Annual Report 2024

Strengthening the common instrument mix for Modal shift on the Alpine corridors

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iMONITRAF! Annual Report 2024

Strengthening the common instrument mix for modal shift on the Alpine corridors

INFRAS / Climonomics / Eurac Research with inputs of iMONITRAF! partners

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iMONITRAF! network – A platform for the most affected transit regions

iMONITRAF! continues to unite the Alpine regions along the major transit corridors to address the pressing challenges of transalpine traffic. Since its inception under the Alpine Space Programme in 2005, iMONITRAF! has evolved into a pivotal plat-form for developing coordinated and effective transport strategies. The network fosters collaboration among policy makers and technical experts to devise and implement joint solutions.

The network's strength lies in its ability to act as the unified voice of the most affected transit regions, advocating for sustainable transport solutions at national, macroregional, and European levels. By bringing together key stakeholders, iMONITRAF! not only addresses environmental and social impacts but also drives forward joint policy initiatives that ensure the long-term sustainability of transalpine transport.

Combined Transport Work Focus 2024 - Insights and recommendations

In light of the ongoing revision of the EU Combined Transport Directive, iMONITRAF! developed a joint typology on measures to effectively support CT. A discussion paper includes recommendations for decision makers at EU level, ensuring that the new toolbox of the CT Directive considers lessons learned in the Alpine regions. The discussion paper highlights that effective solutions to support CT require a balanced approach of push and pull measures. Significant funding for infrastructure and operations is essential to make CT more attractive and accessible. To maintain effectiveness and to adjust the framework to infrastructure upgrades and developments along the transit corridors, a continuous evaluation and adjustments of the policy frameworks are crucial. Coordinated efforts are also vital for testing new technologies and digital solutions.

A revised European framework for CT should incorporate these insights. Specifically, the toolbox as included in the Commission proposal on the revised CT Directive should take an integrated approach – the typology developed by iMONITRAF! could be used as example. Support measures for CT as well as the use of digital solutions only become effective if they are coordinated on the whole corridor. Therefore the new National Policy Frameworks of the CT Directive should also be coordinated at the level of the TEN-T corridors.

EU level: Ensuring that the new EU framework supports modal shift

With a view to improving environmental quality along the iMONITRAF! corridors, a major milestone was reached with the EU Council approving the new EU air quality standards for 2030 – introducing stricter limits on key air pollutants. In addition, the different elements of the Greening Freight Package were further discussed. With the EU elections in view, the first few months of 2024 saw a considerable dynamic around the dossiers of the Greening Freight Package, especially with the discussion of the Weights & Dimensions Directive in the European Parliament. iMONITRAF! participated actively in the decision making process with its joint statement that raised some Alpine claims to be considered in the revision process. Also the other elements of the Greening Freight Package found broad attention and many stakeholders worked on proposals for finetuning and better interlinking the different dossiers. The EU Council ratified the revised CO_2 standards for trucks in May 2024, expanding the scope to cover almost all trucks, urban

buses, and trailers. The revision of the Combined Transport Directive progressed with discussions at the EU Council level. Key issues include the definition of combined transport, use of digital platforms for verifying eligibility, national policy frameworks, and exemptions from driving bans. iMONITRAF! continues to collaborate with EU partners to ensure the revision process benefits the iMONITRAF! objectives of modal shift.

Monitoring update for the year 2023 – trends stabilise on pre-pandemic levels

First rebounds of HGV volumes after the effects of the COVID pandemic were already observed in the previous years. For the monitoring year 2023, traffic volumes have stabilised on pre-pandemic level with traffic numbers very close to the previous year 2022. About **24,350 heavy vehicles per day** (HV/day) crossed the seven major transalpine corridors, nearly the same figure reached in 2022 (-0.1% overall). For **light vehicles**, the increasing trend even continued, with approx. 86,200 vehicles/day, i.e. +3% compared to 2022, and +5% compared to 2019 (before the Covid-19 pandemic).

Transported goods on the iMONITRAF! corridors in 2023 sum up to a total of about 157 mio. tons. Compared to 2022, overall transported tons have decreased by 5% . This decrease is more evident for rail (-11%) than for road (-2%). In 2023, 108.6 mio. tons were transported by road (69%) and 48.7 mio. tons by rail (31%), representing a decrease of overall rail share by 2% compared to 33% in 2022. The **annual air pollutant concentrations** of NO_2 show a further decreasing trend: Compared to 2022, 14 out of the 16 active monitoring stations register a decrease of NO_2 concentrations, while the remaining two (Ora and Oberaudorf along the Brenner) maintain the same values of 2022. The NO_2 values do not exceed the EU annual limit of 40 µg/m³ for any stations. The station of Camignolo (Gotthard) reaches the national limit defined for Switzerland of 30 µg/m³, while the station of Vomp on the Brenner exceeds the Austrian limit of 30 µg/m³while it complies with the tolerance value of 35 µg/m³. If the new Air Quality limits that will be implemented at EU level from 2030 onwards were considered, most of the monitoring stations would exceed the proposed values of 20 µg/m³.

Regarding the **iMONITRAF! target indicator**, the developments of 2023 need to be assessed critically. Developments both on Brenner and the Swiss corridors went into the wrong direction in 2023. Rail modal share decreased and HGV volumes remain stable, so that developments for both indicators lie clearly outside the target path.

Best Practices 2024 – Need to strengthen the modal shift policy mix

In 2024, policy measures and frameworks were enhanced and further developed across all iMONITRAF! regions. As in the previous years, enforcement of existing measures played an important role in pillar 1. Also, the role of coordinated information approaches was further developed, especially regarding upcoming large-scale construction works on the iMONITRAF! corridors. Regarding pillar 2 with the set of regulatory measures, only few adjustments were reported in 2024, given that the instrument mix in this policy pillar is already very comprehensive and ambitious in most iMONITRAF! regions. In policy pillar 3 which is dealing with modal shift, inputs from the regions highlight pricing measures related to road and rail, financial support which is extended to single wagon load transport as well as some pilot projects to strengthen regional rail transport. Overall, evidence shows that an ambitious push and pull framework is necessary to set effective incentives for modal shift – focusing not only on combined transport but also on single wagonload. Looking at passenger transport, all iMONITRAF! regions have continued to pioneer new solutions to increase attractiveness of public transport- including extension and further development of infrastructures and services. Innovative approaches looked at the operability of “Mobility-as-a-service” platforms in the iMONITRAF! regions.

1 Background and objectives

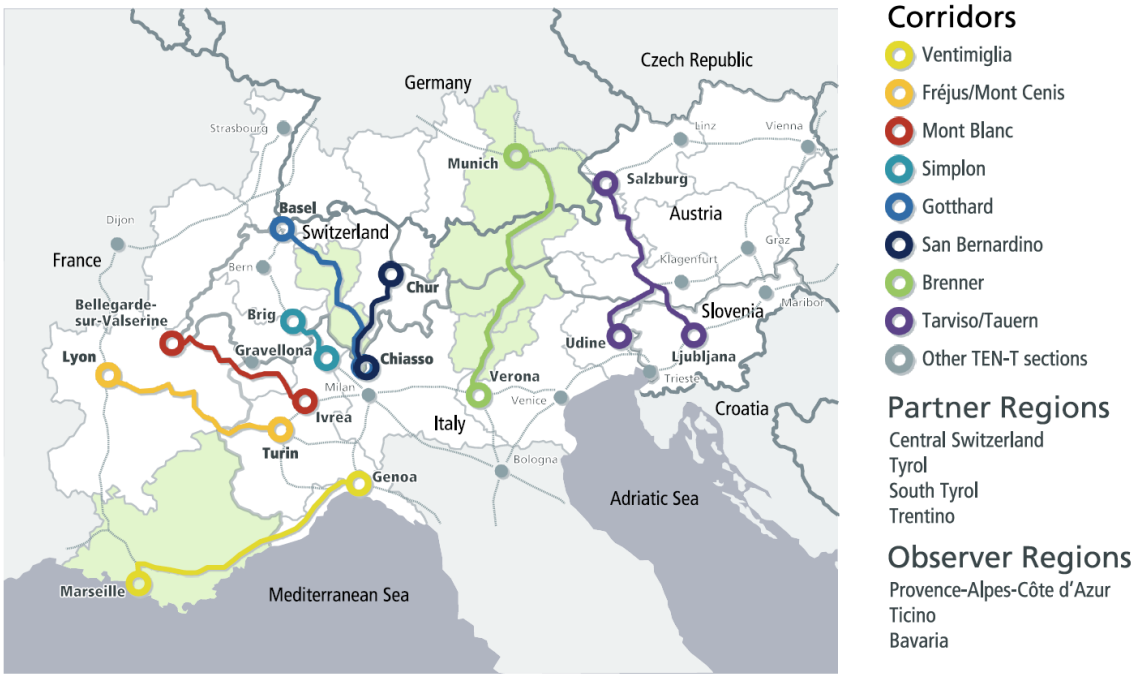
iMONITRAF! network – Common voice and thematic hub on transalpine freight traffic

iMONITRAF! continues to unite the Alpine regions along the major transit corridors to address the pressing challenges of transalpine traffic. Since its inception under the Alpine Space Programme in 2005, iMONITRAF! has evolved into a pivotal platform for developing coordinated and effective transport strategies. The network fosters collaboration among policy makers and technical experts to devise and implement joint solutions.

The network's strength lies in its ability to act as the unified voice of the most affected transit regions, advocating for sustainable transport solutions at national, macroregional, and European levels. By bringing together key stakeholders, iMONITRAF! not only addresses environmental and social impacts but also drives forward joint policy initiatives that ensure the long-term sustainability of transalpine transport.

The iMONITRAF! networks involves seven partner regions and observers along the major transit corridors: On the Brenner corridor, the State of Tyrol, the Autonomous Province of Bolzano – South Tyrol and the Autonomous Province of Trentino are partners of the network, the Free State of Bavaria joins with an observer status. On the Gotthard, Central Switzerland (representing the Cantons of Uri, Schwyz, Obwalden, Nidwalden, Lucerne and Zug) is partner, the Canton of Ticino acts as observer. Ventimiglia as most important East-West corridor is represented by Provence-Alpes-Côte-d'Azur which recently joined the network as observer.

Stakeholders from other corridors are involved in the monitoring system. All in all, the eight most affected transit corridors are represented in the network.



Overview map: *iMONITRAF! Corridors and partner regions*

Strategic milestones in the work programme 2023-2025

The work programme 2023-2025 puts a strong focus on the further development of the iMONITRAF! policy pathway and the common instrument mix. The policy pathway has been developed by iMONITRAF! in 2021 to support the implementation of the Combined Scenario. Indeed, in 2024 activities related to each level of this policy pathway were taken up:

- Regional initiatives considering specific needs: Regional measures were discussed during the strategy meeting in April 2024 and illustrated in detail in the Best practices update.
- Modal shift measures “Pull”: Both main work focuses of the year 2024 have focused on this level of the policy pathway, focusing on a better coordination of measures to support CT and on improvement of rail efficiency.
- Modal shift measures “Pricing”: The work focus on Combined Transport also provided insights on effective pricing frameworks, the monitoring and Best Practice Update in addition show changes in road pricing systems.
- Fall-back measures with cap-and-trade-approach and steering/reservation: the discussion paper on capacity management was further discussed in 2024 – also with stakeholders outside the network (e.g. in the frame of a webinar of the Scandria Alliance).

Objectives 2024 – Focusing on Combined Transport and Rail efficiency

In light of the ongoing revision of the EU Combined Transport (CT) Directive, iMONITRAF! had the objective in 2024 to strengthen its knowledge pool on effective measures to support Combined Transport. The network developed a joint typology on measures, exchanged on lessons learned with different CT support frameworks and developed recommendations for decision makers at EU level, ensuring that the new toolbox of the CT Directive consider insights from the Alpine regions.

With a view to the capacity management topic of the previous year, the network continued its activities around the efficient use of infrastructures – in 2024 however focusing on an efficient use of rail infrastructures. iMONITRAF! partners developed a common understanding on the technical challenges around infrastructure management and on the potential impacts of the proposed elements of the EU Infrastructure Capacity Regulation.

Annual Report 2024 – overview on main iMONITRAF! activities

As in previous years, the Annual Report provides a glance at all relevant iMONITRAF! activities summarized in one document – including developments in the Alpine regions, at national as well as at European level.

The report includes the main activities of the year 2024. It starts out with a summary of the input paper developed by iMONITRAF! on Combined Transport (chapter 2) and then provides an overview on developments at EU level with a special focus on the elements of the Greening Freight Package. Chapter 4 presents networking activities, especially the webinars implemented by iMONITRAF!. In chapter 5, an update of monitoring results is presented, this year in a shortened version and with improved graphical representations. Chapter 6 then presents the update of Best Practice, including information on all iMONITRAF! policy pillars. Finally, the report includes an outlook to the remaining year of the work programme, 2025.

2 An effective instrument mix to support Combined Transport: proposal for a typology and recommendations

2.1 Needs and potential role for CT measures

Combined Transport (CT) plays a key role for strengthening modal shift policies on the Alpine transit corridors. Monitoring results on railway services in chapter 5 (section modal split, especially figure 9) highlight that the share of unaccompanied combined transport (UCT) has increased over the last years. Especially on the Brenner and Gotthard, UCT services cover the largest share (in terms of tons transported on the corridors): 72% on the two Swiss corridors and 61% on the Brenner.

Improving the level-playing-field for CT needs to be seen as important lever to reaching the modal shift targets as included in the iMONITRAF! target indicators (see section 5.2).

With the ongoing revision process of the CT Directive at European level (see chapter 3 for more information), the needs and framework conditions for the combined transport sector received a more visible public stage – also thanks to networking activities of relevant rail/CT stakeholders at European level. The discussion at EU level presents a window of opportunity to bring insights from the iMONITRAF! regions to EU decision-makers, ensuring that the new regulatory framework reflects the needs of Alpine regions. The Alpine transit corridors, which are integral to four of the nine TEN-T Core Network Corridors, play a crucial role in European transport. Therefore, it is vital that the Alpine perspective is considered in further discussions on the CT Directive and the Greening Freight Package. Insights from Switzerland's ongoing development of its CT support framework, which includes measures to enhance short-distance operations and strengthen rail freight transport, can help inform a coordinated approach at the Alpine level.

2.2 Typology of CT measures: our approach to a CT toolbox

Over the years, iMONITRAF! has developed a broad knowledge on modal shift measures, their interaction and lessons learned. Also, other networks and platforms have collected best practices and recommendations that can be used for developing a typology of CT measures and recommendations for an effective CT toolbox. Overall, the following sources were used as basis for developing the typology: a) iMONITRAF! Best Practice collection, as included each year in the frame of the Annual Report, b) CT toolbox of the AlpInnoCT project, c), relevant report of WG Transport of the Alpine Convention, especially the report on Innovations in Rail Freight.[1]

The typology builds on two dimensions which reflect, on the one hand, the push and pull logic and, on the other hand, the different types of policy instruments.

Dimension 1: Focus of the measure - Pull and push logic

On the first dimension, the typology reaches from measures that aim at making rail/CT transport more competitive ("pull") to measures that focus on the competitiveness gap by making road transport less attractive ("push"):

- Rail infrastructure (pull): Measures with a focus on rail infrastructure are the backbone – without high-quality infrastructures all other CT measures cannot become effective.

[1] AlpInnoCT Toolbox of Action: https://www.alpinnoctoolbox.eu/
Alpine Convention WG Transport, Report on Innovation in Rail Freight Transport (2019): https://www.alpconv.org/fileadmin/user_upload/Fotos/Banner/Topics/transport/AlpineConvention_TransportWG_InnovationRailFreight_012019.pdf

- CT/Rail technology (pull): This includes all measures that focus on innovative technologies for rail/CT (trailers, craneable solutions, etc…) and thus make the overall operation of CT more competitive.
- CT Infrastructure (pull): All measures that support the further development of CT infrastructures, especially terminals/transshipment facilities. These CT-specific infrastructures are especially relevant as they determine capacities for CT operations.
- CT operations (pull): All measures that focus on improvements of CT operations, incl. pre- and end-haulage.
- CT market organisation (pull): This includes a diverse set of measures to improve efficiency of the CT market, also including measures to improve market entry of new players.
- Road (push): Here, measures with focus on road freight transport are summarized, with the objective to reduce the competitiveness advantage of road freight.

