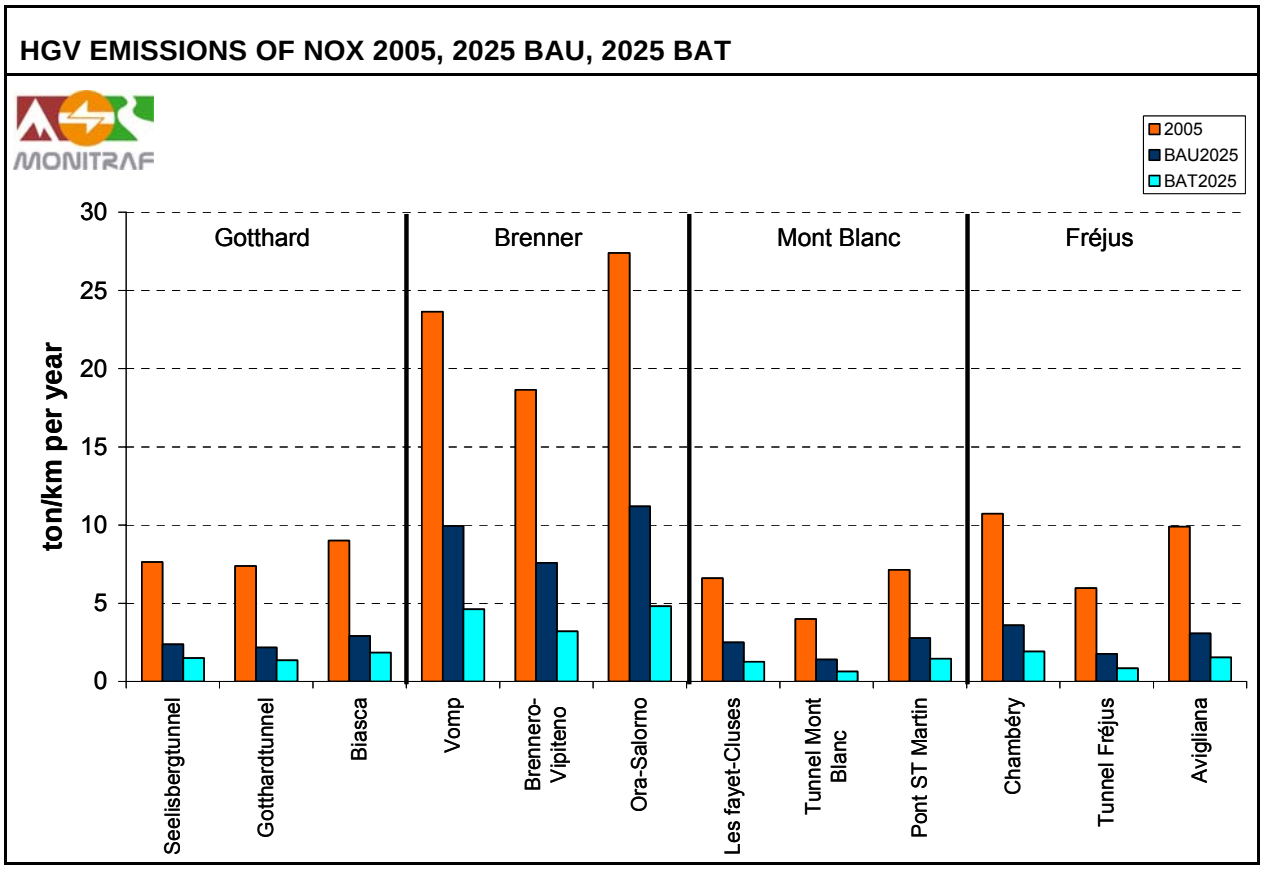


Figure 21 The potential of emission reductions shown in the diagram for 2025 is expected to be reached only under very optimistic conditions. Source: MONITRAF 2007

For **NOx emissions**, the modelling results give an optimistic picture already in the BAU scenario (Figure 21). The technical improvement in the vehicle fleet due to Euro 5 and Euro 6 reduces very strongly the NOx emissions per vehicle. On the other hand, the increase in the number of vehicles partly compensates the technical improvement, but the net effect theoretically leads to a strong reduction. This is due to the shift in the vehicle fleet from mostly Euro 2/Euro 3 to Euro 5/Euro 6. It should be noted that the theoretical potential for reduction on the basis of technical improvements has not been be reached in the period 2000-2006. Therefore, the result of the MONITRAF emission modelling for 2025 must be considered as very optimistic. The large reduction of NOx emissions due to technological improvement may be overestimated as recent measurements on Euro 3 and Euro 4 engines have shown (an update of the emission factors is foreseen in 2008).

In the BAT scenario, the NOx emissions are further reduced but at a smaller rate. This difference is mainly due to the stabilisation of traffic volumes in BAT at the level of 2005 and is also affected by the accelerated technological development (all vehicles Euro 6).

