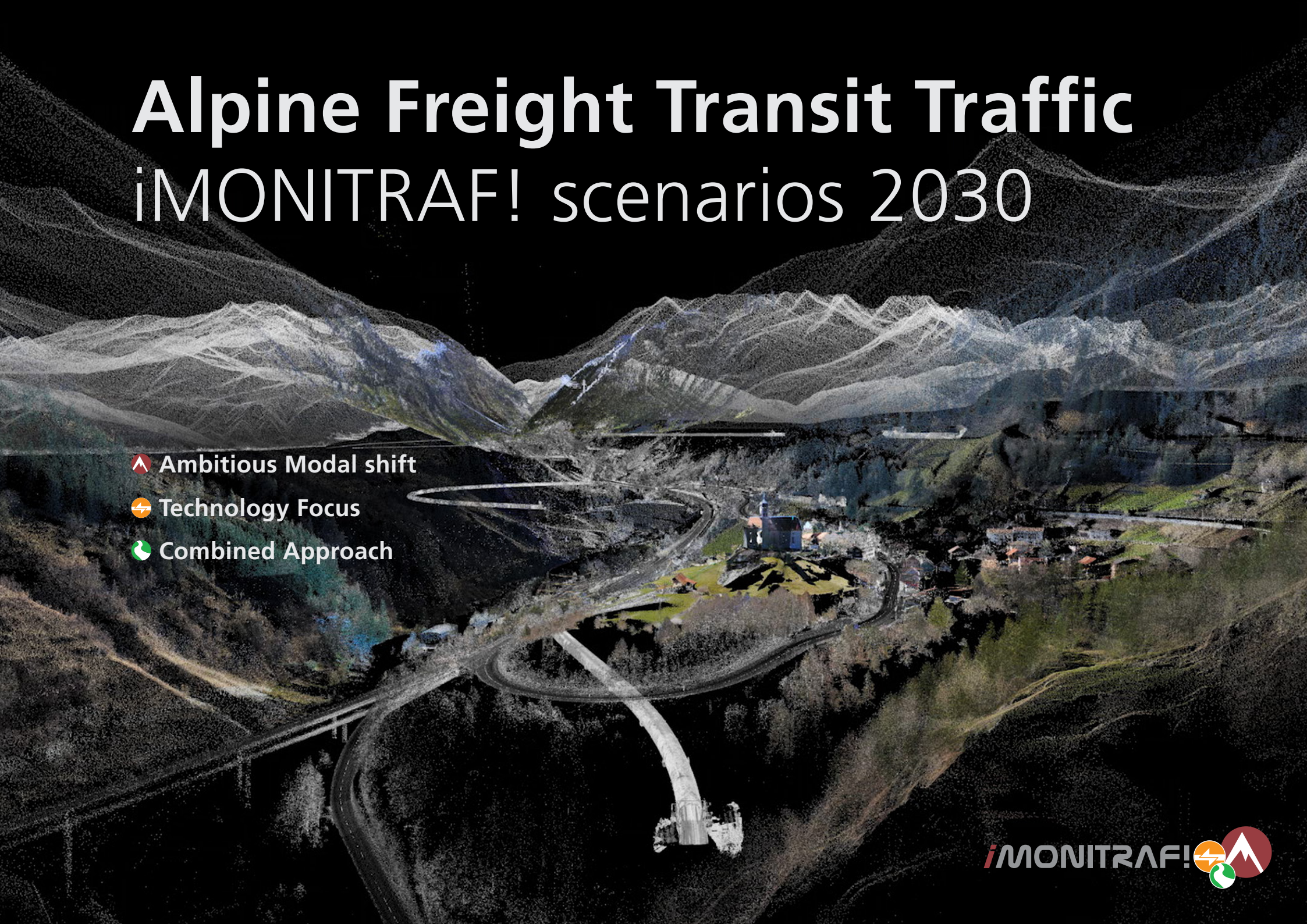
Alpine Freight Transit Traffic

iMONITRAF! scenarios 2030



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iMONITRAF! – Network of the Alpine regions

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Cover page

Punktwolkenvisualisierung der Gotthardtransit-Infrastrukturen,
Professur für Landschaftsarchitektur Christophe Girot, ETH Zürich
www.lvml.net

Joining forces for sustainable Alpine transport

iMONITRAF! is a network that brings together the Alpine regions along the major transit corridors. Individual policies have shown limited success in reducing negative impacts of transalpine traffic. Hence, the Alpine regions have acknowledged the need to work together, to develop joint and coordinated solutions to reduce the impacts of transalpine traffic. Launched under the Alpine Space Programme in 2005, iMONITRAF! has become a "Best Practice" project for political involvement, for technical exchanges and networking and for giving a common voice to the Alpine regions with respect to decision making processes at national, macroregional and European level.