Dimension 2: Mechanism of the instrument – Regulatory, market-based and support

Different types of instruments can be used for addressing the different levels as mentioned above:

- Regulatory framework: Regulatory measures provide important framework conditions to ensure that minimum conditions (e.g. regarding train length, time at borders, etc.) and necessary norms/standards are met. This also includes interfaces to other objectives, e.g. social standards.
- Market-based instruments, including financial support: This includes all instruments that directly influence the cost-competitiveness of CT, e.g. taxes, charges, external cost pricing but also direct financial support like subsidies or indirect financial measures through tax exemptions or reimbursements.
- Management support/communication: This includes all “soft measures” that raise awareness and capacity in the sector, that better communicate the advantages of CT, etc.

Role of digital solutions for better promoting Combined Transport

Considering the efforts of iMONITRAF! to improve capacity management on the Alpine corridors (see activities in 2023) and the efforts of the regions to use the potential of digital solutions in this respect, we also want to highlight the role of digital solutions when it comes to support measures for Combined Transport. Indeed, the typology includes a specific element “CT/rail technology” which can include the promotion of digital solutions and automatization measures. Digital solutions also include additional measures such as freight exchanges, the use of digital papers (in the element “market organisation”) or measures that aim at speeding-up or automating the handling in terminals (in the element “CT operations”).

The table below illustrates the typology of CT measures, based on the two dimensions as explained above. It includes a short explanation for each type of measure and highlights regional measures already implemented along the iMONITRAF! corridors – based on inputs of the regions and an additional desk research of the iMONITRAF! Coordination Point.

OVERVIEW: A TYPOLOGY FOR CT MEASURES

Levels: Pull & Push		**Rail infrastructure (pull)**	**CT/Rail Technology (pull)**	**CT Infrastructure (pull)**	**CT operations**, incl. pre- & end haulage **(pull)**	**CT market organisation (pull)**	**Road (push)**
Policy instruments	**Management Support** (projects, communication, networking)	Planning support and space management	Pilot projects and exchange of experiences on new technologies for CT or rail in general	Planning support and space management *Examples: Simplified planning processes as e.g. implemented under the TEN-T framework*	Pilot projects and exchange of experience on new CT operation procedures *Examples:* *Conroo digital hub to connect trucks with terminals*	Coordination of platforms for efficient exchange between market players *Examples: Use of electronic contracts* *Pilot project for regional CT hubs in remote areas (ReVeLa project)* *KV Data Hub 4.0 & Match2Rail project*	CT promotion aimed at road hauliers *Examples: activities of AGB to promote rail/CT for regional transport*
	Economic / Financial Support (investments, subsidies, taxes, charges)	Financial aid for the construction of rail infrastructure *Examples: Funding of large-scale rail infrastructures (e.g. Brenner base tunnel), funding even across borders (CT contributions to access tracks in Italy)*	Start-up funding or other financial support to enable the testing/demonstration or introduction of new technologies *Examples:* *NiKRASA project Bavaria: pilot project to test transshipment of non-craneable containers* *Pilot projects to test digital Automatic Coupling* *Pilot projects for testing automatic train operations (ATO)*	Financial aid for the construction of transshipment facilities and other infrastructures for CT *Examples:* *Existing subsidy systems in CH, AT, DE* *Regional support in Tyrol with 10% additional funding* *Model projects Bavaria "Freight hubs"*	Financial aid and/or incentives for CT operations and for pre- and end-haulage *Examples: Existing subsidy systems for CT, e.g. in South Tyrol and Trentino as well as in CH with new focus on short-distance CT transport* *Tax exemptions for HGV used in pre- and end-haulage of CT operations (e.g. motor vehicle tax AT)* *Reduced track charges for CT in Germany (but only until Nov 2024)*	Pricing measures that incentivize the efficient use of rail infrastructure (e.g. track charges) *Examples: track charges CH that set incentives for using long train combinations (> 540 m)* *TARO project in Austria to accelarate automatisation in rail freight transport*	Charges for the use of road infrastructure and for the compensation of external costs *Examples: Road charges as implemented in all iMONITRAF! regions, especially Swiss HGV fee, Brenner-Maut*

OVERVIEW: A TYPOLOGY FOR CT MEASURES

Levels: Pull & Push		**Rail infrastructure (pull)**	**CT/Rail Technology (pull)**	**CT Infrastructure (pull)**	**CT operations**, incl. pre- & end haulage **(pull)**	**CT market organisation (pull)**	**Road (push)**
	Regulation (standards, weights, driving ban)	Adjustments to regulations (incl. spatial planning) to enable the construction of rail infrastructure	Adaptation of standards and specifications to enable the testing or introduction of new technologies *Examples:* *Adaptation of standards along the Brenner corridor, e.g. under the frame of "Brenner ohne Grenzen" project*	Adjustments to regulations (incl. spatial planning) to enable the construction of transshipment facilities and other infrastructure for CT *Examples: See above, model project Bavaria "Freight hubs"*	Adaptation of standards and specifications to support efficient operations of CT terminals as well as pre- end end-haulage. E.g special permits for weight, travel times, etc. *Example: measures in the frame of "Brenner ohne Grenzen" project to speed-up cross-border operations* *Additional weight limits for HGV used in pre-and end-haulage of CT operations (Weights & Dimensions Directive)*	Measures to facilitate entry into intermodal market *Examples:* *Verlagerungscoach Austria* *(Modal Shift coach)*	Standards and requirements, such as temporary driving bans, intelligent traffic management systems, environmental standards, conditions for compensating external costs, etc. *Example: Night driving bans CH, Tyrol* *Speed limits* *Weekend driving bans* *Slot system as currently under discussion on the Brenner corridor*

Table 1:

2.3 Towards an effective instrument mix: insights from current experiences in the Alpine regions and recommendations

The detailed analysis of the measures and Best Practices as highlighted in the table above provide some insights on lessons learned and recommendations for the CT toolbox:

- **Reduced Border Waiting Times:** Simplifying and speeding up border-crossings is crucial for making rail/CT more competitive. Implementing regulations on waiting times can significantly accelerate transport on rail. This requires the adoption and coordinated use of innovative digital solutions such as e-papers, train-related electronic data exchange, and automated brake testing.
  → Recommendations: Effective implementation of this measure necessitates coordination across National Policy Frameworks to ensure seamless border-crossings.
- **Incentives through Higher Weight Limits:** The current Weights & Dimensions Directive allows higher weight limits (up to 44 tons) for HGVs used in pre- and end-haulage of CT operations. If the revised Weights & Dimensions Directive extends weight limits also to Zero-emission HGV and other vehicle groups this would compensate the advantage for CT operations.
  → Recommendations: Existing regulations that give a small advantage to CT should not be counteracted by other objectives. The National Policy Frameworks should thus develop integrated incentive structures that maintain additional incentives for CT operations, following the Avoid-Shift-Improve logic.
- **Investments in CT Infrastructures:** Investment support for CT terminals is available in all Alpine countries, though funding rates vary. Ensuring non-discriminatory access to terminals, rail freight tracks, and new IT solutions is essential.
  → Recommendations: Coordinated approaches are needed, especially to optimize the use of limited rail capacities. Investment support should consider the development of both large-scale and smaller local/regional terminals to provide access to CT infrastructures also in remote areas.
- **Financial Aid to CT Operations:** Providing targeted financial aid without creating unwanted windfall profits requires close monitoring and analysis of the transport market. There is significant potential for modal shift in short- and medium-distance transport, which requires a differentiated framework. Specific bonus payments for short-distance transport can be a solution.
  → Recommendations: Support measures should differentiate based on transport distances and regional infrastructure qualities, accounting for cost differences between flat and mountain regions.
- **Support for Demonstration Projects:** Digital solutions and automation technologies can enhance rail and CT efficiency and competitiveness by improving capacity use and reducing transport times. Financial support for pilot projects that test and demonstrate innovative technologies is crucial.
  → Recommendations: The toolbox should allow generous funding for innovative technologies, supported by EU-level projects to ensure a common approach and avoid market segmentation.
- **Coaching for CT Operators:** Austria's "Modal Shift Coach" supports companies in shifting to rail transport by providing guidance and overcoming barriers to using CT services. This concept helps stakeholders navigate the CT market, which functions differently from the road-only transport market.

→ Recommendations: The "Modal Shift Coach" concept should be integrated into National Policy Frameworks and coordinated at the European or corridor level to enhance its effectiveness.

- **CT in Remote Areas:** Shifting freight to rail in remote areas is challenging due to fewer transshipment facilities. However, high transport volumes from these areas can be realized with digital solutions that allow pooling of shipments. Financial support for CT should be closely linked with digital solutions to support market players.
  → Recommendations: National Policy Frameworks should include specific solutions for remote areas to address their unique needs and challenges.
- **Optimized Intermodal Train Concepts:** New approaches to optimize CT market organization, such as the hub logic for train combinations, are necessary to enhance the efficiency of rail infrastructures.
  → Recommendations: The toolbox should allow flexibility to include new elements and missing links to raise efficiency potential in the overall CT market.

Recommendations to EU policy makers on how to design the national policy frameworks and toolbox under the CT Directive

Considering the broad experiences and insights with the support for CT in the Alpine regions, the iMONITRAF! Coordination Point – as technical platform of the Alpine regions – proposes the following recommendations for the further finetuning of the national policy frameworks under the CT Directive and the related toolbox:

- **Integrated toolbox based on a clear typology:** To provide a better decision-making aid, the toolbox of the revised CT Directive should take a more integrated approach – providing information on policy elements along the pull and push logic – starting from basic infrastructure needs to operational aspects (pull approach) to measures that focus on road transport. From our viewpoint, innovative technologies should be integrated in this approach and not be an additional layer in the toolbox.
- **Territorial needs:** A simple list of tools is not sufficient, the regulation should instead provide more insights on how to specifically design the tools based on relevant territorial needs, e.g. considering higher operating costs for CT in mountain areas, or other investment frameworks for new CT terminals in areas with very limited spatial availability.
- **Subsidies for CT operations:** Subsidies for CT services should lead to an optimized use of the limited railway capacities on the Alpine corridors, thus also supporting other EU frameworks, especially the TEN-T guidelines. Subsides for CT operations should set an incentive to build long train combinations to use rail capacities in an efficient way.
- **Cooperation:** Some tools can only become effective if coordinated across borders, especially if they concern the TEN-T core network corridors. We propose that the National Policy Frameworks are coordinated at least along the TEN-T corridors to provide a strong incentive for shifting from road to rail and to avoid and malinvestments.
- **Coordinated approach for "key" digital solutions instead of national or even regional patchwork situations:** at the moment, many innovative approaches are tested, e.g. for automation of terminals, digital hubs to connect vehicles and infrastructures, digital coupling, etc. These should be integrated as far as possible towards a "one-stop-shop" to create a really attractive and transparent market support.
- **Interfaces:** The toolbox for CT support and the national policy frameworks should not be seen as isolated from other policy frameworks and objectives. The toolbox should thus also

include information on related policies and a decision making aid on how to avoid trade-offs and conflicts with other policies.

- **Monitoring and dynamic adjustments:** The Alpine experiences highlight the need for a continuous review and dynamic adjustment of policy frameworks. A regular update of the national policy frameworks should thus be implemented in the EU legislation, considering both infrastructure developments and new conditions in the logistics market.

3 Trends for transport and environmental policies at EU level

At EU level, the different elements of the Greening Freight Package were further investigated by iMONITRAF! and several coordination and networking activities were built around them. At the core of all activities stands the overall objective of iMONITRAF! that the dossiers of the Greening Freight Package should support modal shift. Low, and increasingly zero-carbon, rail is the existing green mode for freight transport and the Alpine countries, together with the EU, are investing large sums into improving the respective infrastructure. Decarbonisation of the remaining road transport fleet is, also under the Avoid-Shift-Improve logic, the next level in the strategic approach, recognising the benefits of zero emission vehicles for the sensitive Alpine environment.

With the EU elections in view, the first few months of 2024 saw a considerable dynamic around the dossiers of the Greening Freight Package, especially with the discussion of the Weights & Dimensions Directive in the European Parliament and the ratification of the new EU CO_2 emission standards for trucks. However, also the other elements of the Greening Freight Package found broad attention and many stakeholders worked on proposals for finetuning and better interlinking the different dossiers. After the elections, the new European Parliament Committee on Transport and Tourism (TRAN) was appointed and new rapporteurs named for the different dossiers. In general, due to the political constellation at EU level it will become increasingly difficult to argue with climate and environmental benefits in mind. New narratives might indeed be needed, putting a stronger focus on economic competitiveness and added value for the regions.

Regarding clean air, a major milestone was reached with the final approval of the EU Council of the new EU air quality standards for 2030 – an opportunity for iMONITRAF! to put local environmental impacts in the focus again.

Weights and Dimensions Directive

The revised Weights and Dimensions Directive (WDD) specifically aims at increasing attractiveness for the uptake of zero-emission HGV by providing additional provisions not only for “regular” zero-emission vehicles (ZEV, with an increase of weight limits up to 44t) but also for cross-border circulation of European Modular System (= “Gigaliners”). This leads to the effect that these long and heavy vehicle combinations can be used in long-distance and cross-border transportation, a segment with a high rail-affinity. On the Alpine corridors, gigaliners would also put a considerable additional strain on the mountainous road infrastructures and lead to additional safety risks. In its statement, iMONITRAF! has highlighted the potential reverse modal shift impacts that these provisions will have and has highlighted that new provisions of the WDD must not counteract efforts to boost modal shift from road to rail. If weights and dimensions for ZEV are extended, these should be restricted to additional weights of batteries/zero-emission technologies – to provide a level-playing field for ZEV compared to diesel trucks but not an additional advantage compared to rail transport.

The proposal with the new provisions for higher weights for ZEV and the cross-border provisions for EMS was agreed by Parliament in March 2024 – not picking up the concerns of rail stakeholders. The EU Council has not yet finalized its position. In the EP, a new rapporteur has been defined after the European elections and on 7 October the TRAN committee voted to start inter-institutional negotiations on the basis of the report adopted in March 2024.

CO_2 emission standards for trucks

In May 2024, the EU Council ratified the agreement on the revision of CO_2-standards for trucks – taking the final step in the legislative process which was initiated in February 2023 with the Commission (COM) proposal. The initial regulation as implemented in 2019 required the emissions from most new trucks to be 15% lower by 2025 and 30% lower by 2030. The new legislation expands the current scope to cover almost all trucks (including vocational vehicles, such as garbage lorries, tippers or concrete mixers as of 2035), urban buses and long-distance buses (above 7.5 tonnes) as well as trailers (an unpowered vehicle towed by a motor vehicle). In 2027, the Commission will review the expansion of the scope also to small lorries. While the initial regulation of 2019 only covered about 60% of annual sales and 70% of emissions, the new standards now cover 90% of sales and 95% of emissions. Keeping in mind the climate-neutrality objective, the ambition of the 2030 target was raised from 30 to 45% and new reduction targets with a 65% reduction up to 2035 and a 90% reduction up to 2040 are included in the new CO_2-standards.

Compliance is measured for every manufacturer on a fleet-wide basis, meaning not every vehicle must meet the specified targets, but fleet-averaged emissions must be reduced by these targets. This allows manufacturers to compensate for high-emitting truck with a low-emitting truck, as long as the average emissions are in line with the CO_2 emission reduction target.