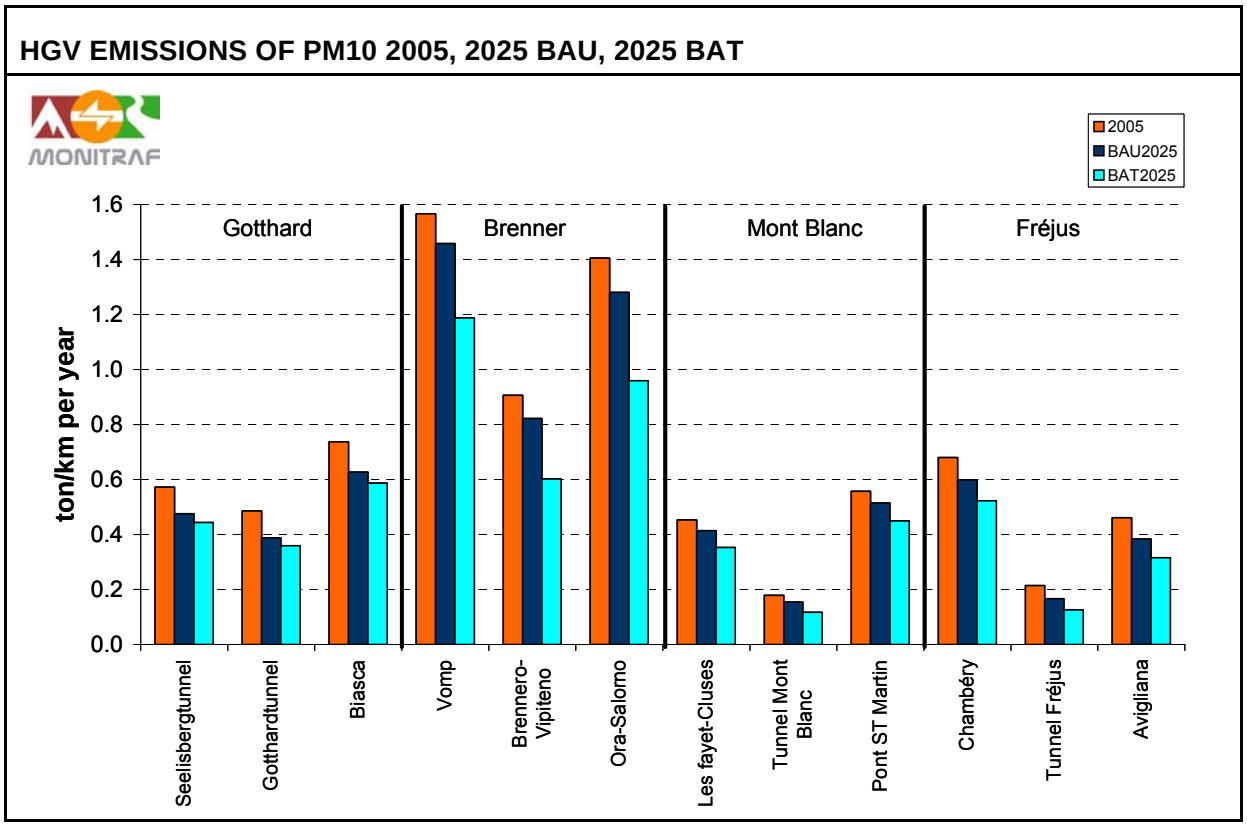


Figure 22 HGV emissions of PM10 for the year 2005 and 2025 calculated for the BAU and BAT scenario. Source MONITRAF 2007

For **PM10 emissions**, the picture looks similar than the one for NOx but the technological improvement is a less distinct. There is only a technological improvement for the exhaust emissions but not for non-exhaust emissions (abrasion, resuspension). Although the technological improvement dominates the increase in traffic volume, the improvement between 2005 and the BAU 2025 is less pronounced as for NOx emissions (Figure 22). For the BAT scenario it can also be seen that the stabilisation of traffic volumes and the modern vehicle fleet lead to a further improvement.

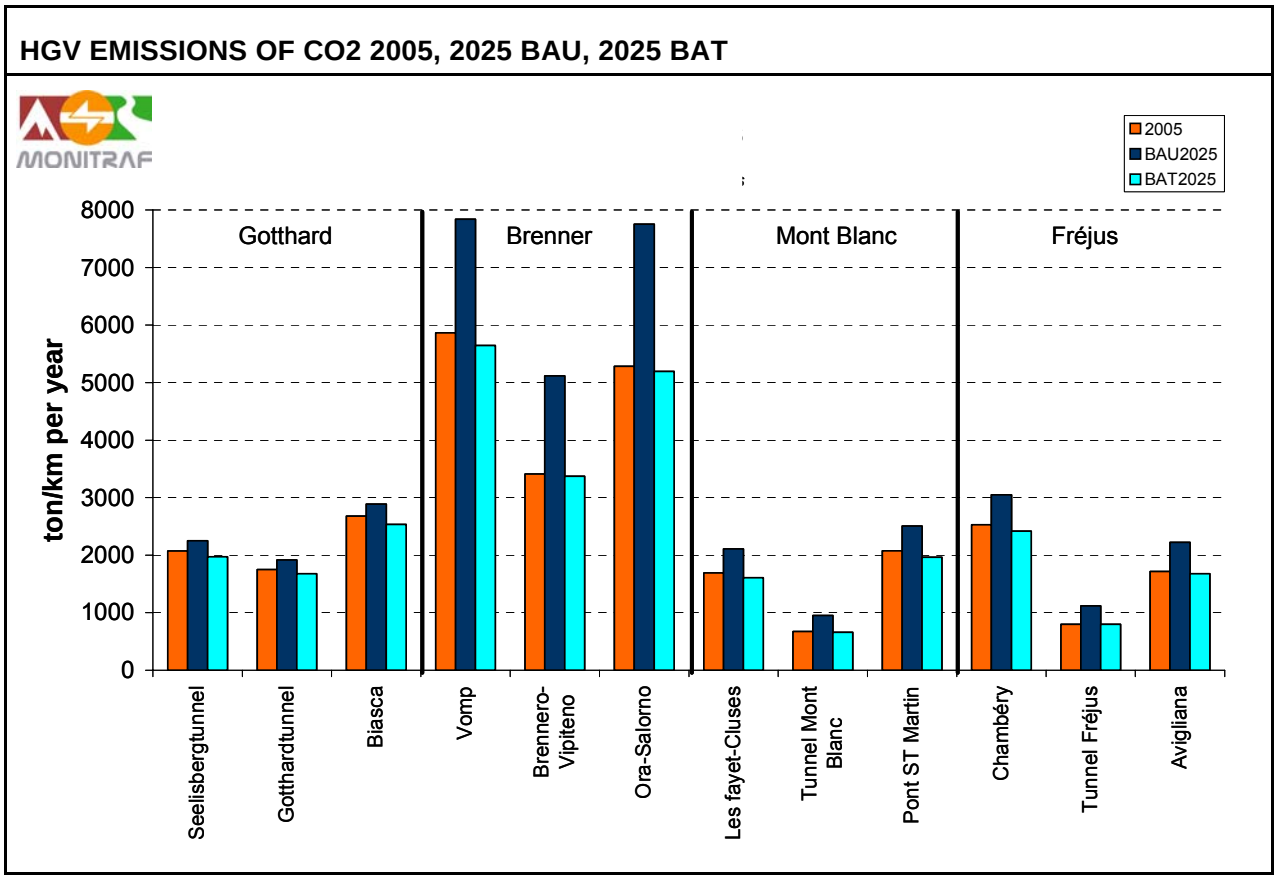


Figure 23 HGV emissions of CO_2 for the year 2005 and 2025 calculated for the BAU and BAT scenario. Source MONITRAF 2007

The difference between the two scenarios for 2025 is most pronounced when looking at CO_2 emissions (Figure 23). Here, the increase in traffic volumes between 2005 and 2025 cannot be compensated by technological improvements so that CO_2 emissions per ton and km increase in the BAU scenario. Although the traffic volume in the BAT scenario is the same than in 2005, the emissions lie slightly below the 2005 values This is due to the fact that high-emission vehicles (Euro 1/2/3) which are included in the vehicle fleet in 2005 are not used any more in 2025.