A sound knowledge base as key to effective policy making

As basis for their work, project partners from the affected Alpine transit regions developed the common monitoring system as evaluation instrument to visualise and interpret the effects of Alpine transport. The common Transport Strategy (2012) defines common environmental and transport targets to meet the challenges of growing traffic volumes and proposes a set of policy measures supporting harmonization between the corridors – building on modal shift as major objective. Toll Plus, as mechanism to improve and harmonize road pricing on the Alpine corridors, became the first instrument for in-depth investigation and iMONITRAF!'s activities for pushing this mechanism forward on EU level can be seen as showcase for effective networking activities. Also, the network is at the pulse of future technological innovation, recognising that technology-driven trends have the potential to lead to considerable impacts on the competitive situation between road and rail.

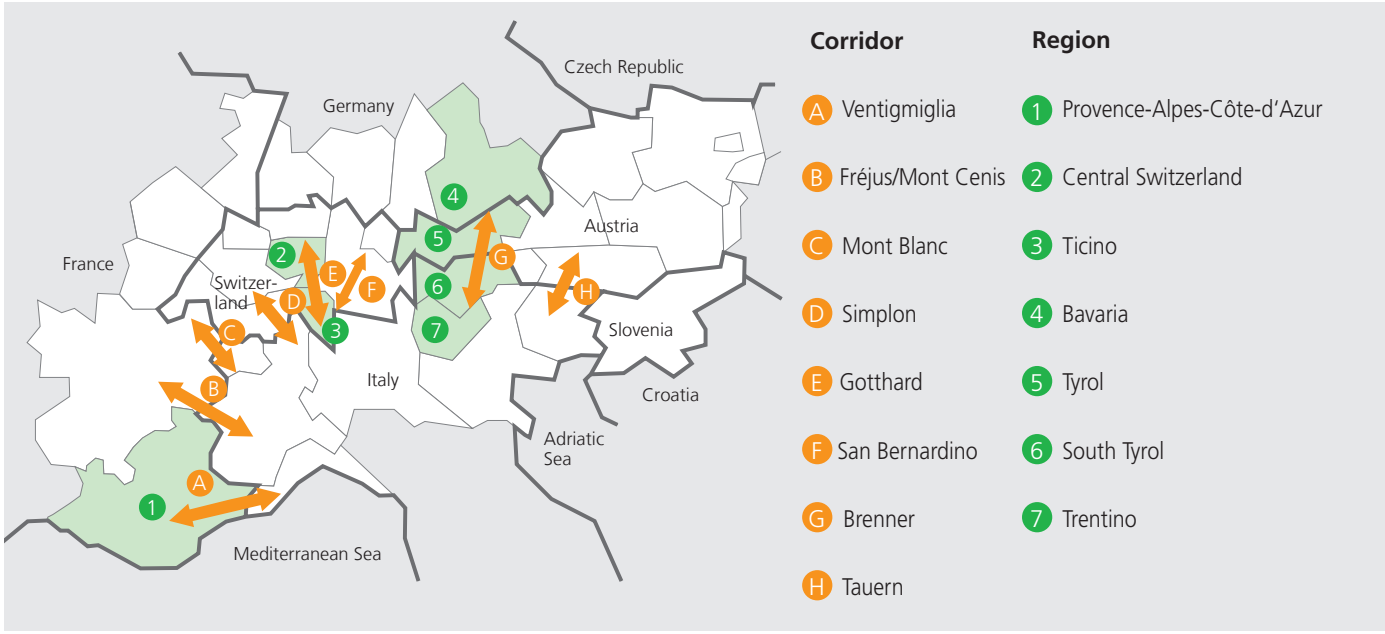

Figure 1: The project focuses on eight Alpine corridors and seven Alpine regions in five countries (France, Italy, Austria, Switzerland, Germany).

The role of scenarios for iMONITRAF!'s approach

DPSIR indicator system as decision making tool

Policy scenarios are an effective tool for guiding strategic discussions on common targets and instruments to reduce the impacts of freight transport in the Alps. Based on insights of the monitoring system and evaluations of potential instruments, iMONITRAF! has defined a common target system as well as a set of policy instruments in its Transport Strategy.
To illustrate the potential effects of these instruments on traffic volumes and the environment up to 2020, a simple evaluation scheme based on the DPSIR approach was developed in 2012 to serve as decision making aid to the transport strategy. It defines a number of specific indicators:

- traffic volumes (D = driver)
- emissions of air pollutants and greenhouse gases (P = pressure)
- ambient air quality (S = state)
- emissions of noise (I = impact)
- combined effects (R = response)

The need for updated scenarios

Eight years later, road traffic numbers however keep on rising and new topics have moved to the top of iMONITRAF!'s agenda: technological change both on road and rail is faster than anticipated and the objective of decarbonisation of transport has gained importance. Therefore, an update of the scenarios for the timeframe 2030 and a modification of the indicator system to better illustrate climate mitigation efforts is now presented.