Combined Transport Directive Update

The proposal for revising the Combined Transport (CT) Directive has progressed, with discussions especially at the level of the EU Council and the Coreper. The dossier was discussed in the relevant Council Working Party “Transport - Intermodal Questions and Networks” both under the Belgian and Hungarian presidencies. Two progress reports are available online. The TRAN Committee has not yet picked up the dossier – due to the European elections that took place in May 2024 and the appointment of a new rapporteur. The following elements of the revised proposal provided most difficult in the ongoing discussions:

- Definition of Combined Transport: Discussions made clear that the proposal of the EU COM with the approach focusing on external cost savings of at least 40% would not find enough support by Member States. A proposal for an alternative definition evolves around the definition that CT requires at least a 50% non-road transport. It was discussed if this requirement needs an additional element with two options that were discussed: i) maintaining the 150 km limit on the road leg with exemptions for reaching the nearest suitable terminal, ii) keeping the 150 km limit only for road-waterborne connections and giving more flexibility for road-rail connections. Fortunately, the first option has then taken forward as compromise – complemented with a well-defined set of conditions to clarifying when the road leg cap may be exceeded. A final decision on this key issue (which was indeed the reason why the revision proposal of 2018 was finally withdrawn) is however still pending as of January 2025.
- Use of digital platforms for verifying eligibility: To proof compliance and eligibility as CT operation, the COM proposal foresees the use of the new eFTI platform (Electronic Feight Transport Information) that is foreseen to be implemented in the frame of the new TEN-T Regulation. However, some Member States argue that this platform will not be available in all countries when the new CT Directive is supposed to become effective, so an intermediary solution will be necessary. The initial suggestion for a temporary digital geocoding platform to be developed by the Commission was deemed complex and unnecessary by many stakeholders.
- National Policy Frameworks: Open questions are also still evolving around the National Policy Frameworks, especially their aspirations and mandatory status. The last statement of the

Presidency made clear that it saw the policy frameworks and the 10% cost reduction target as “voluntary and aspirational”.

- Exemptions from driving ban: The proposal of the COM foresees an exemption for CT operations from all regional driving bans. iMONITRAF! and its partner regions are contrary to a generalised EU-wide exemption from driving bans for the road leg of CT. It is believed the provision of driving bans (such as weekend and holiday bans or sectoral bans on certain goods) is sole competence of the Member States (MS). Driving bans in single MS reflect national (and sometimes regional) needs. They fulfil the aim to guarantee the fluidity and security of traffic or to meet environmental objectives including staying below the EU air quality limit values.

iMONITRAF! continues to collaborate with EU partners, working to ensure that the revision process benefits all stakeholders and avoids unintended negative impacts.

New TEN-T corridors

Following the entry into force of the revised TEN-T Regulation on 18 July 2024, the Core Network Corridors have been transformed into the European Transport Corridors with, a partly, new alignment. Specifically, the following two adjustments need to be mentioned as they are particularly relevant for iMONITRAF!:

- The North Sea – Rhine – Mediterranean European transport corridor (NSRM) merged two former TEN-T core network corridors: Rhine – Alpine and North Sea – Mediterranean. The NSRM corridor stretches across eight European countries, namely Ireland, the Netherlands, Belgium, Luxembourg, France, Germany, Switzerland and Italy.
- The new Western Balkans - Eastern Mediterranean (WBEM) Corridor links central European Member States with the ports of the Adriatic and East Mediterranean Seas via the Western Balkans. It runs through the eight EU Member States of Austria, Slovenia, Croatia, Hungary, Bulgaria, Greece, Cyprus and Italy, as well as Serbia, Bosnia and Herzegovina, Montenegro, Kosovo*.

Update on Action Plan to boost cross-border passenger transport

To implement the Action Plan to boost long-distance and cross-border passenger rail (adopted in Dec 2021), the European Commission announced in January 2023 the support of 10 pilot projects to establish new rail services or improve existing ones. Several of these 10 pilot projects are situated or cross the Alpine area and thus also improve rail services in the iMONITRAF! regions. One project focuses on a new direction between Rome-Munich and Milan-Munich involving Trenitalia, Deutsche Bahn and ÖBB. In 2024, the project was still struggling with bringing the pilot to life – due to lacking harmonisation of regulation, vehicle approval process and capacity management.

New Ambient Air Quality Directive – Aligning EU limit values with WHO recommendations

As a major milestone for the European Green Deal's zero-pollution ambition, the revised Ambient Air Quality Directive entered into force in December 2024. The revised Directive aligns EU air quality standards for 2030 more closely with WHO recommendations and lowers the allowable levels for twelve critical air pollutants: particulate matter (PM2.5 and PM10), nitrogen dioxide (NO_2) and nitrogen oxides (NOx), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide, benzene, benzo(a)pyrene, arsenic, cadmium, nickel, and lead. Especially, the allowed annual limit value for the pollutants with the highest documented impact on human health are affected: limit values for

fine particulate matter are cut by more than half (from 25 µg/m³ to 10 µg/m³), limit values for NO2 from 40 µg/m³ to 20 µg/m³.

The revised Directive comes along with a set of new monitoring and compliance rules that will ensure early action to achieve cleaner air. If air pollution levels are higher than the new 2030 standards over the coming years, Member States will have to analyse whether they are on track to comply with the legislation on time, and, if needed, take measures to ensure compliance by 2030. Member States have two years to adopt the laws, regulations and administrative provisions to transpose the revised Directive. The Commission will adopt relevant implementing acts to complement the new rules and assist with their application.

4 iMONITRAF! Networking activities 2024: Webinars and EU networking activities

The format of short webinars has proven very effective for iMONITRAF! to both strengthen its own expertise and, at the same time, exchange insights and ideas with networking partners in the Alpine transport community – e.g. CIPRA, WG Transport of the Alpine Convention, Alpeninitiative/ProAlps. In 2024, two webinars with link to ongoing EU activities were organized:

Webinar Combined Transport

On 27th June 2024, a webinar was organized to gain insights on the current state of discussion at EU level regarding the Combined Transport Directive. Akos Ersek from International Union for Road-Rail Combined Transport (UIRR) took the group through the main challenges and open questions of the revision process. Several key elements of the revision proposal are still under discussion (see chapter 3) and the webinar gave an opportunity to discuss the impacts of different solutions for the Alpine regions and corridors. Specifically, the following questions were discussed:

- Definition of CT: The group discussed impacts of the different proposed definitions for CT and how they might affect the Alpine regions.
- CT support measures: Discussion of the general approach of the national policy frameworks as proposed by the new Directive as well as the toolbox supporting the frameworks. Advantages and disadvantages of different types of measures were presented by Akos Ersek and discussed in the group – highlight insights also from the iMONITRAF! typology (see chapter 2).
- Definition of cost reductions: One open issue relates to the measurement of relevant cost reductions for CT that shall be achieved through the national policy frameworks. Akos Ersek presented the proposal developed by UIRR and its impacts. The proposal argues that the national Master Plans should lead to – at least – a 10% reduction in operational costs for CT thus making CT more competitive compared to road-only transport. UIRR has, together with its members, developed a proposal on how to achieve this measurement of cost-reductions in an easier way – using market prices as benchmark and not current operational costs (which are difficult to obtain from operators).

- Links to other dossiers of the Greening Freight package: The webinar also discussed the interfaces of the CT Directive with the other dossiers of the Greening Freight package as well asthe revised TEN-T guidelines. It became clear again that all relevant dossiers need to be developed in an integrated approach – to really move towards an effective framework to improve competitiveness of CT.

Webinar Rail Efficiency – Rail capacity management

The proposal for a EU Infrastructure Capacity Regulation is a rather technical dossier which requires a detailed knowhow on how infrastructure managers conduct capacity planning and management and on how timetables are developed. To improve our knowledge on these topics and thus to better understand the impacts and potential need for action related to the Infrastructure Capacity Regulation, a webinar specifically on this dossier was organized. As speakers, Daniel Haltner of RailNetEurope and Matthias Wagner of the Swiss Federal Office for Transport (FOT) were invited and gave detailed insights on the topic.

The presentation of Daniel Haltner provided insights on some core elements of the EU dossier. These elements are mostly based on proposals from the Timetable Redesign Initiative (TTR) as implemented jointly by RNE and Forum Train Europe (FTE) to simplify, unify, and solidify improvements to the European rail timetabling system to significantly increase the competitiveness of railways.[2] The TTR initiative brought together market experts from all relevant stakeholders (railway undertakings, Infrastructure Managers and Allocation Bodies and supporting companies) as well as experts from the fields of timetabling, construction works, IT and legal matters. The currently discussed Infrastructure Capacity Regulation largely builds on the results of the TTR initiative.

- Capacity strategy: To define core elements on how to use capacities, especially the volumes and shares for each market segment. Stakeholders, including the regions, need to be involved in the set-up.
- Flexible approach to capacity planning: The proposal foresees a shift from annual planning to a more flexible approach, allowing an adaptation and rescheduling of allocated capacity.
- Consensual conflict resolution mechanism: To deal with conflicting capacity needs and requests, based on a common set of criteria.

Matthias Wagner (FOT) highlighted the need for action especially for the Alpine corridors and gave insights into related discussions at the Swiss federal level.

Joint statement of iMONITRAF! on Weights & Dimensions and CT Directives

In February 2024, just before relevant discussions in the EU Parliament's TRAN Committee, iMONITRF! developed an integrated statement with Alpine claims on the Weights & Dimensions (WDD) and CT Directives. The statement argued that modal shift should be at the heart of the Greening Freight package. The Weight & Dimensions Directive should not become another regulatory provision for governing road transport that undermines and counteracts efforts to shift to rail, as the European Court of Auditors criticised in its Special report on intermodal freight transport. The WDD and the CT Directive should go hand-in-hand and not cannibalise each other. Their interfaces should be assessed more in-depth and considered throughout the proposals.

[2] https://rne.eu/capacity-management/ttr/

Specifically, the joint statement called on decision makers at European level to review the new provisions for weights and dimensions as included in the proposal of the European Commission. The Weights & Dimensions Directive should be fully in line with the objectives of the EU Smart & Sustainable Mobility Strategy which foresees a doubling of rail freight transport and the creation of a level-playing-field for intermodal transport until 2030.

Networking with other partners in the Alps

Also in 2024, iMONITRAF! used its role as networking hub to closely coordinate efforts with other stakeholders and working groups in the Alps. The “Alpine Transport Community” as initiated by the Alpine Climate Board has again been used as effective platform to “coordinate the coordinators” and to streamline activities.

- EUSALP AG4: During each AG4 meeting, iMONITRAF! presents an update of its activities as well as specific insights. In 2024, especially the CT typology and discussion paper were shared with AG4 members. Through the joint leadership role in both iMONITRAF! and AG4, the State of Tyrol was also able to bring the topic of sustainable transport and mobility at the heart of the incoming EUSALP presidency of Austria and Liechtenstein.
- WG Transport Alpine Convention: The WG Transport has developed its new mandate in 2024 – with many potential interfaces to iMONITRAF! activities. It will be crucial to keep a close contact in 2025 to make use of synergies between the two groups.
- The Simplon Alliance has taken no further steps in 2024. Specific implementation steps have not been launched yet, but iMONITRAF! has stated its interest in supporting specific implementation activities. Especially, all activities related to a better coordination of tolls and pricing systems, the support for CT and the exchange on capacity management instruments is highly relevant for iMONITRAF! and considerable synergies could be used.
- iMONITRAF! closely cooperated with other institutions and stakeholders in the field of transalpine freight transport, especially a close cooperation with CIPRA and the Alpine Initiative has been further established throughout 2024.

5 Monitoring of iMONITRAF! indicators

5.1 Foreword – iMONITRAF! monitoring approach

***Monitoring indicators*:** Since monitoring data for a full calendar year is published by the different sources throughout the following year, the monitoring data presented in the iMONITRAF! Annual Reports focuses on the previous year. Therefore, the Annual Report 2024 presents data for 2023 for the following indicators: 1) road traffic volumes, 2) transported tons and modal split, 3) concentration of air pollutants, and 4) exposure to noise. Additionally, the report presents monitoring data for 2024 regarding further four indicators: 5) toll prices, 6) fuel prices, 7) alternative-fuel refuelling stations, and 8) unitary pricing components. Table 2 provides an overview of these indicators. Some methodological choices are made for the data collection, analysis and interpretation. This chapter focuses on the description of the monitoring results, while the Annex provides the relevant methodological explanations for each indicator.

***Corridors and countries*:** Data concerning the indicators 1-8 is collected at the corridor or country level. Data for indicators 1, 2, 3, 4, 5 and 7 refers to monitoring stations along the main transalpine corridors: Ventimiglia, Fréjus/Mont Cenis, Mont Blanc, Gotthard, San Bernardino, Simplon, Brenner, and Tarvisio/Tauern (Table 2). Data for indicators 6 and 8 are country-based, referring to Austria, Germany, Switzerland, Italy and France. To identify the transalpine corridors and countries object of the analysis, a consistent colour scale is adopted (Table 1 and Figure 1).

iMONITRAF! monitoring indicators				**Level of analysis**												**Figures**
N.	**Indicators**	**N.**	**Sub-indicators**	**Corridor level**								**Country level**				
				Ventimiglia	**Fréjus/Mont Cenis**	**Mont Blanc**	**Gotthard**	**San Bernardino**	**Simplon**	**Brenner**	**Tarvisio/Tauern**	**Austria**	**Germany**	**Switzerland**	**Italy**	**France**	
1.	Road traffic volumes	1a.	All vehicles	●	●	●	●	●		●	●						Figure 2 + 3
		1b.	Light vehicles	●	●	●	●	●		●	●						Figure 4 + 3
		1c.	Heavy vehicles	●	●	●	●	●		●	●						Figure 5 + 3
2.	Transported tons and modal split	2a.	Transported tons rail-road	●	●	●	●	●	●	●	●						Figure 6 + 7
		2b.	Modal split rail-road	●	●		●		●	●	●						Figure 8
		2c.	Modal split rail services	●	●		●		●	●	●						Figure 9
3.	Concentration of air pollutants	3a.	Nitrogen dioxide (NO_2)	●	●	●	●	●		●	●						Figure 10 + 11
		3b.	Particulate matter (PM_{10})	●	●	●	●	●		●	●						Figure 12 + 13
4.	Exposure to noise	4a.	Overall noise level		●	●	●	●			●						Figure 14
		4b.	Night noise level		●	●	●	●			●						Figure 15
5.	Toll prices	5a.	Whole price for transit	●	●	●	●	●	●	●	●						Figure 16
		5b.	Km price for transit	●	●	●	●	●	●	●	●						Figure 17
6.	Fuel prices (petrol and diesel)											●	●	●	●	●	Figure 18
7.	Alternative-fuel refuelling stations			●	●	●	●	●	●	●	●						Figure 19
8.	Unitary pricing components											●	●	●	●	●	Figure 20

Symbolic colours of the corridors: Ventimiglia; Fréjus/Mont Cenis; Mont Blanc; Gotthard; San Bernardino; Simplon; Brenner; Tarvisio/Tauern.
Symbolic colours of the countries: Austria; Germany; Switzerland; Italy; France.

Table 1: *List of monitoring indicators addressed in the iMONITRAF! Annual Report.*

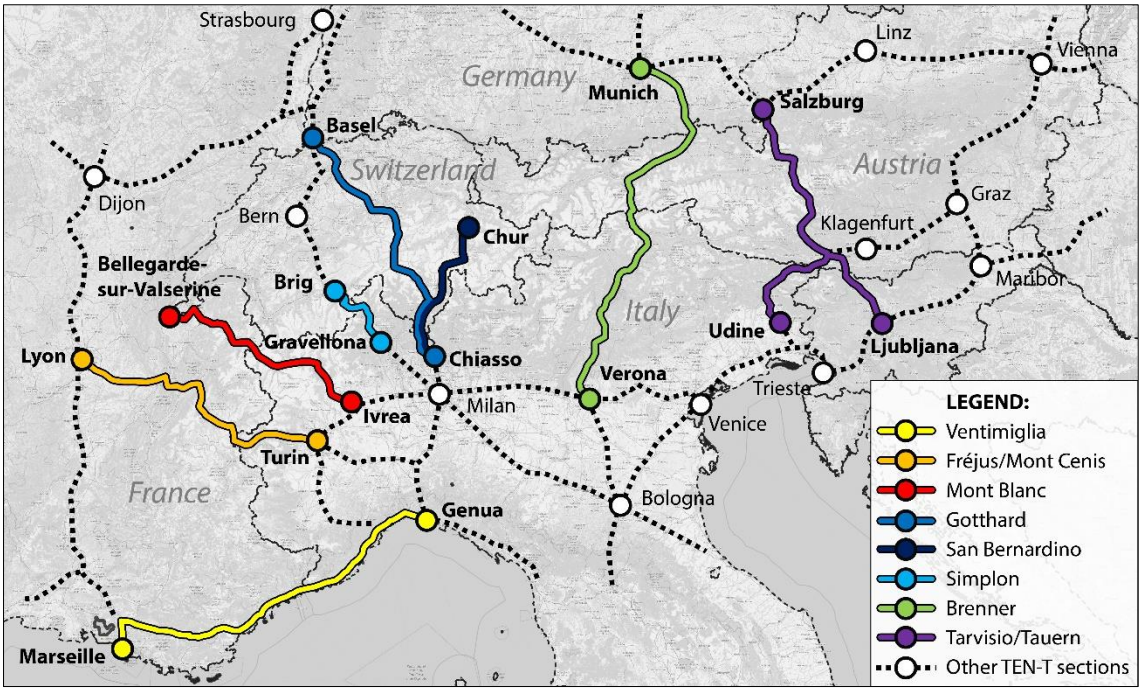


Figure 1: *Map of the transalpine corridors and Alpine countries addressed in the iMONITRAF! Annual Report.*

***WebGIS application*:** The data presented in this report (together with further data) is available in the iMONITRAF! WebGIS: http://sdi.eurac.edu/AlpinePoKforTransportandMobility/. This application allows visualising, analysing and freely downloading the data collected during the last year, as well as time series as data is collected in the iMONITRAF! Framework since 2005.