5 DEVELOPMENT OF A MONITRAF MONITORING SYSTEM

The need for a common monitoring system

The common monitoring system builds the basis for all other measures as it delivers the necessary information. A high-quality, validated and politically accepted data basis on the development of traffic in the Alpine regions (road/rail), its quality (congestion on road, delays on rail) and its impacts (air pollution, noise, accidents) is a crucial starting point for the identification of political objectives and corresponding measures. Such a data basis will also be necessary to evaluate the different measures in the Alpine countries as well as the common MONITRAF measures and to work towards an optimal instrument mix.

As the provision of comparable data within the MONITRAF project has shown, not all data is easy to obtain at the moment and that a direct comparison of data is often difficult due to different methodologies and definitions. MONITRAF activities have made clear that a comprehensive data collection is extremely complex and that it will be quickly outdated if data is not collected in a continuous way. The need for a more comprehensive monitoring system with comparable data for the Alpine region has already been identified by several actors and within the frame of the transport agreement between the EU and Switzerland a common traffic observatory is currently under construction. Also, the Alpine Convention plans the development of a monitoring system but has not yet specified its design. Based on these activities and the knowledge obtained with in the MONITRAF project, there is a unique chance for MONITRAF partners to establish a continuous monitoring system and to provide latest and up-to-data information on traffic development and its environmental impacts. The establishment of such a monitoring system is included in the MONITRAF resolution as a recommendation for further work.

Concept of a continuous monitoring system

According to the results of MONITRAF, a continuous monitoring system should build on the following objectives:

- The MONITRAF monitoring system should mainly aim at comparing **environmental pressures/burdens** from Alpine traffic. Data on concentration levels and emissions needs to be periodically presented in a comparable and representative way in order to allow an optimum design of common measures. Data on traffic development can be obtained from the parallel activities on European level.
- The monitoring system should further allow an **evaluation of the effectiveness of common measures**. This requires both a continuous monitoring of the environmental situation (time-series) as well as an exchange on implementation, enforcement and success of the Best Practices with regard to other aims.
- With respect to regional measures, the monitoring system should be the basis to **trigger off intervention measures** when threshold values (e.g. critical concentration levels) are exceeded. This requires a close link of the monitoring system to the relevant authorities and an on-line availability of data.

Based on the experience gained within the MONITRAF project, it seems advisable to set up the continuous monitoring system in five steps (see Figure 24)In order to prevent that each time, the verification of accuracy of data takes up as much time as it did within MONITRAF, a standard operation procedure needs to be defined. The development of an interface helps the partners to enter the data and enables an efficient functioning of the database. The most important step is the collection of monitoring data which will lie within the responsibility of the partners of Alpine regions. As the main focus will lie on the comparison of the environmental situation, the MONITRAF monitoring system should focus on indicators that represent environmental pressures due to Alpine traffic and should include information on concentrations of air pollutants (immissions) and noise levels as well as emissions of vehicles (modelling results). The modelling of emissions and the interpretation are further important steps within the monitoring system to obtain a comparable picture of sustainable development in the Alpine region. Including a good communication concept, the common monitoring system can continue to strengthen the common voice of the Alpine regions. Information obtained from the monitoring system can, for example, be presented in an annual report and discussed with politicians and stakeholder on an annual conference serving as exchange platform and strengthening the network of Alpine regions.

The monitoring system will also provide the necessary data for a continuous improvement of the set of common measures. Based on the information on Best Practices (collected through the partners in the Alpine regions) and the monitoring results a comparison of the effectiveness of measures in the different corridors becomes possible. If any unwanted effects of the measures (e.g. traffic shifts between corridors) can be observed, the information can provide the basis for further adjustments in the instrument mix.