Reference case and new scenarios

As some of the targets are not specified for the 2030 timeframe, the policy scenarios take a new approach and start from a Reference scenario 2030, which is derived from today's situation. In addition, three policy scenarios which consider different rationales are assessed and compared with the reference case:

- Modal shift scenario: assuming a very ambitious modal shift policy, making use of push and pull measures
- Technology scenario: assuming an accelerated market diffusion of alternative technologies
- Combined scenario: combining the positive aspects of both approaches

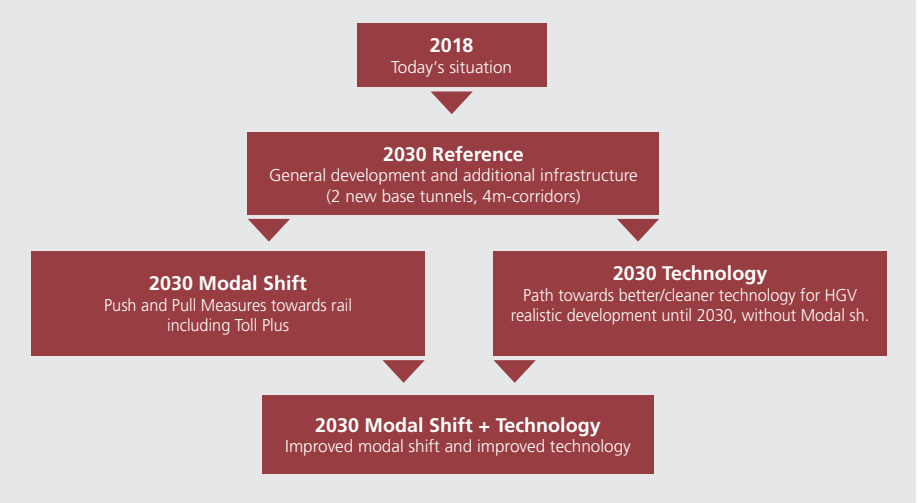

Figure 2:
In addition to the Reference scenario 2030, two scenarios "Modal shift" and "Technology" and their combination are assessed with the DPSIR approach

Traffic modelling to define the reference case

By means of a model for transalpine freight transport for the Alpine Arc between Ventimiglia and Tarvisio the 2030 Reference scenario is derived in a four-step approach, based on 2018 data:

1. Past development shows a very strong correlation between Italian foreign trade and freight transport over the Alpine Arc B. Country-specific trade projections for Italy are translated into total transalpine freight projections for 2030.
2. The overall volume of freight transport is broken down to the level of transalpine relations, taking into account region-specific developments (infrastructure).
3. Freight volumes per relation are allocated to available transport modes, based on a cost-comparison approach (see figure 3).
4. The modal freight traffic volumes per relation are allocated to the transalpine corridors.

The model determines the number of transalpine HGV (road) and transalpine tonnage (road and rail). The numbers provide the driver indicator (D) for road and rail freight transport (differentiated into rolling motorway, unaccompanied combined transport, wagon load transport).

Transport costs road Bavaria ► Lombardy via Brenner

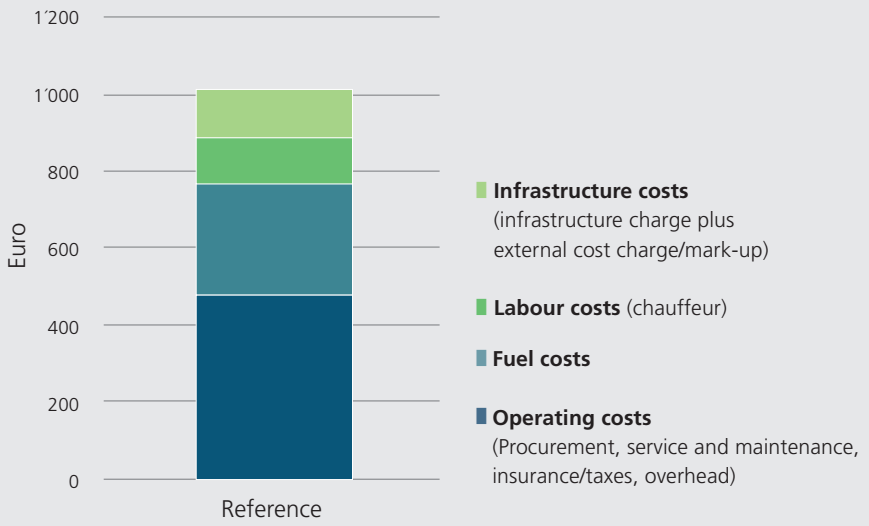

Figure 3:
Illustration for road transport costs for the relation Bavaria – Lombardy via Brenner in the Reference scenario.