5.2 Evaluation of monitoring results

Indicator 1: Road traffic volumes

Figures 2,4 and 5 show the annual average daily traffic for all, light and heavy vehicles in the period 2005-2023, while Figure 3 focuses on 2023. In both cases, daily average traffic data is obtained by summing the vehicles circulating along the corridors, divided by 365 days (366 in leap years).

(1a) All vehicles (Figures 2 and 3): In 2023, the annual average daily number of vehicles crossing all iMONITRAF! corridors is ca 110,500 vehicles/day, i.e. +2% compared to 2022, and +5% compared to 2019 (before the Covid-19 pandemic). With 31,850 vehicles/day, the Brenner corridor presents the highest traffic flows (29% of the total transalpine traffic volume), followed by Ventimiglia and Gotthard. Compared to 2022, traffic-flow variations range between -0.4% (Gotthard) and +8% (Tarvisio), showing a general stabilisation after 2021 and 2022, two years shaped by the post-Covid-19 rebound of traffic flows. As such, the pandemic effects appear totally compensated in 2023. The only corridors showing a slight decrease of traffic flows in 2023 compared to 2022 are the Brenner (-0.2%) and Gotthard (-0.4%). All the others register increases between ca +2% and +8% compared to 2022.

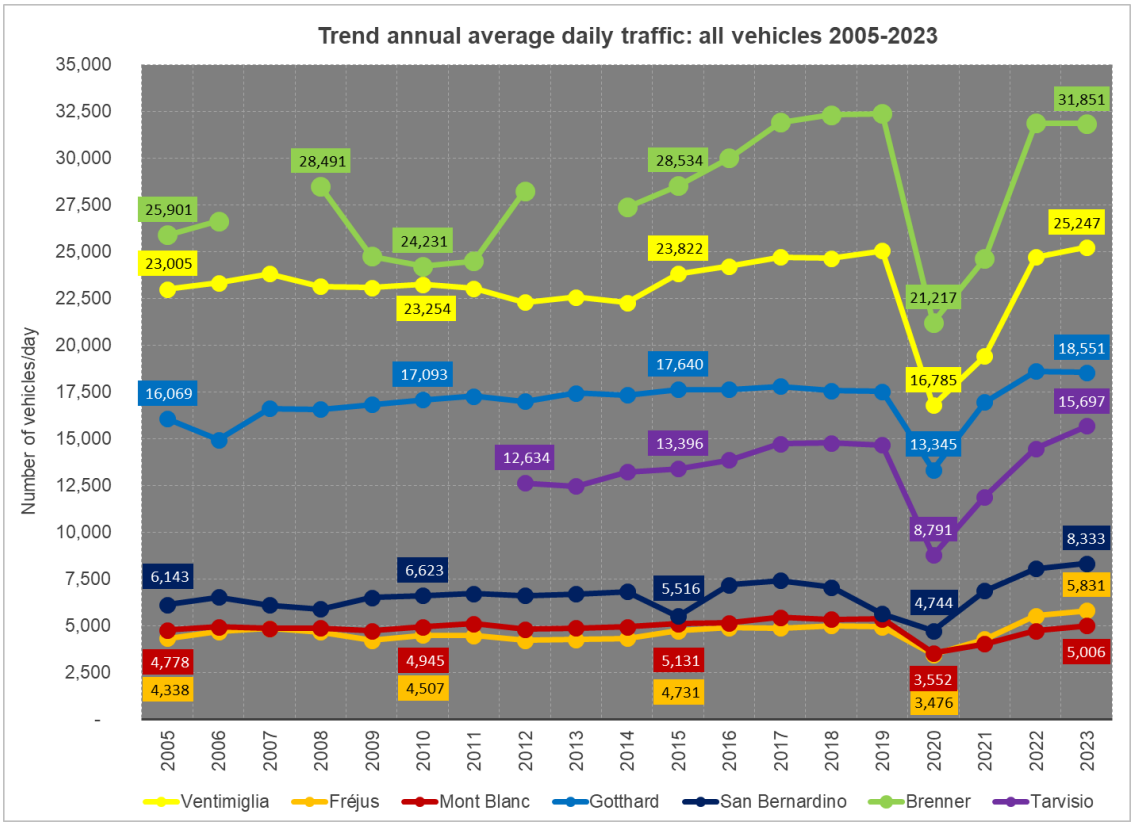


Figure 2: *Annual average daily traffic: all vehicles per day.*

MAIN INSIGHTS: Ca 110,500 heavy and light vehicles cross the seven major Alpine corridors per day: ca +2% compared to 2022 and +5% compared to 2019. As in the previous year, overall flows exceed the pre-pandemic values.

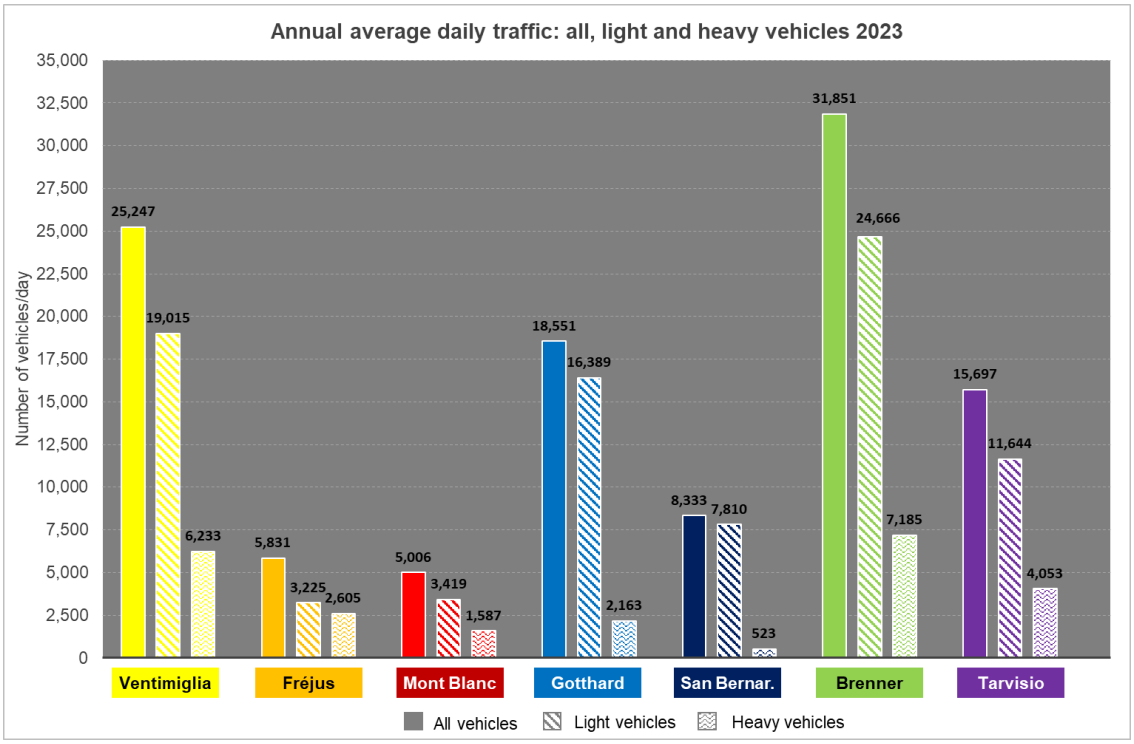


Figure 3: *Annual average daily traffic: all, light and heavy vehicles per day in 2023.*

MAIN INSIGHTS: The Brenner corridor registers the highest amount of both light and heavy vehicles (ca 24,700 and 7,200), representing almost 30% of total flows across all the observed iMONITRAF! corridors.

(1b) Light vehicles (Figures 3 and 4): In 2023, the annual average daily number of light vehicles crossing all iMONITRAF! corridors amounts to ca 86,200 vehicles/day, i.e. +3% compared to 2022, and +5% compared to 2019 (before the Covid-19 pandemic). This condition is similar to the above mentioned for all vehicles (light plus heavy vehicles). As seen before, the Brenner corridor presents the highest traffic flows: ca 24,700 light vehicles/day (i.e. ca 29% of the overall volume), again followed by Ventimiglia and Gotthard. Compared to 2022, light-vehicle flows are also generally stable, with increases for all corridors ranging between +0.02% (Gotthard) and +12% (Tarvisio). This increasing trend confirms the return of flows to the pre-pandemic conditions for almost all corridors. Compared to 2019 values, only Ventimiglia, Mont Blanc and Brenner register slightly lower light-vehicle flows, by ca 0.5%, 5% and 1% respectively.

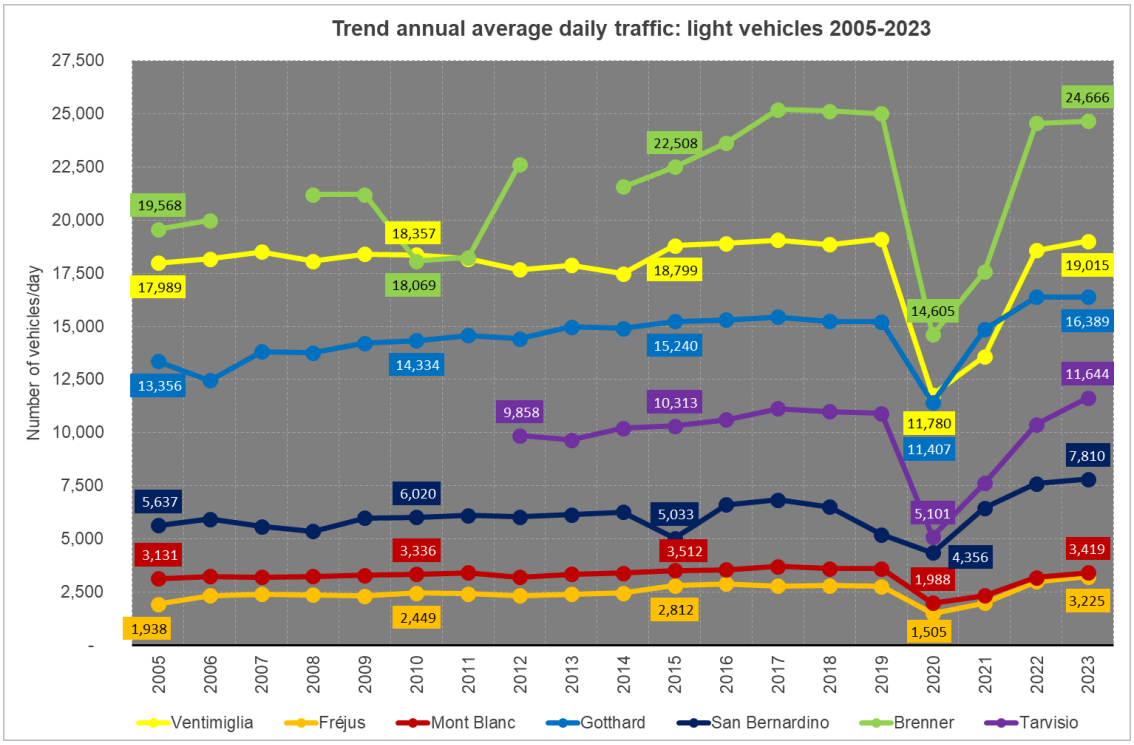


Figure 4: *Annual average daily traffic: light vehicles per day.*

MAIN INSIGHTS: Ca 86,200 light vehicles per day cross the seven transalpine corridors: ca +3% compared to 2022 and +5% compared to 2019. Overall flows exceed the pre-pandemic values of 2019 by 5%.

(1c) Heavy vehicles (Figures 3 and 5): In 2023, the annual average daily number of heavy vehicles crossing all iMONITRAF! corridors summed up to ca 24,350 vehicles/day. This is almost the same figure reached in 2022 (-0.1% overall). As for light vehicles, Brenner registers the highest flows: ca 7,200 heavy vehicles/day, which corresponds to 29.5% of the total flows across all the IMONITRAF! corridors. Ventimiglia and Tarvisio follow closely, with ca 6,200 and 4,100 heavy vehicles/day on average. Compared to 2022, total heavy vehicle flows are almost stable: 24,366 in 2022 against 24,349 in 2023. However, trends across the single corridors differ from each other. Gotthard, Brenner and Tarvisio register a slight decrease of flows in 2023 compared to 2022: ca -3%, -2% and -1%, respectively. The other four observed corridors register minor increases of flows in the range of +1 to +3% (except for San Bernardino: +12%, but with very low absolute flows).

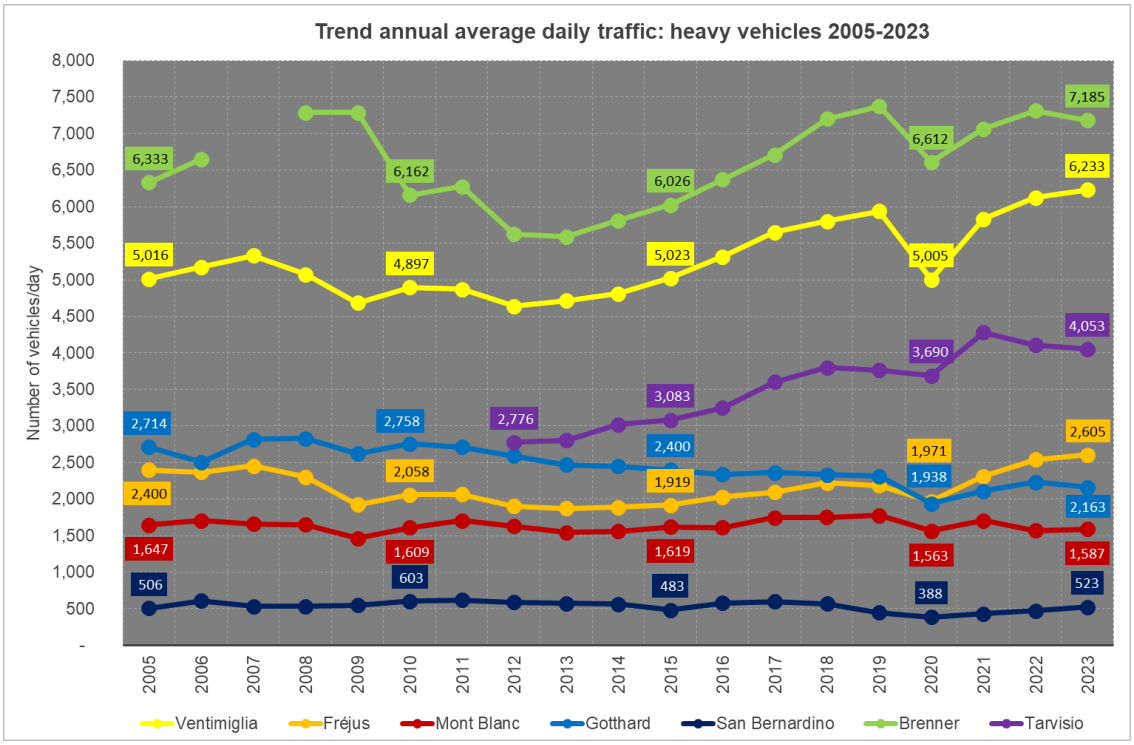


Figure 5: *Annual average daily traffic: heavy vehicles per day.*

MAIN INSIGHTS: Ca 24,350 heavy vehicles per day cross the seven iMONITRAF! corridors: ca the same as in 2022 and +2% compared to 2019 (pre-pandemic values).