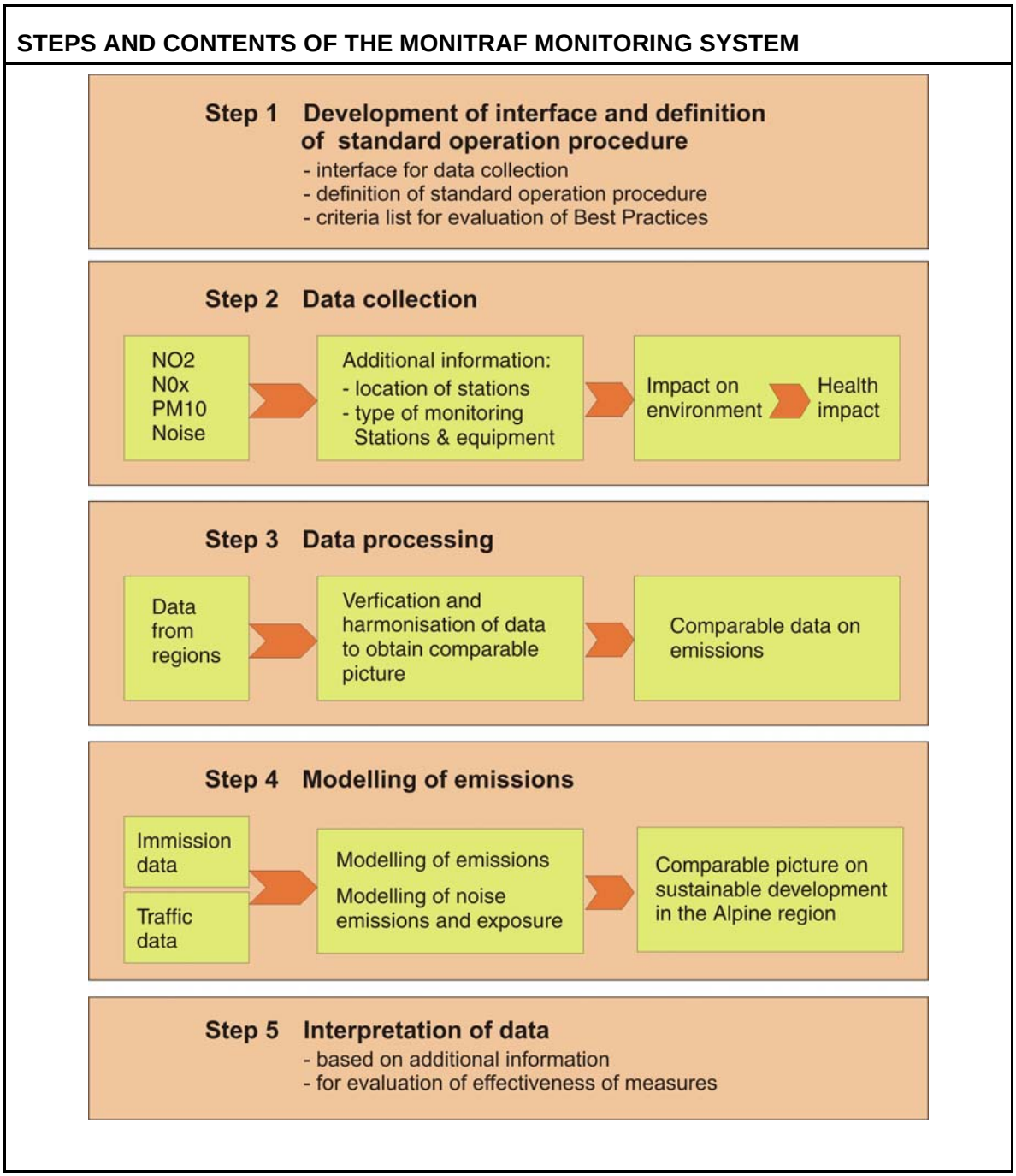


Figure 24 Steps and contents of the MONITRAF Monitoring System. Source: MONITRAF 2007

6 THE NEED FOR COMMON MEASURES

6.1 Working towards a sustainable transport policy

The data collected and compared within MONITRAF shows that the dilemma between the creation of economic benefits through a further development of transport infrastructures and its negative impacts for the environment and inhabitants of transit regions is especially visible in the sensitive Alpine region. This imbalance has led to a re-alignment of European transport policies and the objective of sustainable development has become more and more important. All Alpine countries as well as the European Union have developed strategies for the reduction of Alpine transit traffic on the road which include a wide rang of different measures and instruments. However, following the general political strategies and the current political direction, the measures and instruments differ widely and – instead of creating synergies – run the risk to create new unwanted distributional effects between regions, e.g. through shifting freight traffic from one corridor to another. Also, some of the measure become not fully effective because they would need flanking instruments not only in the country where the measure has been implemented but also in the whole Alpine region.

An assessment of Best Practices for transport policy and their impacts can give a good overview on the effectiveness of measures and the flanking measures which are necessary for reaching a sustainable development path. A comprehensive overview of Best Practice measures from regional, national up to the European level enables the MONITRAF regions to learn from each other and to focus their future activities on the most effective and promising measures. In order to strengthen the voice of the Alpine regions and to prevent further distributional impacts between them, the MONITRAF regions have gone even one step beyond the process of "learning from each other" and developed a set of common measures which would lead to a significant improvement of the situation if implemented in all countries. As MONITRAF is not supposed to question and harmonise the overall approach of Alpine polices, the MONITRAF ideas are based on existing experiences with Best Practice measures in all Alpine countries as well as the framework set by European legislation.

6.2 Policy and legal framework

The assessment of existing transport policies and Best Practices has shown that most activities run in line with the White Paper on transport policy of the European Commission of 2001 and follow the main strategy to shift traffic from road to rail and to build new rail infrastructure. The White Paper also includes the idea of a more flexible cross-financing from road to rail which has been taken up by several countries (European Commission 2001). On national level, Switzerland has introduced the most stringent transport policy with a legally binding modal shift aim, the building of new base tunnels and the distance-related heavy vehicle fee (LSVA). The Austrian strategy is dominated by regulatory measures which are mostly implemented on the regional level. An important part is the construction of the Brenner base tunnel which shall support the shift from road to rail. The policy approach in Italy and France focuses on the provision of new rail infrastructure (new base tunnels) with accompanying regulating measures while fiscal instruments play a less important role. An overview of elements of national and EU strategies is provided in table 2.

All these existing initiatives are however not sufficient to achieve a sustainable improvement of living and environmental conditions along the transit corridors from the viewpoint of the Alpine regions. The planned rail infrastructure projects will not lead to a sufficient shift from road to rail if it they are not accompanied by an effective set of additional measures.

In addition to the political framework on the different levels, MONITRAF has assessed the legal background which needs to be considered when defining common measures. On the one hand, this legal background information contains an overview of the competences of the MONITRAF regions. This overview makes clear that according to the federal structures of the relevant countries, some of the regions have only few competences to implement or enforce new measures (especially in Italy and France). Concerning the implementation of regional measures on motorways and national roads, the overview of competences shows that in most countries the competence lies with the federal state or road operator. Only in Austria, Tyrol has the competence to implement measures on their regional motorway stretches. MONITRAF partners have also collected information on the major legal documents concerning freight traffic in their regions. This information will be available in form of a normative database soon.