Challenges remain high despite favourable infrastructure development

The Reference scenario 2030 assumes that the current policy mix is maintained and that rail infrastructures are developed with an ambitious timeframe: the base tunnels at Brenner and Mont Cenis are finalised and the 4m-corridor is fully developed on all corridors with base tunnels. Otherwise no additional action to develop the access routes and terminals on the rail corridors and no additional policy actions are assumed. Technological change will lead to a modest reduction of CO_2 and PM10 emissions of HGV and a strong reduction for NO_x emissions – but without any additional incentives the fleet modernisation won't go beyond EURO VI.

The new railway infrastructures are finalised in this scenario: modal shift is improved and environmental burdens related to road transport are reduced. But without any additional action, the new railway capacities are not fully used and environmental pressures remain a challenge.

Only slight relief for human health and the environment

The DPSIR indicators in this Reference scenario take a favourable development, but challenges remain with respect to air quality and climate change:

- Driver: Due to new high-speed capacities offered by the base tunnel infrastructures on Fréjus/Mont Cenis, Gotthard and Brenner, additional transport demand can be absorbed by rail transport. Transalpine HGV volumes are slightly reduced on Fréjus, Brenner and Tauern and increased on Ventimiglia and Gotthard corridors (see page 7).
- Pressure: Due to the shift to cleaner and more efficient vehicles – only EURO VI HGV will operate by 2030 – specific emissions of CO_2 eq, NO_x and PM10 are reduced in the reference case.
- State: Ambient air concentrations of NO_2 and PM10 follow the general decrease of traffic emissions. For NO_2 they are more pronounced than for PM10 since PM10 emissions from abrasion processes are higher than exhaust emissions. However, also emissions from non-road and stationary sources will decrease until 2030 intensifying the decrease.
- Impact: The noise index follows traffic numbers. Where the number of transalpine HGV or transalpine freight trains increase, also the noise index will rise and vice versa.
- Modal split: Due to the new base tunnels and 4m-corridors modal split is increased on all corridors except Ventimiglia.

Figure 4: Freight train approaching the portal of the Gotthard base tunnel

	Corridor	2030 (Reference) mio HGV/yr	1000 freight trains/yr
	Ventimiglia	1,88	0,90
	Frejus/Mt.Cenis	0,77	9,8
	Mont-Blanc	0,64	---
	Simplon	0,09	21,5
	Gotthard	0,86	47,2
	San Bernardino	0,18	---
	Brenner	2,36	27,1
	Tauern	1,09	95,1

Table 1:
Number of heavy goods vehicles (HGV) and freight trains 2030 per corridor

Interpretation of freight transport development up to 2030

As in the present situation, Brenner remains the corridor with the highest freight transport volumes also in 2030. For the Gotthard, a strong increase of freight transport is expected until 2030 due to the growing importance of the relations from Netherlands, Belgium and northern Germany to Lombardy and Piemonte (ports in Le Havre, Antwerpen, Rotterdam and the German North Sea ports expect growth rates of more than 60% until 2030, Genova and Livorno even higher). This also happens, albeit to a lesser extent, to the Fréjus, Mt. Cenis, Mt. Blanc corridors. For eastern Europe, economic activities are expected to stagnate. Whereas freight tonnages (road and rail) are projected to increase more than 20% on the western corridors, they are stagnating on the eastern corridors. Compared to the present state, the modal split will be increased at Mt. Cenis and Brenner thanks to the new base tunnels and on Gotthard due to the 4-m-corridor.