Overall, the period 2020-2023 (i.e. from the beginning of the Covid-19 pandemic until the last year) shows a consistent rebound trend for light and heavy vehicles across corridors. As visible in Figures 4 and 5, the Covid-19 pandemic had a sharper effect on the flows of light than heavy vehicles. Nevertheless, both types of flows generally returned to the pre-pandemic levels by 2022, and consolidated in 2023. In fact in 2023, all observed corridors register traffic flow values similar to or higher than those of 2019. A relevant decrease of total flows by ca 7% can be seen only for Mont Blanc (in 2023 compared to 2019). However, this condition is linked also to the maintenance works affecting the Mont Blanc tunnel in the last two years. A slight decrease (by ca 2%) is visible only for the Brenner in the same period.

Indicator 2: Transported tons and modal split

Figure 6 shows the development of the annual amount of tons transported along the iMONITRAF! corridors in the period 2005-2023 by road and rail, while Figure 7 focuses on 2023. To provide more detailed information, Figure 8 focuses on the modal split road-rail for the corridors offering both options, while Figure 9 shows the modal split among the different types of available rail services.

(2a) Transported tons rail-road (Figures 6 and 7): In 2023, over 157 Mt are transported across the eight observed corridors. About 108.6 Mt are transported by road (69%) and ca 48.7 Mt by rail (31%). Following the trend of the previous years, the Brenner corridor on the road alone registers the highest amount of transport goods among the iMONITRAF! corridors: ca 38.8 Mt are transported per road along the Brenner, i.e. almost 25% of the total annual amount of transported tons across all Alpine road and rail corridors. The Ventimiglia road corridor registers the second highest amount (21.7 Mt), followed by the Gotthard rail corridor (18.1 Mt). Compared to 2022, a

decrease of transported tons is generally registered. Overall, the number of transported tons decreases by ca 5%, from 166.2 to 157.5 Mt. This trend is more evident for rail (-11%) than for road (-2%). The corridor registering the sharpest decrease is Mont Cenis (rail): -41%. However, this is due to a rockslide that caused the closure of the rail line since August 2023. Also the Tauern, Brenner and Gotthard register a relevant decrease of tons transported by rail: -20%, -12% and -8% respectively. However, these variations bring the rail values of these three corridors almost back to the pre-pandemic figures of 2019. Among the road corridors, negative variations are less evident: max -5% in most cases. Only the Mont Blanc (road) registers a more visible decrease by ca -8%. However, this is influenced by the maintenance works that affected the operation of the Mont Blanc tunnel. To summarise, 11 out of the 14 observed road and rail corridors register a decrease in 2023 compared to 2022, and the three most evident decreases regard rail corridors.

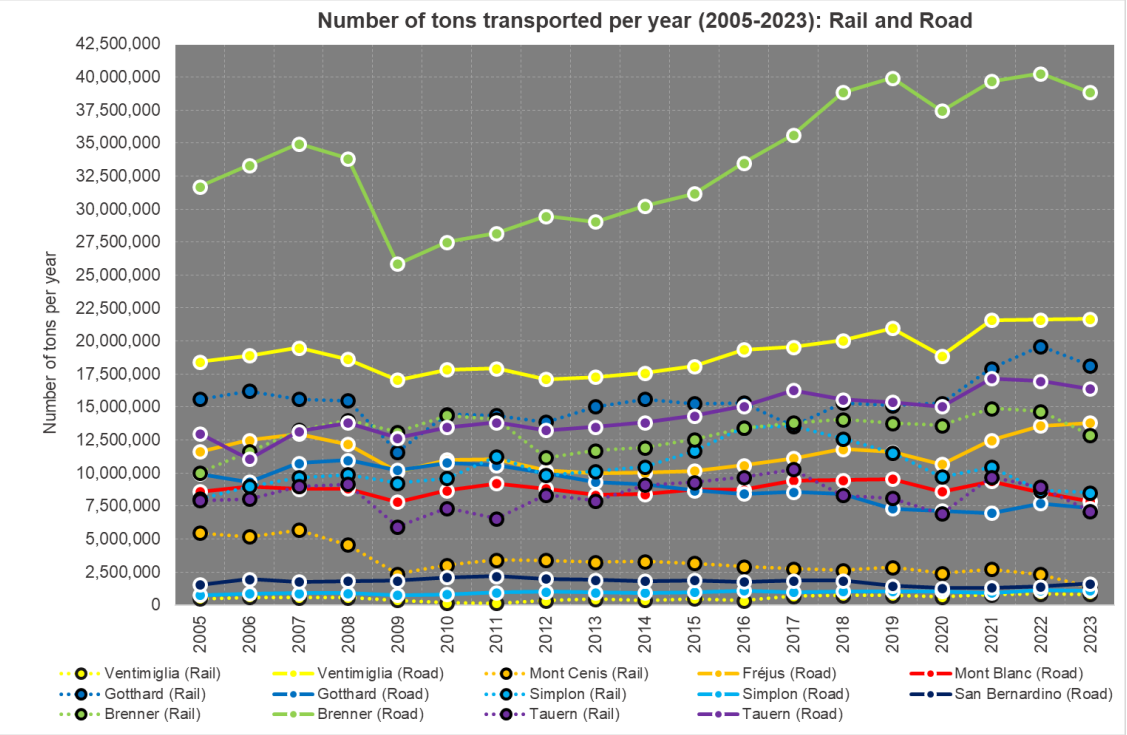


Figure 6: *Number of transported tons per year by rail and road.*

MAIN INSIGHTS: 108.6 Mt/year by road (69%) and 48.7 Mt/year by rail (31%). Both rail and road volumes decreased compared to 2022, by 11% (rail) and 2% (road), leading to an overall decrease by ca 5%.

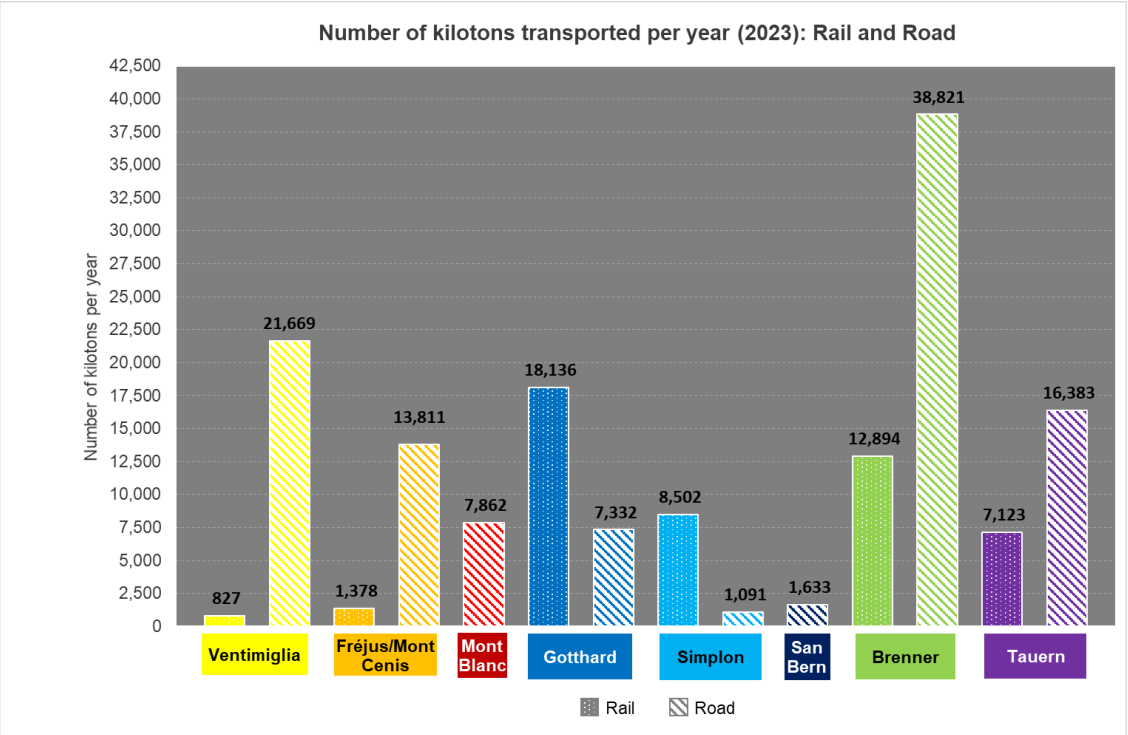


Figure 7: *Number of transported kilotons per year by rail and road in 2023.*

MAIN INSIGHTS: Highest road volumes at the Brenner (38.8 Mt/year) and rail ones at the Gotthard (18.1 Mt/year). This hierarchy is the same as in 2022 and in the previous years.

(2b) Modal split rail-road (Figure 8): In 2023, two out of the six corridors offering both rail and road transport exceed the share of 50% for rail transport: Simplon (89%) and Gotthard (71%). The other four ones register shares between 4% and 30%: Tauern (30%), Brenner (25%), Mont Cenis (9%), and Ventimiglia (4%). Compared to 2022, a decrease (or stabilisation) of rail shares is visible for all the corridors (coherently with the description of transported tons provided in paragraph 2a). Simplon and Ventimiglia maintain the same share of 2022: 89% and 4% respectively. Gotthard passes from 72% to 71%. Brenner, Tauern and Mont Cenis register the most negative changes: -2%, -4%, and -6%, respectively. For Tauern and Mont Cenis in particular, this trend is in line with that one of 2022, when rail shares slightly decreased compared to 2021. However, the variation at Mont Cenis must be interpreted by considering the rockslide of August 2023 mentioned above.

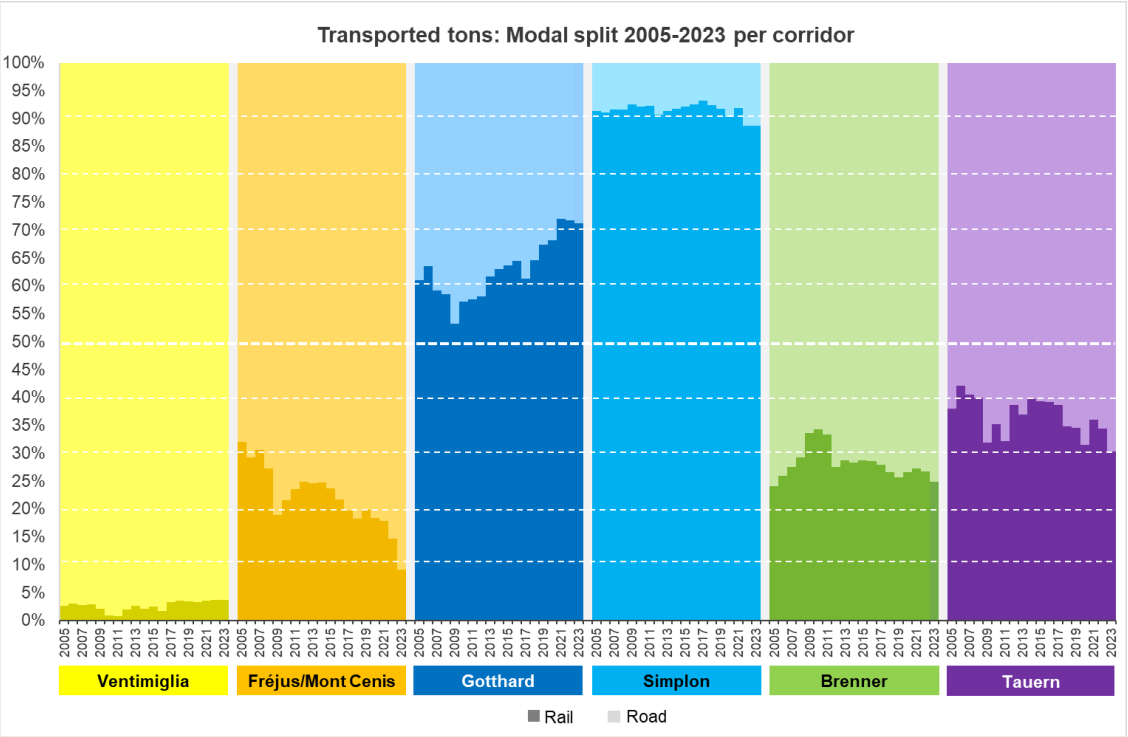


Figure 8: *Modal split of transported tons per year: road and rail.*

MAIN INSIGHTS: General stabilisation or decrease in rail share for most of the corridors: Simplon and Ventimiglia maintain the same rail share of 2022, while Brenner, Tauern and Mont Cenis register decreases in range 2-6%.

(2c) Modal split rail services (Figure 9): The railway component distinguishes the type of service between conventional transport, unaccompanied combined transport (UCT) and accompanied combined transport (ACT). In 2023, conventional rail transport is the most diffused option for Ventimiglia and Tauern (ca 60% for both) and plays a relevant role for the other four rail corridors (with a share between 15% and 44%). UCT is instead the most adopted option in the other four corridors (Mont Cenis, Gotthard, Simplon, Brenner), with values between 72% (Gotthard) and 56% (Mont Cenis). Finally, ACT generally plays a minor role, covering a share of ca 18% and 16% for the Brenner and Simplon, while being phased-out at the other rail corridors.

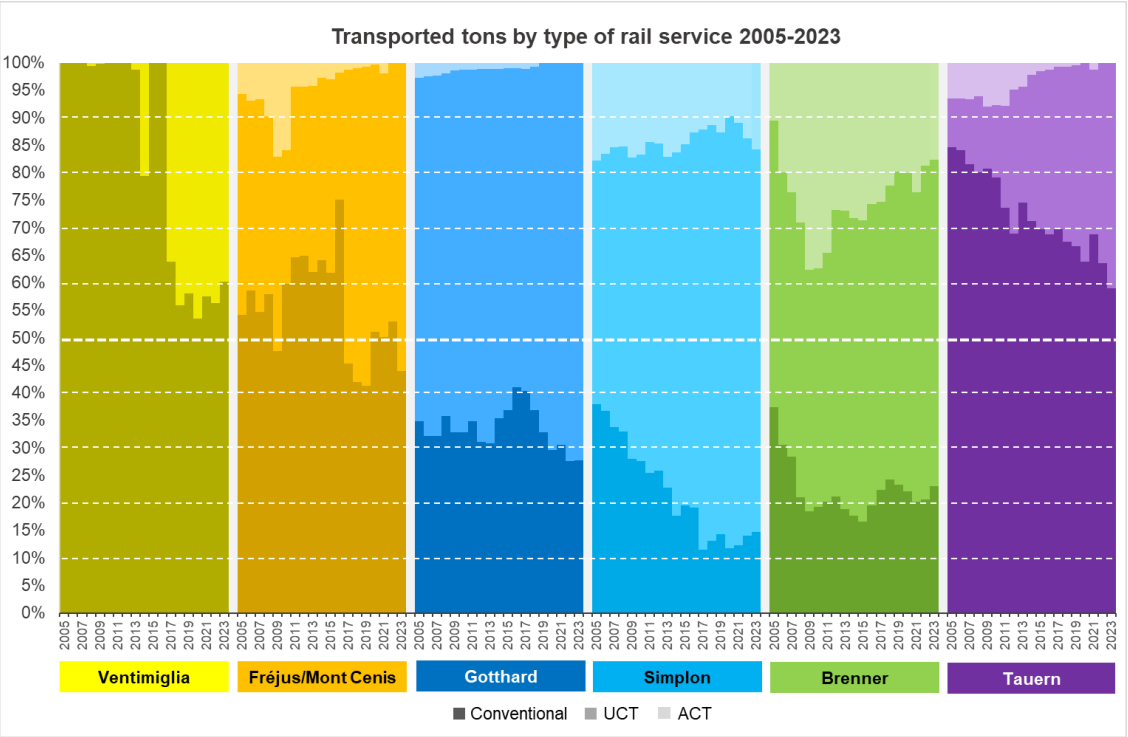


Figure 9: *Modal split of transported tons per year: rail service type.*

MAIN INSIGHTS: *Conventional rail service and UCT remain the most used types of rail transport in most of the corridors. ACT plays a minor role and is used only at the Brenner and Simplon corridors.*

Indicator 3: Concentration of air pollutants

Figures 10 and 12 illustrate the trend in annual average for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) ambient concentrations in the period 2005-2023. Figures 11 and 13 focus on 2023. NO_2 data is collected at stations near the highways of the observed iMONITRAF! corridors since NO_2 is mainly related to road transport (and particularly to diesel vehicles). Similarly, the analysis of PM_{10} concentration data is restricted at the roadside stations.