ELEMENTS OF NATIONAL/EU STRATEGIES (MAIN ASPECTS)				
Aspect	**F** **Rhône-Alpes**	**I** **Brenner and Aosta Vallley**	**CH** **Gotthard**	**A** **Brenner**
National/EU alpine policy	General policy aims (modal shift, transport security)	General policy aims (modal shift, transport security) Due to geographic situation, no instruments which aim at increasing road transport costs.	Specific policy aims according to the reduction aim for freight traffic in the constitution (Alpine Initiative) and modal shift. Focus on fiscal instruments with accompanying measures.	Specific policy aims (reduction of negative impacts of road transport, modal shift). Tyrol: Focus on regulating measures
Design of street infrastructure	Tunnel (Mont Blanc, Fréjus)	Tunnel to France, no tunnel at Brenner	Tunnels at Gotthard and San Bernardino	No tunnels
Institutional aspects (road)	Tunnels are run by private operators	Motorways are partly run by private operators, partly by public-private partnerships	Tunnels are operated by public authorities.	Motorways are run by private operators (public business)
Condition of rail infrastructure	New rail base tunnel and access lines between Lyon and Torino is planned.	New rail base tunnel and access lines between Lyon and Torino is planned. Rail base tunnel at Brenner is planned.	Two rail base tunnels under construction: Lötschberg 2007¨ Gotthard 2017	Rail base tunnel at Brenner is planned.
Fiscal instruments	› Motorway toll and tunnel charges (for HGV differentiated according to environmental criteria) › Implementation of Eurovignette Directive under way, first trials in 2008.	› Motorway toll for HGV (undifferentiated) › Sticker for passenger vehicles.	› HGV fee (differentiated according to distance, weight and emission standard) › Sticker for passenger cars for motorways.	› Motorway toll for vehicles > 3.5 t (according to Eurovignette-Directive) › Sticker for motorways for PV › Additonal charges for specific stretches of alpine roads (all vehicle types)
Regulating measures for road transport	› Weekend driving bans for HGV › Bans of transport of dangerous goods from tunnels. › Security regulations for tunnels	› Weekend driving ban for HGV › Night driving ban for loud HGV (South Tyrol) › Driving bans for HGV Euro 0+1 in South Tyrol (dynamic adjustment to Euro 2) › Ban on passing on Italian Brenner motorway	› Night and weekend driving ban for HGVs › Additional accompanying measures (transport and speed controls) › Traffic regulation system at Gotthard tunnel (dosing system)	› Weekend driving ban for HGVs › Night driving ban in lower Inntal and night driving ban for loud HGV at Brenner › Speed limits on Inntal motorway during wintertimes › Driving bans for HGV Euro 0+1 in Tyrol (dynamic adjustment to Euro 2) › Ecopoint system until 2003
Additional measures rail	› Rolling motorway at Mont Cenis › Subsidies to rolling motorway	› Subsidies to rolling motorway and CT-Terminals › Subsidies to rolling motorway	› Subsidies to CT and rolling motorway › Subsidies to terminals	Subsidies rolling motorway.

Table 2: *PV: Passenger vehicle, CT: Combined transport. Source: MONITRAF 2007*

6.3 Main directions for common MONITRAF measures

Taking into account the Best Practice measures implemented in the MONITRAF regions, four main directions of common measures have been developed and brought to the political level. The first of these main directions is the common monitoring system which has been described in chapter 5 and serves as basis for three more policy-oriented set of measures. The main directions focus both on measures which can be implemented on regional level as well as on measures with a national or even European scope.

Main direction "Common proposal for traffic regulation on transit corridors"

Most MONITRAF regions have introduced regulating measures for HGV road transport which aim at reducing air pollution and noise. All countries have introduced Sunday or weekend driving bans, Switzerland and Austria have in addition introduced a night driving ban (in Switzerland on national level, in Austria for specific motorway stretches in Tyrol). Tyrol, South Tyrol and France have banned high-emission vehicles from the Alpine passages (Euro 0 and 1 are banned from Brenner, Euro 0 from Fréjus and Mont Blanc tunnels), in Italy the municipal administrations can decide on a temporal and/or regional ban of high-emission vehicles. Austria also makes use of speed limits to reduce winter smog and is currently discussing the implementation of a sectoral driving ban with the EU. For safety reasons, some sort of dosing system or regulation on minimum intervals between vehicles has been implemented for all tunnels.

An analysis of existing approaches and a comparison of its impacts has shown that a carefully designed set of these measures can lead to an improvement of air quality. Based on this experience, MONITRAF recommends a set of regional measures with both general and intervention measures.

Night and Sunday driving bans as well as a **ban of high-emission vehicles** should be implemented as general and permanent measures. The ban of high-emissions vehicles leads to a reduction of NO_2 concentrations and soot emissions. Night driving bans can also improve air quality and are crucially for an improvement of noise exposure during resting hours.

- When introducing bans of high-emissions vehicles it has to be ensured that the impact does not get lost when the vehicle fleet is shifting to more efficient vehicles (Thudium 2003). Similar to the example of Tyrol, a dynamic adjustment of the ban of emission categories needs to be implemented (e.g. one year after the introduction of a new Euro category, the next lowest category is banned (Euro 5 displaces Euro 2, Euro 6 displaces Euro 3, etc.)).
- The main objective of night driving bans is a noise reduction for the local population at resting times. In addition, night driving bans also have positive effects on air quality. They need a careful design under the consideration of seasonal and meteorological effects in order to create a win-win situation.. Experience in Tyrol has shown that a too early end of the night driving ban in the morning can lead to an unwanted building up of NO_2 concentrations which then only reduce slowly over the day during stable weather conditions (Landesverwaltung Tirol 2003). It also needs to be closely examined if night bans are only applied on motorways or on the complete road system. The experiences with night driving bans in MONITRAF regions need to be communicated via the exchange within the common monitoring system in order to have a learning-process.

A set of **intervention measures** which are implemented at times of high concentrations/pollution peaks can supplement the permanent measures. Intervention measures could include a flexible use of speed limits as well as an extension of the ban of high-emission vehicles.

- As the example from Tyrol has shown, speed limits can lead to a reduction of air emissions in times with high concentration (Amt der Tiroler Landesregierung 2007). A flexible approach to speed limits would require a well-functioning automated traffic control mechanism connected to air monitoring systems. The air monitoring system would need to include an "early warning" function, in order to prevent the building of peaks. The speed limit should already be applied at a critical concentration and not only after exceeding threshold values.
- In addition to the flexible use of speed limits, an extension of bans of high-emission vehicles might be implemented as intervention measure. For example, during times of critical compensations, the next highest emissions class would also be banned. This however includes a quick and clear communication (similar to "Phase rouge") so that operators can react to this measure.

All regulations on regional level need to be closely coordinated with measures for improving the competitiveness of rail (see main direction "modal shift and internalisation of external costs") in order to prevent a shift of traffic (to

other roads, to other times of the days) and to prevent unwanted effects on air pollution. A direct support of the regional measures on the road could be reached through additional supply of rolling motorways and a subsidy for their usage. Through the interaction of road and rail measures, operators would then have a clear incentive to switch to the rolling motorway.