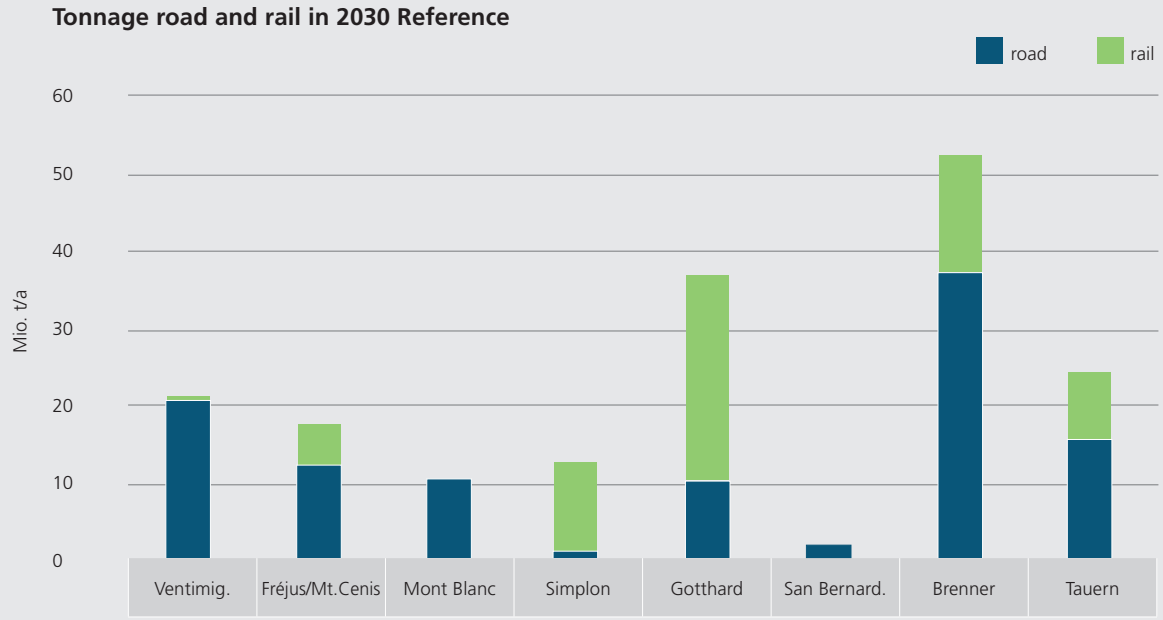

Figure 5:
Freight tonnages per corridor for road and rail 2030 in the Reference scenario. 30% of the total tonnages pass over the Brenner corridor, 20% on the Gotthard. Modal splits are very high at Simplon and Gotthard. Note that 2030 projection stem from 2019. Meanwhile, the COVID-19 crisis led to reduced freight transport volumes in spring and early-summer 2020. A slow recovery can be observed since then. It is expected that this drop in traffic numbers has little effect on the long-term perspective 2030. Also note that the DPSIR scheme focuses on the relative change of indictors with regard to the Reference scenario (and not on absolute indicator values).

Modal shift scenario

Modal Shift to make full use of new railway capacities

In the Modal shift scenario, impacts of transalpine transport are reduced through a reinforced modal shift policy. The policy mix implemented in this scenario builds on iMONITRAF!'s set of common measures and the recommendations developed by the network:

- Toll Plus as targeted pricing mechanism for the Alpine corridors is implemented in an ambitious approach. Toll rates are increased by 21 €ct/vehicle km on Ventimiglia, Fréjus/ Mont Cenis, Mont Blanc, Tarvisio and by 25 €ct/vkm on Brenner corridor. On the Swiss corridors, the HGV fee (LSVA) is continued.
- Subsidies for CT are maintained and further developed in this scenario, providing financial support to services and infrastructures
- Thanks to the possibility of cross-financing of Toll Plus revenues, Rail infrastructures are developed beyond the assumptions in the reference case: access routes along the corridors are improved and terminal capacities are increased such that 0.2 Mio HGV per year (Fréjus/ Mt. Cenis) and 0.3 Mio HGV per year (Brenner) are shifted from road to rail.

Accelerating modal shift requires ambitious common efforts of all Alpine regions and states: a transparent financial framework and support system is necessary to improve the level-playing field between road and rail transport and to ensure that the new railway capacities are effectively used.

Positive environmental effects – but flanking measures are needed

Additional modal shift efforts improve most of the indicators of the DPSIR approach:

- Driver: The ambitious policy approach leads to an increased modal shift: road transport volumes are considerably reduced in this scenario, especially on the corridors with new base tunnels (Mont Cenis and Brenner).
- Pressure: Emissions of NO_x, PM10 and CO_2 also develop in a very favourable direction, with "desired" effects on most of the corridors and "good" effects on Brenner and Mont Cenis. Only the Tauern corridor moves in an "undesired" direction, it is the only corridor where road traffic volumes keep on the rise.
- State: Reduced emission levels also lead to an improvement of air pollutant concentrations but effects are less pronounced due to other emitting sources which also have an impact. Limit values are reached at most of the measurement sites but some critical sections remain.
- Impact: Road noise emission indices decrease along all corridors. However, the rail noise indices increase along the railway lines. That is the main challenge of this scenario: It requires a strong support for additional noise abatement measures, as already claimed by the iMONITRAF! regions.
- Response: Modal shift increases significantly, all corridors with rail alternatives see a positive development.

Main developments in the Modal shift scenario compared with the Reference scenario (2030)

Modal shift scenario vs. Reference									
Indicators		**Corridors**							
		Ventimiglia	Fréjus/MC	Mont Blanc	Simplon	Gotthard	S.Bernardino	Brenner	Tauern
Driver (Traffic)	HGV	-0,3%	-29,2%	-2,9%	-4,8%	-6,1%	-4,7%	-18,3%	1,5%
	Freight trains	7,7%	72,7%	no trains	3,3%	6,3%	no trains	37,8%	7,0%
Pressure (Emission)	CO_2eq	-0,3%	-29,2%	-2,9%	-4,8%	-6,1%	-4,7%	-18,3%	1,5%
	NO_x	-0,3%	-29,2%	-2,9%	-4,8%	-6,1%	-4,7%	-18,3%	1,5%
	PM10	-0,3%	-25,3%	-2,9%	-1,4%	-4,3%	-4,7%	-16,4%	1,7%
State (Concentration)	NO_2	-0,1%	-10,3%	-0,7%	n.a.	-1,2%	-0,6%	-4,5%	0,4%
	PM10	-0,1%	-9,2%	-0,6%	n.a.	-1,1%	-0,5%	-4,0%	0,3%
Impact (Noise index - Δ dB(A))	Road	0,0	-1,4	-0,02	-1,2	-0,4	-0,1	-0,9	0,0
	Rail	0,2	2,4	no trains	0,2	0,3	no trains	1,5	0,3
Response (%-points)	Modal Split	0,2%	22,0%	n.a.	0,5%	2,4%	n.a.	12,1%	-2,1%