(3a) Nitrogen dioxide - NO_2 (Figures 10 and 11): In 2023, the highest concentrations are measured at the stations of Bressanone sud/Brixen süd, Avio and Vomp (Brenner). This result is related to the road traffic volumes, but it is affected also by other elements like the composition of vehicle fleet (share of vehicle categories, share of EURO classes) and meteorology. In 2023, the NO_2 values do not exceed the EU annual limit of 40 µg/m^3 for any stations. The station of Camignolo (Gotthard) reaches the national limit defined for Switzerland of 30 µg/m^3, while the station of Vomp on the Brenner exceeds the Austrian limit of 30 µg/m^3 while it complies with the tolerance value of 35 µg/m^3. Compared to 2022, 14 out of the 16 active monitoring stations register a decrease of NO_2 concentrations, while the remaining two (Ora and Oberaudorf along the Brenner) maintain the same values of 2022. On average, the concentrations decrease by 9% across all the monitoring stations. The stations registering the most evident decreases are Susa (Fréjus), Camignolo (Gotthard), and Ugovizza-Tarvisio (Tarvisio), all registering a variation of -17%.

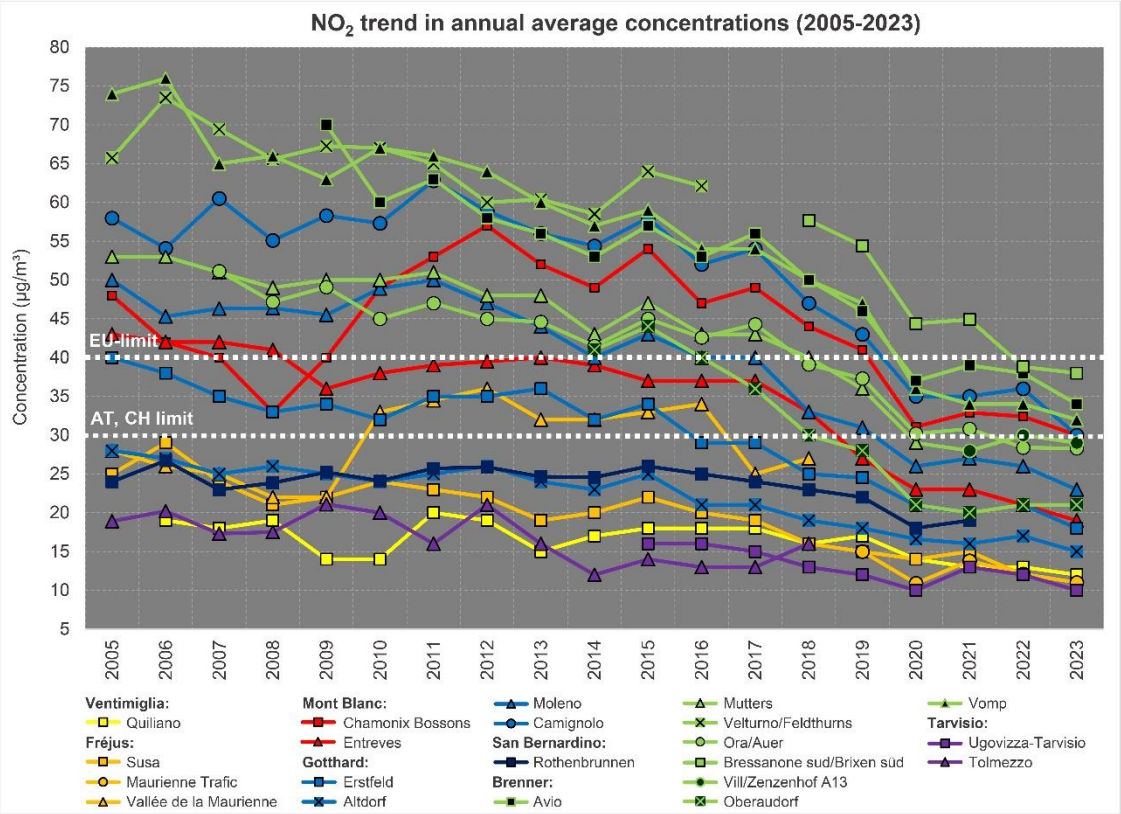


Figure 10: *NO_2 trend in annual average concentrations (2005-2023).*

MAIN INSIGHTS: *2023 values are on average lower by 9% than those of 2022 across all the stations. 14 stations out of 16 register a decrease of values, while two stations maintain the same values of 2022.*

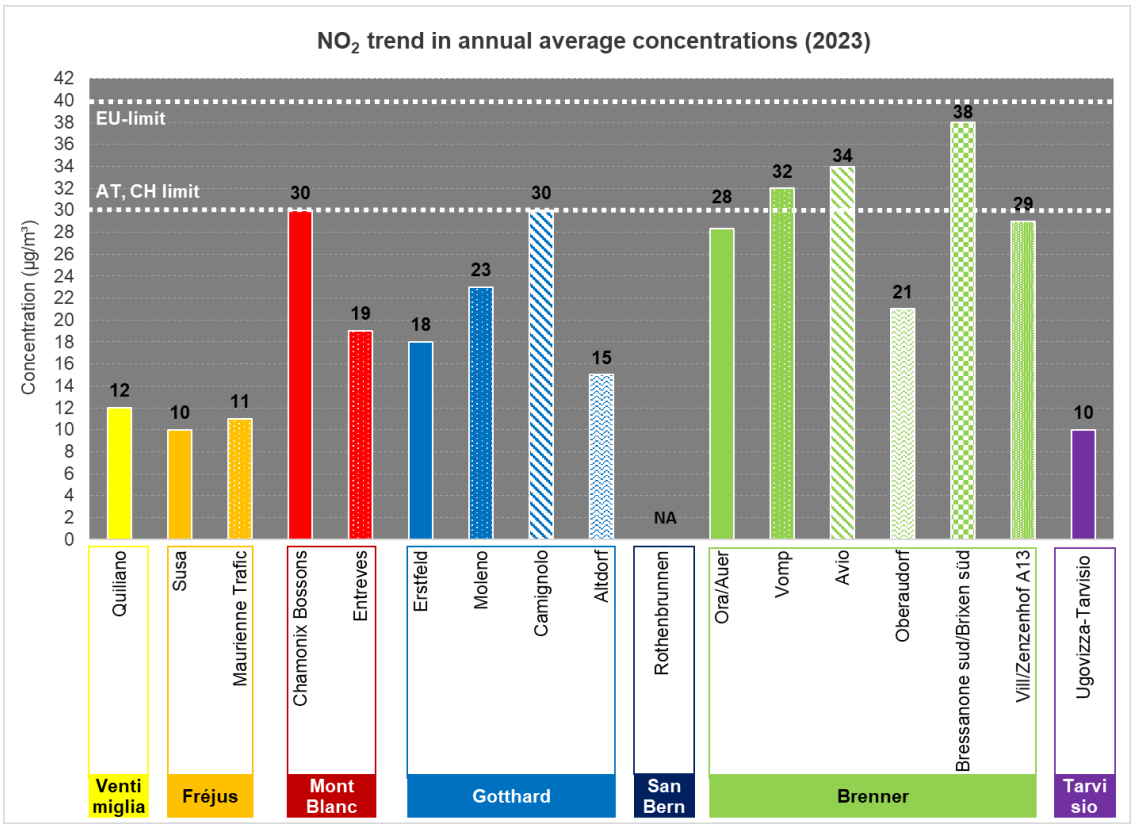


Figure 11: *NO_2 trend in annual average concentrations (2023).*

MAIN INSIGHTS: *No station exceeds the EU limit of 40 µg/m³. The five stations with the highest values are located along the Brenner (3 stations), Gotthard (1 station) and Mont Blanc (1 station).*

(3b) Particulate matter - PM_{10} (Figures 12 and 13): In 2023, the highest PM_{10} concentrations are registered at three Brenner monitoring stations: Avio, Ora/Auer, and Bressanone sud/Brixen Süd; as well as at one Ventimiglia station: Quiliano. Nevertheless, no station reaches or exceeds neither the EU limit of 40 µg/m³ nor the national limit of 20 µg/m³ set in Switzerland and Austria. Compared to 2022, a general decrease of PM_{10} concentration values is registered. Specifically, 15 out of the 16 monitoring stations register a decrease of values and one station (Vill/Zenzenhof A13 at the Brenner) maintains the same value of 2022. On average, the decrease registered across all the station is of -13%. The stations registering the most evident negative variations are Camignolo and Altdorf (Gotthard) with respectively -30% and -23%, followed by Quiliano (Ventimiglia) with -18%.

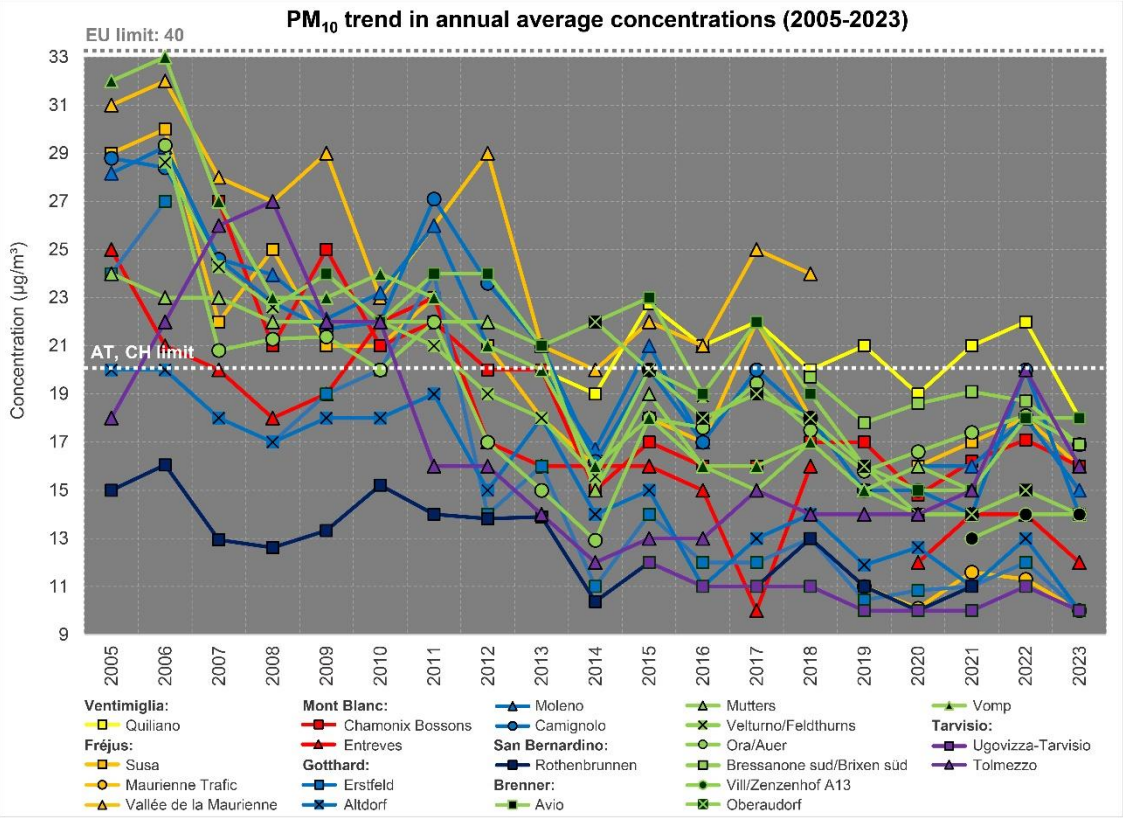


Figure 12: *PM_{10} trend in annual average concentrations (2005-2023).*

MAIN INSIGHTS: *2023 values are on average lower by 13% than those of 2022 across all the measuring stations. 15 stations out of 16 register a decrease of values, while one station maintains the same value of 2022.*

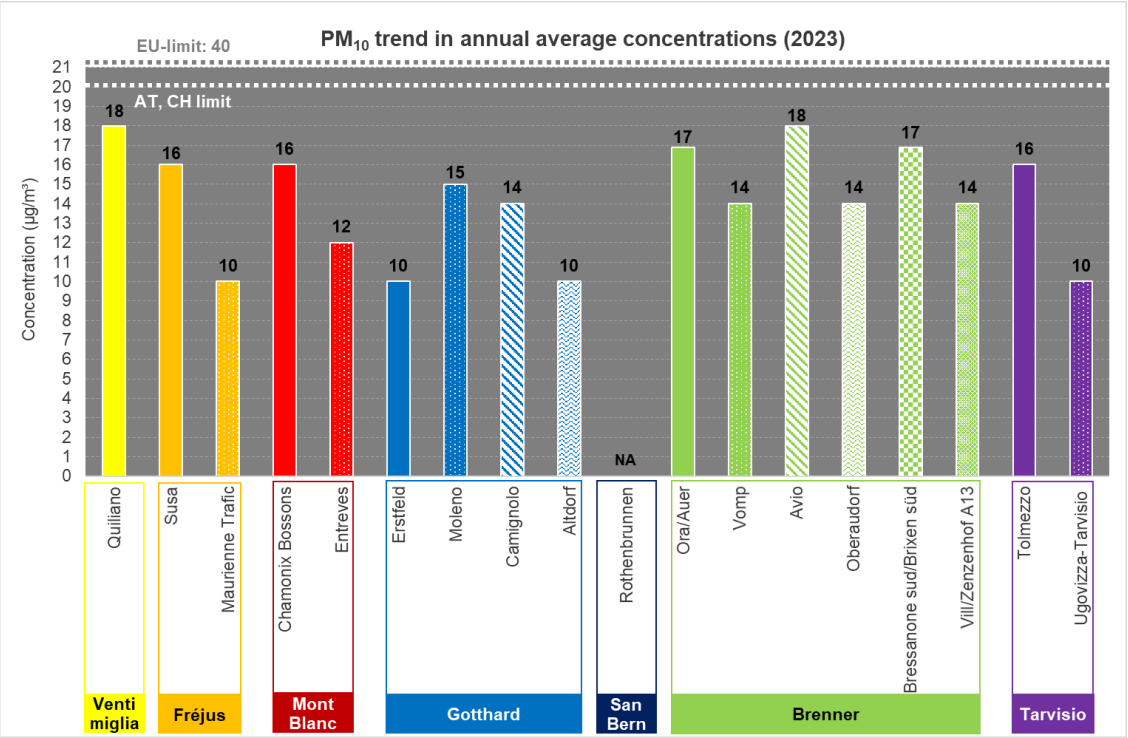


Figure 13: *PM_{10} trend in annual average concentrations (2023).*

MAIN INSIGHTS: *No station exceeds the EU limit of 40 µg/m³. The four stations with the highest values are located along the Brenner (3 stations) and Ventimiglia (1 station).*

A couple of caveats are necessary: PM_{10} concentrations are (more strongly than NO_2) influenced by sources other than transport, such as wood heating installations. Yet, secondary PM_{10}, built from gaseous precursor concentrations (NO_x, SO_2, NH_3, VOC), can contribute to half of the PM_{10} concentrations measured. The long-term trends can therefore not only be traced back to the development of PM_{10} emissions of road vehicles.

Indicator 4: Exposure to noise

Figures 14 and 15 illustrate the trend in annual average level of exposure to noise through two indicators: L_{den} and L_{night}, respectively. The former defines the overall level registered during the day, evening and night and is used to describe the general annoyance caused by noise. The latter indicates the levels registered during the night only and it is used to describe sleep disturbance.