Main direction "Modal shift and the internalisation of external costs"

Currently, the Alpine Countries have different tolls/charges for HGV. Switzerland has introduced a distance-related heavy vehicle fee in 2001 which sets a financial incentive for shifting from road to rail. The other MONITRAF regions are bound to the framework of the Eurovignette Directive for implementing tolls or charges. Currently, Austria, France and Italy charge motorway tolls as well as specific tolls for the tunnels or Alpine Passages. However, the charges differ considerably with very high tunnel tolls at the French/Italian tunnels and lower tolls at the Brenner motorway. As the Eurovignette Directive does currently not allow the integration of external costs into HGV charges or tolls, existing charges do only represent infrastructure costs.

The following figure presents the tolls/charges for the four most important corridors lying in the MONITRAF project area. The tolls are presented for a standard HGV (Euro 3, 5 axles) carrying 40 tonnes. It can be seen that the tolls vary considerably between the French corridors with the highest tolls – due to the high tunnel tolls – and the Brenner corridor with rather low tolls.

TOLLS FOR MAIN ALPINE ROUTES FOR STANDARD HGV

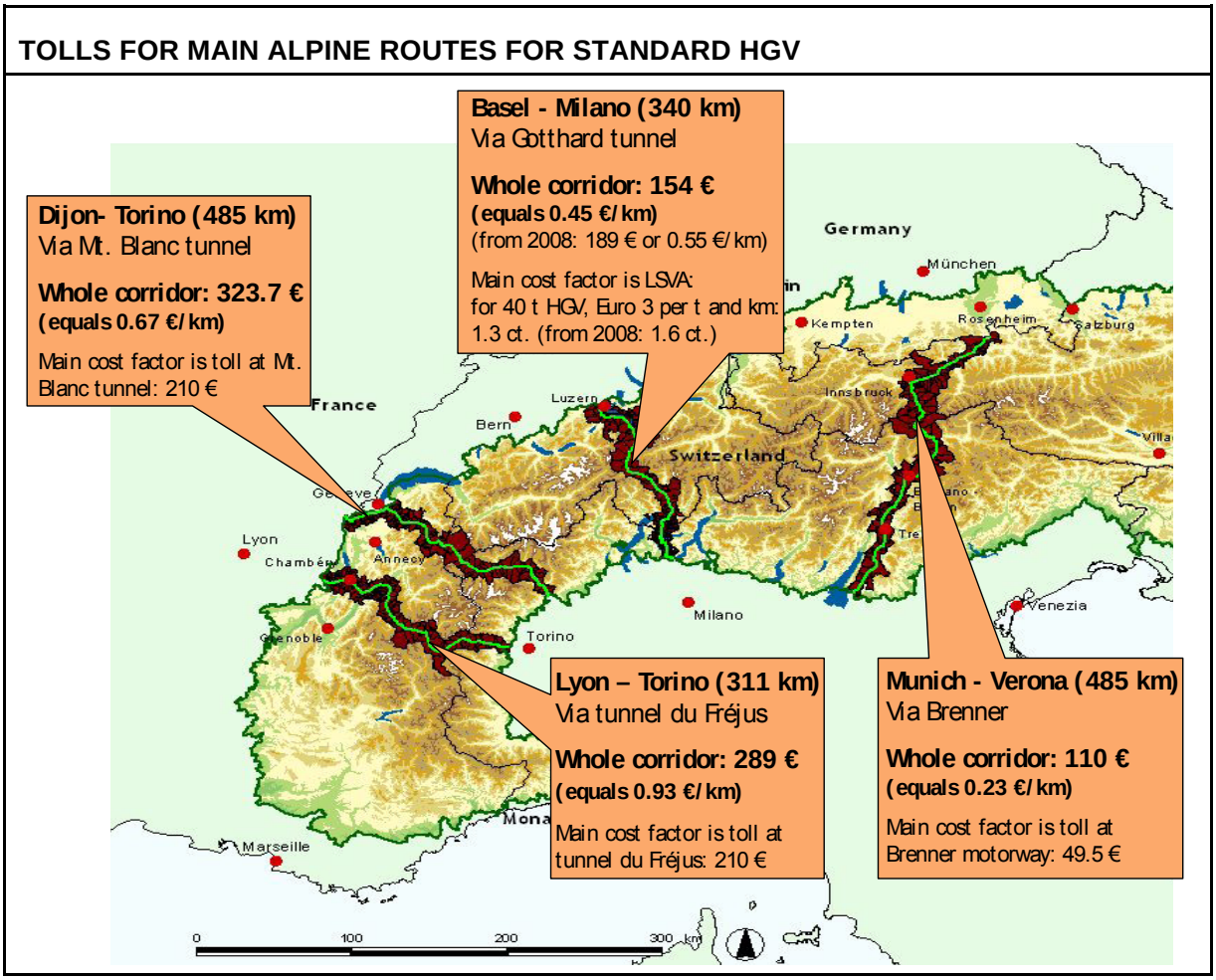


Figure 25: The information shows tolls for a standard HGV (Euro 3, 40 t, 5 axles) as of 01.01.2008. All information excludes value added tax.

The current system of tolls/charges has two major drawbacks. The first is the **missing inclusion of external costs in road charges** which leads to a distortion of prices between road and rail. This is especially true for the sensitive Alpine region where environmental pressures are in general higher than in flat regions and where the same level of pressures leads to higher damages. With the upcoming revision of the Eurovignette Directive, this problem can be resolved and MONITRAF calls for a harmonised surcharge on HGV tolls for higher emissions, noise and accidents in sensitive Alpine regions. Also, the European legislation should allow more flexibility concerning the recycling of revenues (cross-financing).

The second problem which is still unresolved is the **difference (level and structure) in tolls on the Alpine corridors** which leads to an inefficient use of road infrastructure and to diverted traffic and longer distances. A harmonised approach of HGV charging would clearly be preferable and is recommended by the MONITRAF project. The ongoing process to implement these external costs into the EU Eurovignette should lead to increased tolls at least to a comparable level of existing international agreements (e.g the Overland Transport Agreement between Switzerland an the EU). "

However, measures focusing on the road part alone are not sufficient. On the other side, the attractiveness of rail needs to be improved in order to achieve a shift from road to rail. This includes the building of new infrastructure (especially new base tunnels in Switzerland, at the Brenner and Mont Cenis) and financial support to combined traffic to set additional incentives for a modal shift. The experience in Switzerland has shown that a well-designed subsidy scheme for rail transport can effectively support modal shift policy (Interface and RappTrans 2006). Furthermore, a rigorous enforcement of regulations on speed limits, driving times and other social regulations is necessary that rail can reach a competitive advantage over road transport.