Table 2:
Percent numbers give the change of the indicators in the Modal shift scenario compared to the Reference scenario.

HGV heavy goods vehicle
CO_2eq carbon dioxide equivalents
NO_x nitrogen oxides
PM10 particulate matter (smaller 10 micrometers)
NO_2 nitrogen dioxide
dB(A) decibel

- low change
- good
- desired
- undesired
- not good

Technology scenario

Technological improvements to decarbonise road freight

This scenario illustrates the potential of accelerated technological change of road freight transport with speeding-up decarbonisation of the vehicle fleet. An ambitious Toll Plus approach, differentiated according to CO_2 classes as called for by iMONITRAF!, and a set of targeted regulatory measures can trigger this process to ensure that the cleanest vehicles are used in the sensitive Alpine environment. In comparison to the reference case, a significant share of vehicles uses alternative fuels (natural gas) or hybrid solutions, and electric solutions start to become available for long-distance transport in this optimistic Technology scenario.

The decarbonisation strategy brings along ambivalent effects for the Alpine corridors: greenhouse gas emissions and local air pollutants are effectively reduced but traffic volumes and thus noise levels remain high. There are no additional incentives to use the new railway capacities.

The decarbonisation of the fleet affects pressure and state indicators

In comparison to the Modal shift scenario, the Technology scenario leads to a more harmonized picture for all corridors, as the same vehicle mix is assumed. Technological change leads to lower specific emissions of the vehicle fleet, improving air quality along all transit corridors in a similar way:

- Driver: Traffic volumes remain unchanged compared to the Reference scenario.
- Pressure: CO_2 emissions are reduced by 12% and NO_x emissions by 21% on all transit corridors compared to the Reference scenario, due to lower emissions of vehicles powered by natural gas and the incoming share of electric vehicles. The reduction of PM10 is less pronounced as non-exhaust emissions remain unchanged by technological change.
- State: Lower emissions also lead to an improvement of ambient air quality, all corridors move in a "desired" or "good" direction in this Technology scenario. Limit values are reached at most of the measurement sites but some critical sections remain.
- Impact & Response: Noise levels are not affected, as this scenario assumes that technological change has no effect on noise of HGV and freight trains. Similarly, modal shift as response function remains unchanged compared to the Reference scenario.

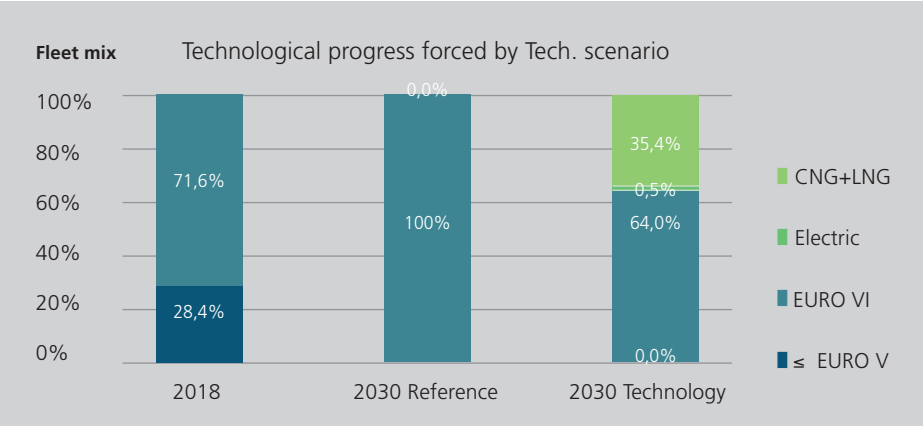

Figure 6: Technological improvement of HGV fleet: shares of Diesel vehicles (EURO V and VI), natural gas (CNG & LNG) and electric drivetrains in the scenarios

Main developments in the Technology scenario compared with the Reference scenario (2030)