(4a) Overall noise level - L_{den} (Figure 14): In 2023, L_{den} lies in the range between 67.6 dB(A) registered at Châtillon (Mont Blanc) and 77.2 dB(A) at Camignolo (Gotthard). The other active monitoring station considered along the Gotthard (Reiden) registers the second highest value: 76.3 dB(A). Compared to 2022, two different trends can be observed. The two stations along the Mont Blanc corridor and the station of Reiden at north of the Gotthard corridor show a sensible decrease of noise values: ca -4% for all of them. Conversely, the stations of Camignolo at south of the Gotthard corridor and the one of Rothenbrunnen (San Bernardino) register a slight increase by ca 1%. The decrease registered for Reiden is related to the maintenance works that took place in the area, and to the replacement of the old pavement with a quieter one. Instead, the decrease showed by the Mont Blanc stations is due to the maintenance works that limited the traffic along the highway, thereby influencing the noise measurements occurred in the affected days. These maintenance works were mostly performed in the night and evening hours.

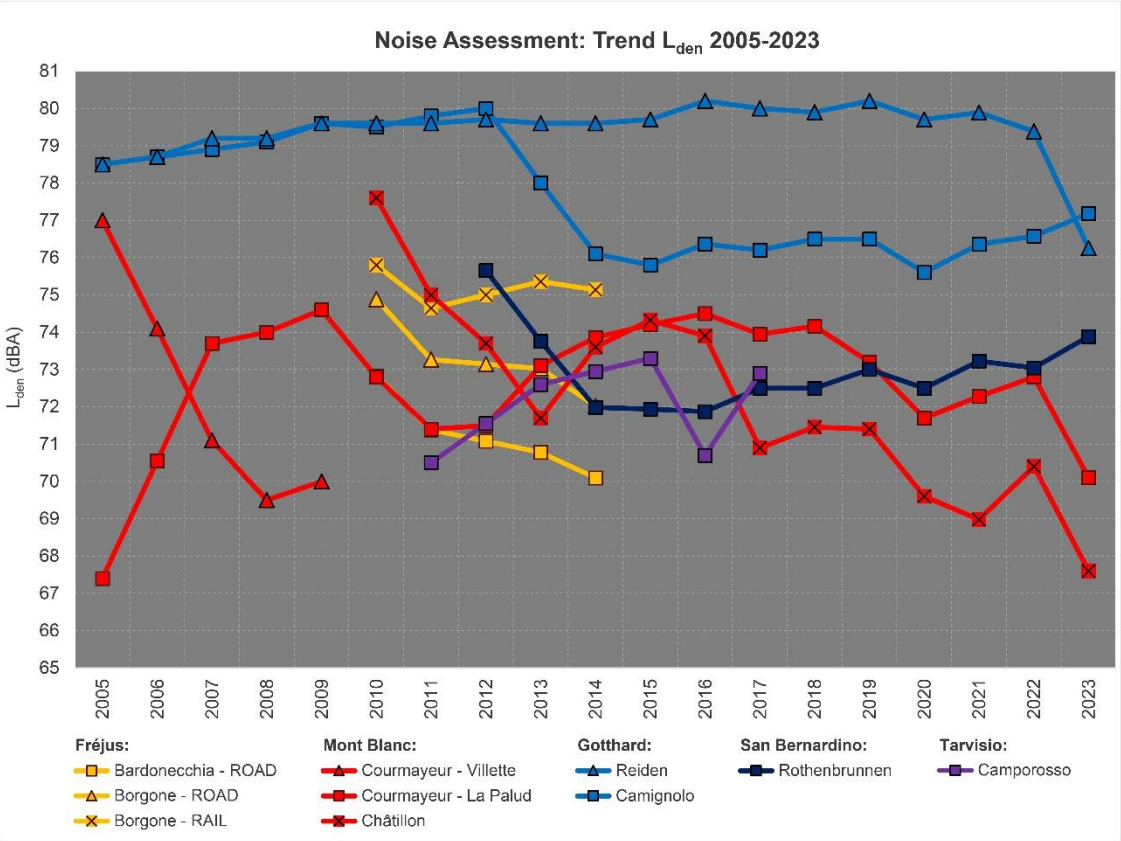


Figure 14: *L_{den} trend in daily average noise level (2005-2023).*

MAIN INSIGHTS: *Similarly to air pollutant concentrations, also noise levels register a decrease in 2023 compared to 2022 in three out of five stations, and maintain consistent values in the remaining two stations.*

(4b) Night noise level - L_{night} (Figure 15): The L_{night} data basically reflects the hierarchies and trends described for L_{den}. In 2023, L_{night} lies in the range between 59.5 dB(A) at Châtillon (Mont Blanc) and 69.4 dB(A) at Camignolo (Gotthard). This latter is closely followed by Reiden (Gotthard), with 68.9 dB(A). Compared to 2022, also the L_{night} values show a sharp decreasing trend for the two Mont Blanc stations and for Reiden along the Gotthard, while a slight increase is visible for Camignolo (Gotthard) and Rothenbrunnen (San Bernardino). Such discrepancies in trends can be linked to the same reasons described above for L_{den} referring to the stations of Reiden (Gotthard), Châtillon and La Palud (both Mont Blanc).

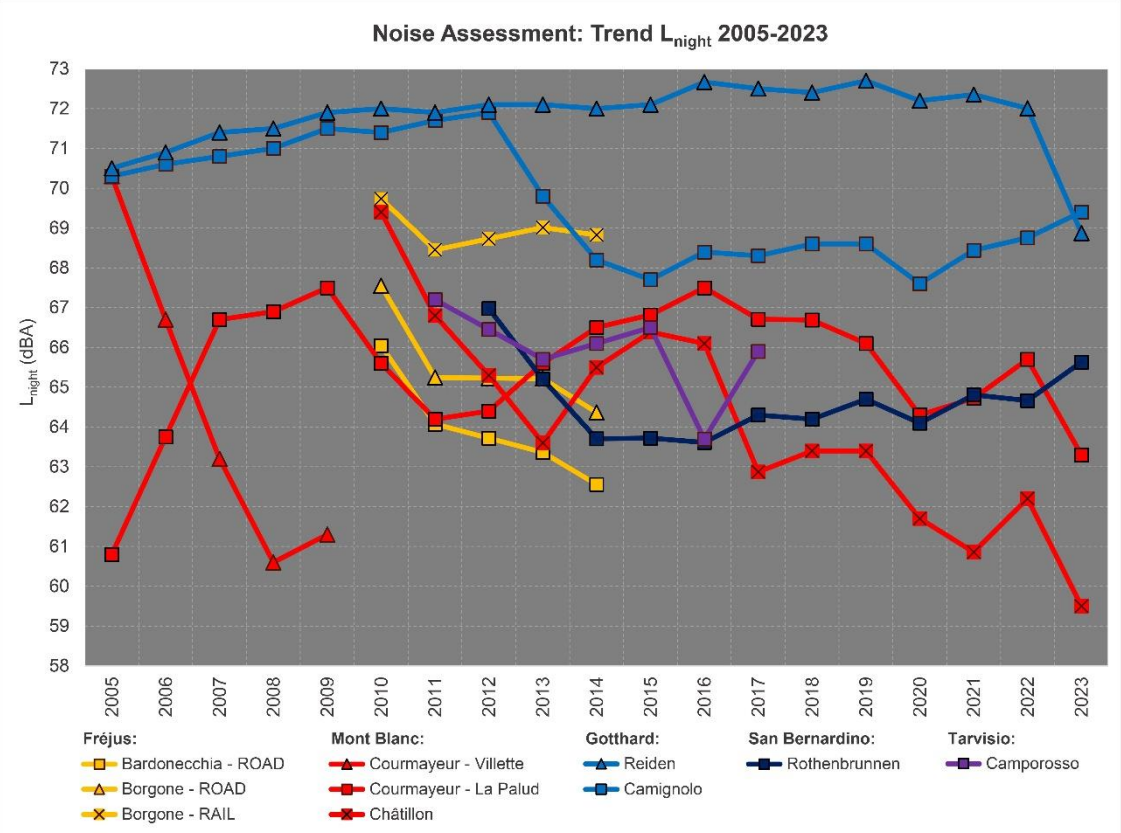


Figure 15: *L_{night} trend in night average noise level (2005-2023).*

MAIN INSIGHTS: *The noise levels during the night follow the general trend of the noise levels during the day. Noise levels lie in the range between 59.5 dB(A) at Châtillon (Mont Blanc) and 69.4 dB(A) at Camignolo (Gotthard).*

Indicator 5: Toll prices

Toll prices (as well as all other economic indicators) are presented for 2024. Figures 16 and 17 show the total price of a single transit in direction north-south for each corridor, and the kilometric cost of the same transit, respectively. For freight forwarders, the kilometric price is an important criterion for choosing the most convenient corridor and transport mode. Prices are reported for a standard passenger car and three standard heavy vehicles of 5 axles and 40 t, with a distinction between EURO-classes II, V and VI.

(5a) Whole price for transit (Figure 16): In 2024, the highest tolls for ***passengers cars*** are applied at the Fréjus and Mont Blanc (€95.90 and €89.90 respectively). These values are highly affected by the cost of the passage across the tunnels. The charges for Ventimiglia, the Swiss highways and Brenner are in the mid-range, while the costs at Tarvisio are the lowest (€32.90). For ***heavy vehicles***, road tolls follow a similar West-East-divide as for passenger cars: highest tolls apply at the Fréjus and Mont Blanc; middle-range values at Gotthard and San Bernardino; lowest values for Brenner and Tarvisio. Ventimiglia does not fit into the West-East-divide as it does not include a tunnel charge and thus has the lowest price of the French-Italian corridors. Simplon charges low prices but its distance is considerably shorter than the other corridors. Besides, it is relevant to notice how prices vary across EURO classes. Italian and French highways apply the same tolls to all the EURO classes, as evident for the Ventimiglia, Fréjus and Mont Blanc corridors. This partially affects also the Brenner and Tarvisio, since they involve Italian, Austrian and German sections. Accordingly, the variability of their tolls is limited: EURO II heavy

vehicles pay ca 12-13% more than EURO VI ones. The most evident EURO-dependent variation is registered at the Gotthard and San Bernardino, where EURO II heavy vehicles pay ca 36% more than EURO VI ones. Compared to 2023, a general increase of toll prices is registered. For ***passenger cars***, the increase ranges between +2% (for Swiss corridors) and +6% (for Ventimiglia and Tarvisio). For ***heavy vehicles***, increases are more evident, especially when considering EURO II vehicles. Excluding the Swiss corridors (all registering +2% variations for all EURO classes), increases amount to: +4% for all EURO classes at Ventimiglia; +5% for all EURO classes at Fréjus and Mont Blanc; +6-9% at Tarvisio and +12-17% at Brenner depending on the EURO class (with the EURO II heavy vehicles registering the highest increase). For the Brenner corridor, the increase in toll prices is due to the inclusion of the new CO_2-charge within the toll pricing schemes applied in Austria and Germany (see chapter 6 and Annual Report 2023 for more information).

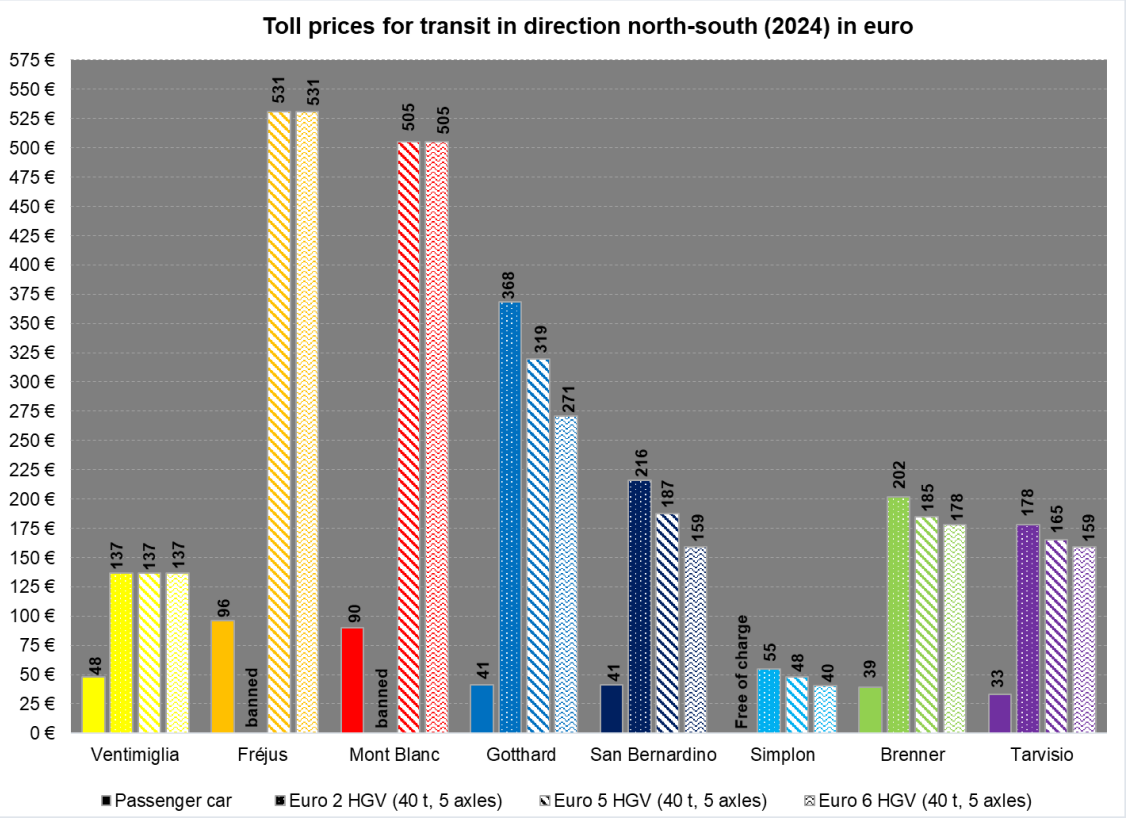


Figure 16: *Toll prices for a single transit on the iMONITRAF! corridors in direction North-South (2024).*

MAIN INSIGHTS: *Similarly to the previous years, considerable differences along corridors are visible. The French-Italian corridors with specific charges for using the road tunnels are those with the highest toll prices.*

(5b) Km price for transit (Figure 17): In 2024, the order of corridors from highest to lowest prices remains similar to that one derived from absolute costs. For instance, focusing on a EURO VI heavy vehicle of 40 t, the highest km values are registered at the Mont Blanc (€2.22/veh-km) and Fréjus (€1.78/veh-km). Also the variations compared to 2023 are generally consistent: Brenner and Tarvisio are the two corridors showing the highest increase of km prices, with a peak of +17% when it comes to EURO II heavy vehicles of 40 t crossing the Brenner corridor.

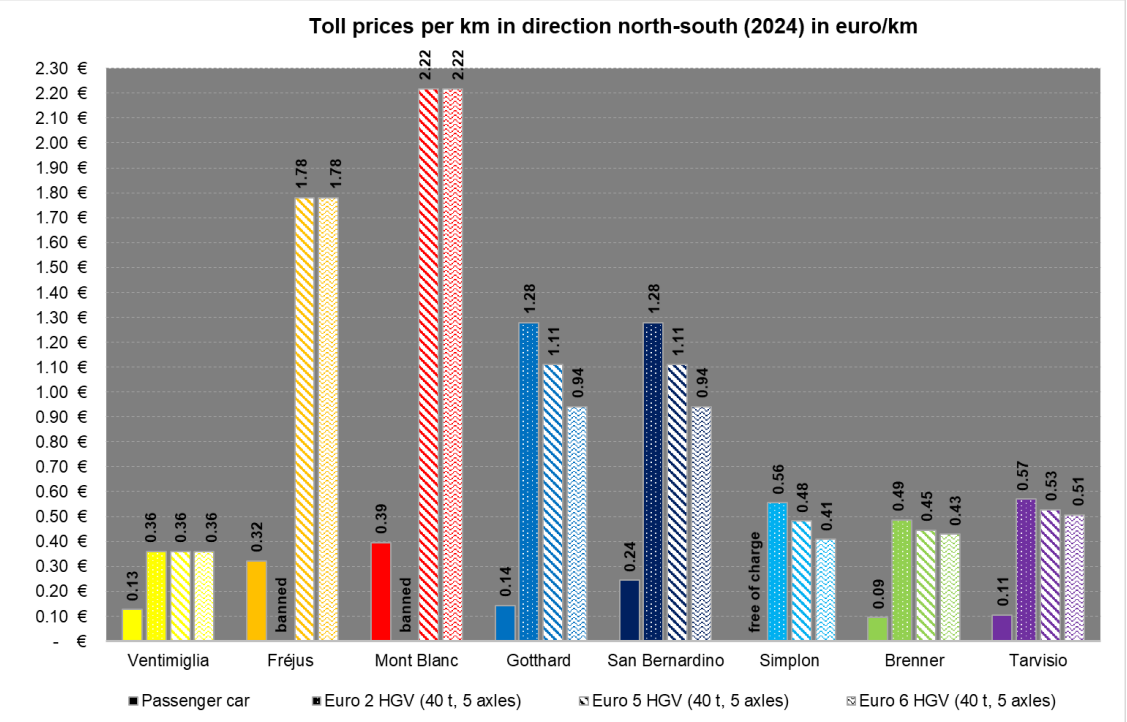


Figure 17: *Kilometric toll prices (€/km) for a single transit on the iMONITRAF! corridors in direction North-South (2024).*

MAIN INSIGHTS: *Considerable differences between the kilometric toll prices can be seen, showing a similar pattern than the absolute values. Generally, corridors with high kilometric toll prices tend to have lower traffic volumes and vice versa.*

Indicator 6: Fuel prices

Figure 18 reports the average yearly prices of diesel and petrol at national level in Austria, France, Italy, Switzerland and Germany (i.e. the key countries crossed by the iMONITRAF! corridors).