Innovative instruments for controlling Alpine freight traffic

The development of transalpine freight traffic over the last years has made clear that regulations or moderate increases of charges or tolls alone are not sufficient to reduce the volume of HGV freight traffic on the road and its environmental impacts. Thus, it needs to be discussed if an innovative instrument is necessary which can limit the overall amount of HGV traffic in the Alps.

With the ecopoint system, Austria had already introduced a measure pointing into this direction. After the system had to be stopped due to pressure from the EU, the idea has been further developed into a cap-and-trade solution which has been presented under the name "**Alpine Crossing Exchange**" by the Alpine Initiative and taken up by both Austrian and Swiss politicians. In Switzerland, the Alpine Crossing Exchange has officially been taken up in the Swiss modal shift policy and two comprehensive studies have been conducted (Ecoplan and RappTrans 2004/ Ecoplan, RappTrans and Moll 2007).

The idea of an Alpine Crossing Exchange has also been taken up on international level and the process of the 'Suivi de Zurich' has commissioned a international feasibility study. MONITRAF has send a proposal with MONITRAF inputs for the description of work to be considered for the Suivi de Zurich study, also stating the wish to support the further discussion on the European level and to bring in the regional perspectives. From a MONITRAF point of view, the international introduction of an Alpine Crossing Exchange is supposed to have a positive cost-benefit balance if negative impacts on the regional economies are prevented through specific regulations for short-distance traffic.

Including the proposal for a common monitoring system, four main directions of common measures are proposed by MONITRAF. The focus of the overall set of main directions is a considerable reduction of transit traffic and its environmental impacts (environmental dimension). Important additional aims are improved accessibility, an economic contribution to the development of the regions in transit corridors (economic and social dimension) as well as a fair distribution of impacts of transit traffic between the Alpine corridors and countries (political dimension). The MONITRAF measures also give the possibility for developing a common voice of Alpine regions with a common approach for implementing super ordinate and comprehensive measures for reducing Alpine transit traffic.

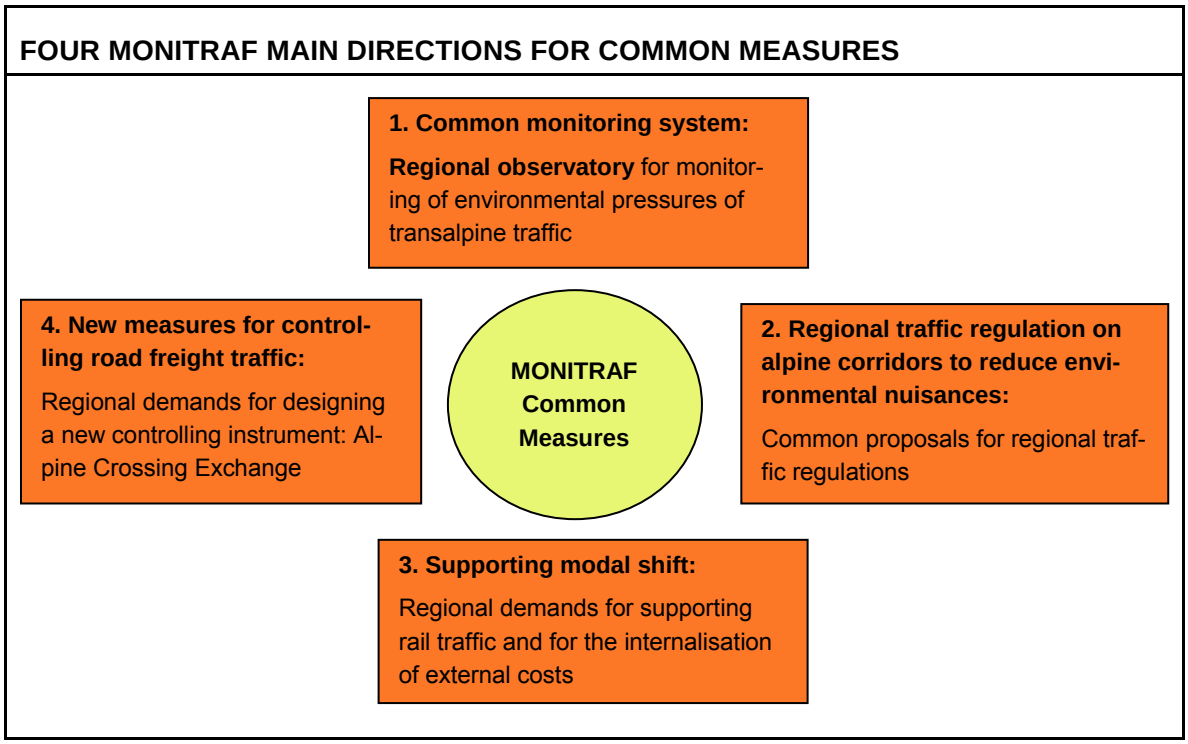


Figure 26 Four MONITRAF Main directions for common measures. Source: MONITRAF 2007

7 NEXT STEPS

Setting the stage

The main directions of the common MONITRAF measures have been discussed intensively with the regional representatives and politicians. A common approach could only be achieved in accord with the regional particularities and the specific situation on competences of each region. Even though some measures have to be taken at a broader and higher political level they also have to be adapted locally in order to be accepted and to be efficient.

It took some time for the fine adjustment but in the end the common MONITRAF measures were summarised into a political resolution. At the final conference in Innsbruck the political representatives of the MONITRAF regions will sign the resolution and will set a signal for the common voice of the Alpine regions.

The MONITRAF resolution is based on the four main directions for common measures. The documents highlights the view of the MONITRAF regions that the cross alpine traffic leads to high environmental impacts and thus to a big burden for the local population and nature. It is pointed out that all MONITRAF regions follow the same objective of reducing the negative effects and aspire the enhancement of quality of life in the regions. As shown in the previous chapter unilateral measures do not lead to the expected results. The resolution reflects this perception and points out the meaning of a common cross Alpine approach. Following the main MONITRAF direction the measures recommended in the resolution include a common monitoring system, regional measures to reduce environmental nuisance, proposals of the improvement of the modal shift situation and the support of the implementation of the Alpine Crossing Exchange as innovative marked-based instrument. A continuous network and cooperation which would support the implementation of the measures is suggested in the resolution. Moreover does the document reflect the importance of the continuation of the MONITRAF activities and the subsequent institutionalisation of a common monitoring system.