Technology scenario vs. Reference									
Indicators		**Corridors**							
		Ventimiglia	Fréjus/MC	Mont Blanc	Simplon	Gotthard	S.Bernardino	Brenner	Tauern
Driver (Traffic)	HGV	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
	Freight trains	0,0%	0,0%	no trains	0,0%	0,0%	no trains	0,0%	0,0%
Pressure (Emission)	CO_2eq	-11,9%	-11,9%	-11,9%	-11,9%	-11,9%	-11,9%	-11,9%	-11,9%
	NO_x	-21,0%	-21,0%	-21,0%	-21,0%	-21,0%	-21,0%	-21,0%	-21,0%
	PM10	-0,4%	-0,4%	-0,4%	-0,2%	-0,3%	-0,4%	-0,4%	-0,4%
State (Concentration)	NO_2	-20,6%	-18,3%	-17,3%	n.a.	-22,6%	-21,3%	-19,3%	-21,1%
	PM10	-1,1%	-5,9%	-6,9%	n.a.	-5,5%	-5,7%	-6,2%	-5,8%
Impact (Noise index - Δ dB(A))	Road	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
	Rail	0,0	0,0	no trains	0,0	0,0	no trains	0,0	0,0
Response (%-points)	Modal Split	0,0%	0,0%	n.a.	0,0%	0,0%	n.a.	0,0%	0,0%

Table 3:
Percent numbers give the change of the indicators in the Technology scenario compared to the Reference scenario. The Technology scenario only affects the indicators Pressure and State of our DPSIR approach

- low change
- good
- desired
- undesired
- not good

Combined scenario

Modal shift and Technology scenario

A comprehensive strategy, focusing on both the modal shift rationale and the decarbonisation of road transport, combines the positive aspects of both approaches. In this Combined scenario, the new capacities of the railway base tunnels are effectively used and road transport is reduced in comparison to the Reference scenario. As policy instrument, Toll Plus plays a crucial role in this combined strategy: ambitious toll levels incentivize the shift from road to rail and the differentiation according to CO_2 classes ensures that the remaining vehicle fleet uses the best-available technologies. The ambitious approach on Toll Plus requires additional action of iMONITRAF!, to ensure that the new provisions of the Eurovignette as relevant European framework are implemented at national level and that the idea of a combined approach is also considered in the revision process of the Swiss HGV fee.

The Combined scenario shows that iMONITRAF!'s comprehensive policy-approach is the way forward: modal shift from road to rail and decarbonising the remaining vehicle fleet can be achieved with the help of Toll Plus – but strong efforts for its implementation are still needed.

Figure 7: On the Gotthard corridor, road and rail infrastructures are already optimised. The new highspeed railway line takes a central position. (Source: AlpTransit Gotthard AG)

Less HGV traffic remains common rationale

The Combined scenario illustrates that an effective improvement of the DPSIR indicators is only possible with a reduction of overall HGV transport volumes. This confirms the existing strategy of iMONITRAF! and illustrates that the measures as proposed in the common strategy of 2012 are still valid:

- Driver: In the combined approach, traffic volumes shift from road to rail, the new base-tunnels have the desired effects.
- Pressure: Emissions of greenhouse gases and local air pollutants can be reduced in an effective way, especially NO_X emissions come down to a sustainable level.
- State: Reductions of HGV due to modal shift and technological improvements to reduce emissions reinforce each other so that air quality reaches the best state in the Combined scenario. The effect is stronger for NO_2 than for PM10.
- Impact & Response: With respect to noise emissions, the Combined scenario has the same effects as the Modal shift scenario. Road noise emission indices decrease and rail noise indices increase along the corridors. The increase of rail noise can be compensated by additional measures (e.g. noise barriers, low-noise rolling stock and rail tracks), that have to be integrated as flanking measures when moving towards higher modal splits.

Main developments in the Combined scenario compared with the Reference scenario (2030)

Combinded Modals shift and Technology scenario vs. Reference									
Indicators		**Corridors**							
		Ventimiglia	Fréjus/MC	Mont Blanc	Simplon	Gotthard	S.Bernardino	Brenner	Tauern
Driver (Traffic)	HGV	-0,3%	-29,2%	-2,9%	-4,8%	-6,1%	-4,7%	-18,3%	1,5%
	Freight trains	7,7%	72,7%	no trains	3,3%	6,3%	no trains	37,8%	7,0%
Pressure (Emission)	CO_2eq	-12,2%	-37,6%	-14,5%	-16,2%	-17,3%	-16,1%	-28,0%	-10,6%
	NO_x	-21,2%	-44,1%	-23,3%	-24,8%	-25,8%	-24,7%	-35,4%	-19,8%
	PM10	-0,7%	-25,6%	-3,3%	-1,6%	-4,6%	-5,1%	-16,7%	1,3%
State (Concentration)	NO_2	-25,5%	-29,1%	-20,5%	n.a.	-29,8%	-29,1%	-26,8%	-25,8%
	PM10	-1,3%	-15,1%	-7,5%	n.a.	-6,7%	-6,3%	-10,3%	-5,6%
Impact (Noise index - Δ dB(A))	Road	0,0	-1,4	-0,0	-1,2	-0,4	-0,1	-0,9	0,0
	Rail	0,2	2,4	no trains	0,2	0,3	no trains	1,5	0,3
Response (%-points)	Modal Split	0,2%	22,0%	n.a.	0,5%	2,4%	n.a	12,1%	1,2%

Table 4:
Percent numbers give the change of the indicators in the Combined scenario (Modal shift and Technology) compared to the Reference scenario.