With the signature of the resolution it is the first time that the regions engage themselves to take common measures and to support a common and sustainable strategy for the transalpine freight traffic.

Towards a continuous platform of the Alpine regions

An effective as well as efficient set of measures will have to be adjusted over time according to monitoring results and new developments on regional, national and European level. MONITRAF currently acts as a common voice for the most affected Alpine regions but the voice will be lost if MONITRAF is not institutionalised to live on after the official project end. It needs to be ensured that the existing MONITRAF platform is further developed to serve as exchange platform for the regions. The platform should not be restricted to the monitoring data base but should much more serve as Best Practice forum and for an active exchange with experiences on measures. Also, it could be used to formulate common positions, strategies and claims to higher authorities. In order to ensure that the platform does not exclusively exist as virtual space, a yearly conference or workshop could be hosted (rotational in MONITRAF regions). The yearly meeting would produce a MONITRAF year book including monitoring information and the evaluation of measures.

Elements and perspectives of future MONITRAF activities

Activities within the MONITRAF project have made clear that the exchange of Best Practices, ideas and data on transalpine traffic and its impacts between the different Alpine regions is a crucial precondition for developing a common approach. Also, the needs and problems of the Alpine regions can be easier and more effectively communicated with a common and strong voice in order to accelerate political processes. Thus, MONITRAF aims at continuing its activities after the official end of the project and works towards a MONITRAF 2 project.

The following specific objectives are the basis for this prolongation of MONITRAF activities:

- Implementation of the common monitoring system which is proposed as common measure within this report. MONITRAF regions will be responsible for delivering data on environmental indicators in order to obtain a continuous and comparable data set.

- Publication of monitoring data in a yearly report as basis for further developing and improving common measures.
- Further developing the MONITRAF network and extending the network to the Alpine Convention as well as further Alpine regions.
- Establishment of a regional platform to exchange idea and experiences with Best Practices with annual conferences.

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ANNEX 1: COMMON RESOLUTION OF THE MONITRAF PARTNERS

Freight traffic and its impacts are a major challenge for the Alpine countries and requires an international approach in order to prevent distributional impacts. Alpine transit regions are particularly concerned by the necessity to conciliate economic activity and transport on one hand and environmental protection on the other hand. Measures have to be taken at a broader then regional level, but they have to be adapted locally in order to be accepted and to be efficient. The regions Tyrol, South Tyrol, Central Switzerland, Ticino, Piemonte, Rhône-Alpes and Valle d'Aosta have set off the project MONITRAF aiming at the development of a common and sustainable strategy for transalpine freight traffic. It is the first time, that a collaboration within the most affected transit regions across the Alps is taking place. In order to reach the objectives of sustainable development, political representatives from all MONITRAF regions decide to take the following actions:

1. Continuous information platform for monitoring activities

The representatives of the MONITRAF regions will support further activities to establish a continuous platform to monitor transalpine transport and its impacts. This platform shall show the interaction between transalpine transport, environment and the society, provide evidence on the effectiveness of measures, as well as strengthen the role and influence of the Alpine transit regions.

The future monitoring system will build on results of the output of the current MONITRAF project. Most important are

- Establishing permanent indicators to measure the sustainable development in transit regions (e.g. air pollution concentrations, noise levels and meaningful spatial and socio-economic indicators),
- Providing an easy access to regular information across the Alps, elaborated by regional, national and international bodies,
- Enabling a common interpretation of the developments between different corridors.

At the same time the regional platform serves as a vehicle to exchange existing knowledge on the effects of transport nuisances to human health and nature and the effects of transport policy measures. It builds as well bridges to research activities with a similar focus.

The monitoring system developed within the MONITRAF project shall be established and used within a permanent network of partners of Alpine regions. The findings of the monitoring activities should be published periodically and discussed at regular meetings with regional, national and EU representatives involving especially the partners of the Alpine convention.

► For this purpose MONITRAF is seeking a continuation of its monitoring activities on the basis of the MONITRAF results, in order to ensure a permanent exchange at the regional level to give the Alpine transit regions a common voice.

2. Regional claims for a sustainable transalpine transport policy

The monitoring system serves as basis for the further development of a common policy approach and the implementation of an effective set of measures. The representatives of the MONITRAF regions support the following policy directions to decrease nuisances of **transalpine freight** transport:

- The transit regions should be better involved within the national and international discussion to install **effective regional measures to reduce regional environmental nuisances**. Best Practice examples have shown, that namely specific traffic bans (e.g. during the night or specific periods with high concentration levels, for specific vehicle categories and emission classes) have a direct and significant positive environmental impact.
  ► The further exchange of common best practice measures at regional level shall have a high priority in further activities.

- The measures at **national and international level to support the shift from road to rail** should be implemented with high priority, such as the consideration of (high) external costs of sensitive Alpine corridors in the further development of the EU Eurovignette directive and the subsequent harmonisation of transit road charges at a level respecting existing international agreements, the rigorous enforcement of existing regulations, the quick realisation of the TEN corridors at Mont Cenis and Brenner axis (based on existing decisions) and the prolongation of the NEAT-infrastructure as well as an increased support of combined transport to make it more attractive and competitive. This should include financial, logistic, qualitative and infrastructural measures. The promotion of the rail alternative shall be enforced by improved cross financing possibilities from road to rail.
  ► The MONITRAF regions will elaborate a common consultation on the expected recommendations on the further development of the EU-Eurovignette directives and the consideration of external costs.
- The **introduction of new and innovative market based measures** such as a well coordinated Alpine Crossing Exchange to reduce environmental emissions should be evaluated further. The representatives support the intentions of the process of ‚suivi de zurich' to launch an international feasibility study on best research of traffic management systems for transalpine freight transport. This study should consider important regional goals and preconditions such as a significant contribution to reduce environmental nuisances, no diversion between Alpine corridors and no discrimination of short distance regional transport in the Alpine regions.
  ► MONITRAF regions expect to be involved in the further elaboration of the study on best research of traffic management systems and want to bring in their regional views and experience.

The MONITRAF regions will contribute to these efforts by supporting regional measures to reduce the nuisances of **regional passenger transport** and by offering alternatives to motorised individual transport. The regional potentials due to the high level of accessibility for passenger transport in transit regions should be increased in order to maximise regional benefits.