- low change
- good
- desired
- undesired
- not good

Joint efforts are needed more than ever

The new policy scenarios illustrate the need for an ambitious policy approach, coordinated between and along the transalpine transit corridors. The new rail infrastructures will need additional efforts and measures to be put in place, otherwise traffic volumes on the road remain above an environmentally compatible level. iMONITRAF! has already laid the foundations for a common policy mix to accelerate both modal shift and technological change, but additional action to overcome the implementation gap is still necessary.

iMONITRAF! has already laid a sound foundation for further common action: the network is "small but powerful" and has gained valuable insights on rising the common voice at national and EU level.

Moving forward with common measures

The recent activities of iMONITRAF! with respect to Toll Plus provided a showcase on how in-depth investigations and intensive networking can pay off: the claims of the network were effectively heard at EU level and taken up in the revision process of the Eurovignette Directive. iMONITRAF! can build on this experience when moving forward with additional measures:

- Toll Plus and a full implementation of the Eurovignette Directive remains a focus, additional efforts are needed to ensure that new provisions of the EU framework are implemented in the Alpine countries.
- Support systems for combined transport are a key element to reach high modal shift levels and iMONITRAF! will strengthen its know-how on potential measures.
- Bringing low- or even zero-emission HGV onto Alpine motorways requires additional incentives and iMONITRAF! regions will continue their exchange on potential measures.
- iMONITRAF! partners will further investigate the potential of additional steering instruments (e.g. Alpine Crossing Exchange).

Strengthening the knowledge hub

To support its policy activities, iMONITRAF! also needs to further develop and strengthen its expertise and data source:

- The common monitoring network of iMONITRAF!, as widely recognized knowledge source, will be further developed.
- The exchange of Best Practices – as summarized in iMONITRAF!'s Annual Reports – is continued to get further insights on developing common measures.
- iMONITRAF! will further develop its role as knowledge hub for other networks & institutions, especially it will ensure that the position of the most affected Alpine transit regions is considered in discussions at national and European level as well as within the macroregional strategy EUSALP.
- iMONITRAF! will closely analyse the impacts of the COVID-19 crisis on the alpine freight transport system. Chances that arise in the wake of Corona recovery programmes shall be used in a coordinated approach. The close integration into the EU Green Deal offers a new window-of-opportunity.

Recognising the importance of the common voice of the Alpine regions for an effective transport strategy, the network of iMONITRAF! shall continue its fruitful cooperation – building on its success factors and lessons learned and, at the same time, opening up for new approaches and ideas.

Herbert Dorfmann
Member of the European Parliament

As the Alpine regions along the major transit corridors suffer considerably from increasing traffic volumes, their needs and characteristics should find specific consideration in the design of relevant European legislation. iMONITRAF! has established a common voice of those regions and a strong reputation on Alpine transport policy. The network's actions on the Eurovignette Directive have showcased its expertise and willingness to influence the relevant decision making process at EU level. I am glad that we can draw on iMONITRAF! to find tailor-made solutions that support the modal shift from road to rail in transalpine freight transport.

Ingrid Felipe
Deputy Governor and Provincial Minister for Mobility, Tyrol

From my perspective, iMONITRAF! stands for close cooperation and solidarity between the involved Alpine regions for the achievement of their common objectives: the promotion of a shift to rail, the expansion of the polluter-pays principle, and the harmonization of measures to reduce the negative effects of traffic on people, nature and infrastructure.

Daniel Alfreider
Deputy Governor and Provincial Minister for Mobility, Autonomous Province of Bolzano - South Tyrol

iMONITRAF! is a showcase example of cross-border cooperation between regions along the most important Alpine transit corridors. Traffic monitoring is one of the concrete results and an important reference point for the implementation of future joint projects leading the way to a sustainable transport policy in the Alpine Space.

Dimitri Moretti
Member of the Cantonal Government, Canton of Uri

Protecting the sensitive mountain region from negative impacts of transit traffic can only work effectively if the affected regions coordinate their efforts in a common approach. iMONITRAF! is the established platform for this coordination – thanks to this network the transit regions can profit from an exchange of experiences and can raise their common voice to protect the Alps.

Further information
Background documents (download from www.imonitraf.org → publications):

- Monitoring system, implemented in the Platform of Knowledge
- iMONITRAF! Resolution on Toll Plus 2016, In-depth analysis on Toll Plus Scenarios. Options for regional transport within Toll Plus
- iMONITRAF! Report on Innovative Technologies 2018
- iMONITRAF! Annual Reports 2013 - 2019

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