In 2024, average prices registered across the five observed countries are €1.73/litre for diesel and €1.78/litre for petrol. The highest diesel and petrol prices are registered in Switzerland (€1.99 and €1.90)[3], while the lowest values are reached in Austria (€1.59 and €1.58). Compared to 2023, prices are lower by 4% for diesel and 2% for petrol across all the considered countries. The most evident decreases regard the prices of diesel in France, Germany and Austria (-6%, -5% and -4%, respectively); as well as the prices for petrol in Italy, France and Germany (-3% for all of them). Only the Swiss petrol price shows an opposite trend: +2% compared to 2023. Considering a longer perspective of the last five years (2020-2024), the decrease of prices registered in 2024 compared to 2023 is in line with the previous decrease registered in 2023 compared to 2022 (-5% for diesel and -2% for petrol on average across the five observed countries). Nevertheless, the values registered in 2024 are still sensibly higher than those registered in 2021 for all the countries (last year before the beginning of the war in Ukraine and of the growth of the inflation rate that affected the EU in the last three years).

[3] Exchange rates (EUR/CHF) used for the estimation: 1.0694 (January 2024); 1.0204 (May 2024); 1.0251 (July 2024); 1.0645 (October 2024). Source: http://www.frasi.net/utilita/cambiovalute/default.asp?ISO=CHF

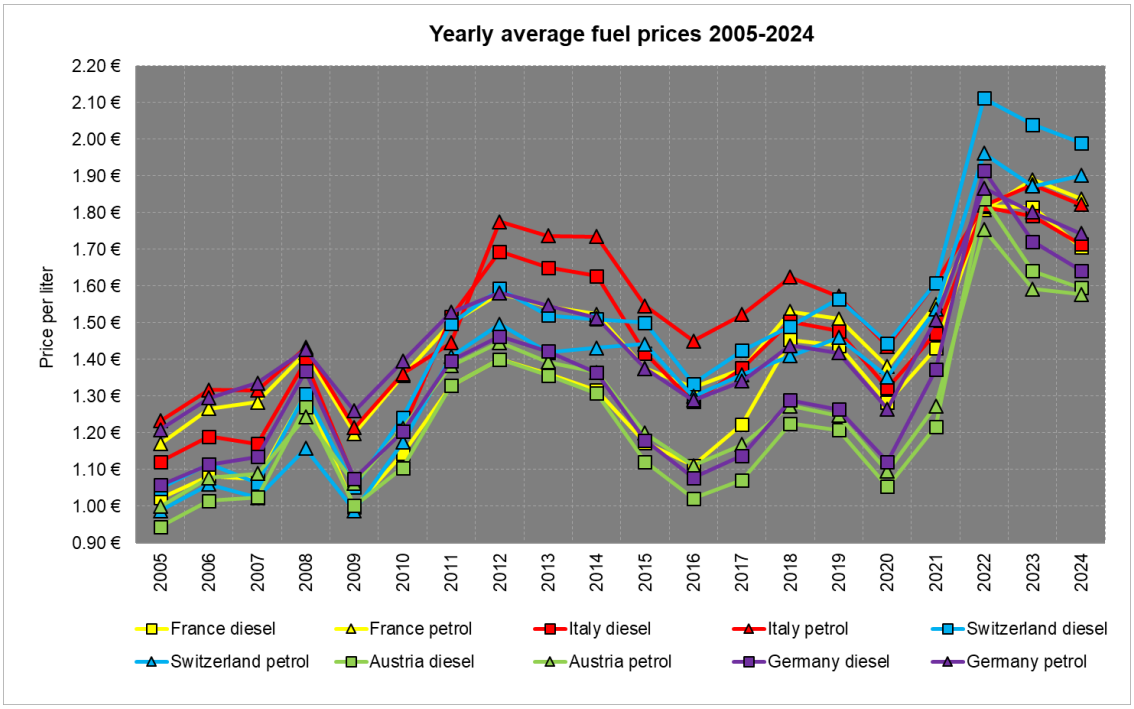


Figure 18: *Annual average fuel prices for diesel and petrol at the national level in € per litre (2024).*

MAIN INSIGHTS: *Fuel prices have generally decreased by 4% for diesel and 2% for petrol compared to 2023. This decrease is consistent with that one registered in 2023 compared to 2022, but prices are still much higher than in 2021.*

Indicator 7: Alternative-fuel refuelling stations

Figure 19 illustrates the alternative-fuel (AF) stations per corridor available in both directions (North-South and South-North) in 2024. The length of the corridors is defined considering the same origins and destinations used for the indicator 6 (toll prices). Methodological details about the data sources and the counting of the stations are available in the Annex.

EV charging stations are the most diffused AF stations along the iMONITRAF! corridors, with 81 stations in total in 2024 (regardless of the number of single charging points). With 19 and 18 stations, the Brenner and Ventimiglia register the highest amount, followed by Gotthard and Mont Blanc (both 11). Hydrogen and LNG stations are instead the least diffused across the iMONITRAF! corridors, with 7 and 4 stations in total, respectively. Only three out of eight considered corridors offer hydrogen refuelling stations: Brenner (3), Fréjus and Gotthard (both 2). Instead, LNG stations are available only along the Brenner (2), Tarvisio and Mont Blanc (both 1). LPG and CNG stations are widely diffused, although not as much as the EV charging stations. In total, 57 LPG and 49 CNG stations are counted along all the corridors. The Brenner and Gotthard are the two corridors with the highest number of CNG stations (22 and 9 respectively), thus covering over 60% of the total. Instead, LPG stations are more evenly distributed among corridors, with the Brenner, Gotthard, Fréjus and Ventimiglia all providing between 10 and 12 stations.

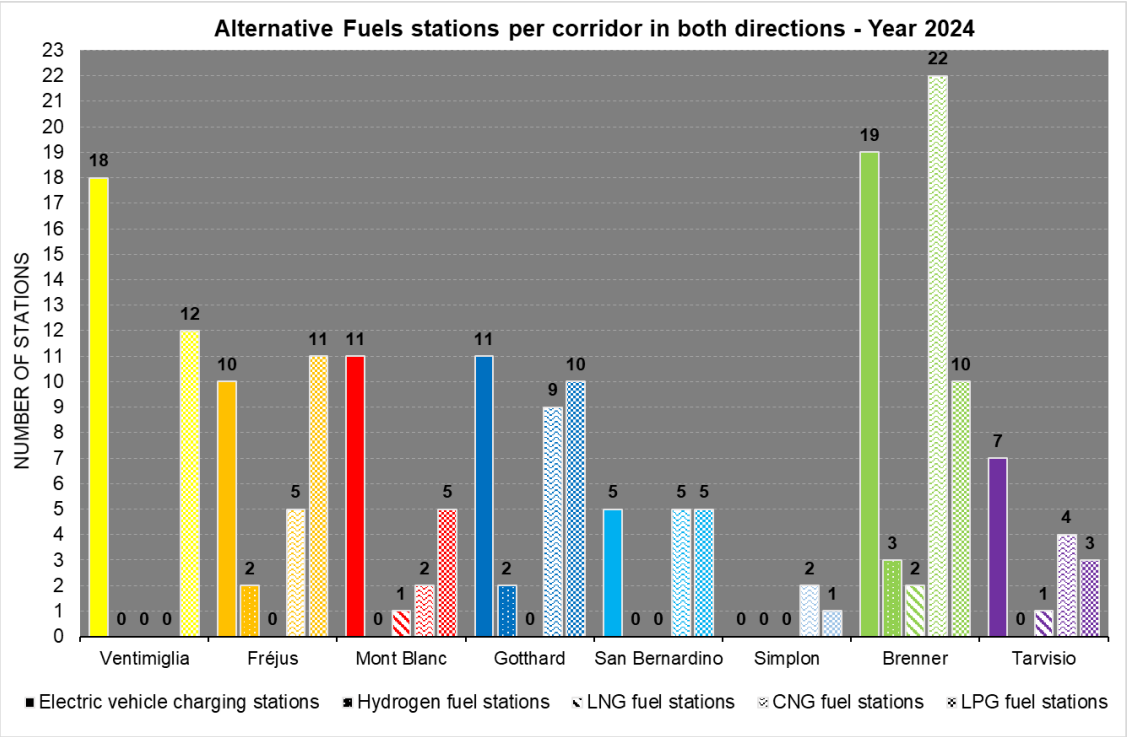


Figure 19: *Alternative-fuel stations per corridor in both directions (2024).*

MAIN INSIGHTS: *EV charging stations are most diffused across the iMONITRAF! corridors with 81 charging stations in total. LPG and CNG stations are also diffused (57 and 49 respectively). Hydrogen and LNG stations are low available.*

Indicator 8: Unitary pricing components

Figure 20 shows the aggregated amount of €/year that vehicle owners have to pay during a vehicle lifecycle to cover taxes related to its purchase and ownership. We consider four taxes (purchase tax, registration tax, ownership tax, insurance tax); four sample vehicles (petrol and electric light vehicle, diesel and electric heavy vehicle); and five countries (France, Italy, Switzerland, Austria, Germany). To allow the aggregation of tax components and comparison among vehicles and countries, we apply some conversions as detailed in the methodological Annex.

Light vehicles: For petrol cars, Italy has the highest total cost (€1,008/year), while Switzerland registers the lowest one (€691/year). The purchase tax covers the largest share for most countries (over 60% on average), while the registration tax has a minor influence (2% on average). The ownership and insurance tax show heterogeneous trends. The former ranges between not being due in France to almost 60% of the total in Switzerland. The latter goes from 6% of the total in Switzerland and Austria, to 23% in France. For electric cars, the aggregated costs show different trends among countries. In Switzerland and Austria, the amount decreases by 9% and 12%. This is mostly due to the reduction or elimination of the ownership tax. In the other three countries, increases between 22% and 32% are registered, mostly due to the higher purchase price (and thus tax) and average insurance premium of the e-cars compared to the petrol ones.

Heavy vehicles: For diesel heavy vehicles, Switzerland shows the highest tax cost (€3,651/year), while France registers the lowest value (€1,261/year). These differences are mostly linked to the ownership and insurance tax, while the registration and purchase tax have minor influences (the latter is deducible in all the countries). The ownership tax covers ca 50% of the total cost on average among the five countries, but with relevant differences between Switzerland (88% of the total) and France or Italy (29% of the total in both cases). The insurance tax is almost even among

France, Italy and Germany (ca 60% of the total), while its relative weight is lower in Austria (39%) and especially in Switzerland (12%). The condition of electric heavy vehicles in comparison with their diesel counterparts significantly varies across countries. In France and Italy, diesel and electric trucks pay almost the same amount (since no specific deduction is given). In Germany and Austria, electric trucks pay respectively 17% and 59% less than diesel ones, thanks to a reduction (Germany) or elimination (Austria) of the registration tax. Finally, the total costs applied in Switzerland are 50% higher for electric trucks since their higher kW power negatively affects the ownership tax (according to the online calculator of the Canton of Ticino).

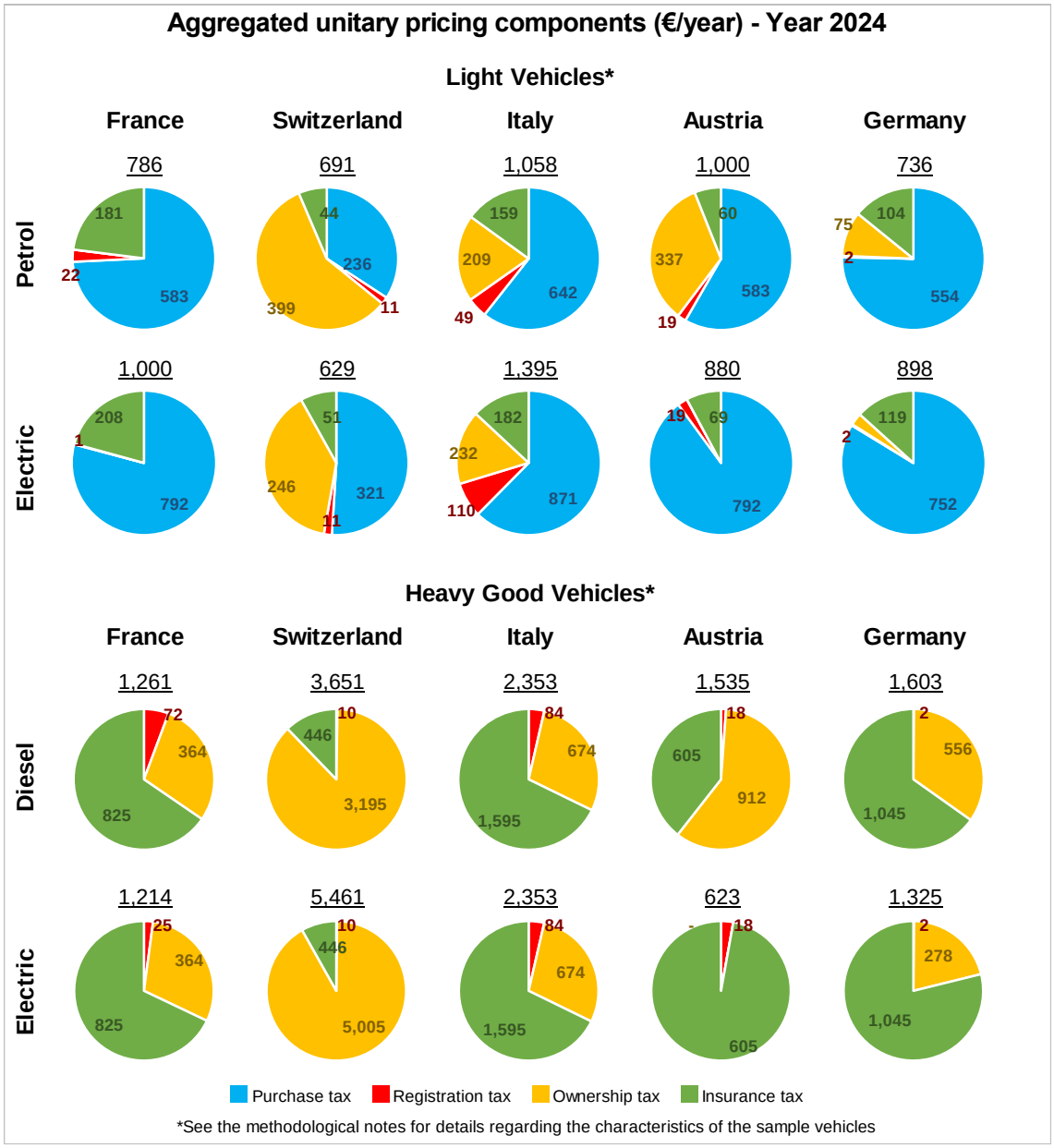


Figure 20: *Aggregated unitary pricing components (2024).*

MAIN INSIGHTS: *Italy and Switzerland register the highest total costs when considering the aggregated tax components. Some tax deductions for electric light and heavy vehicles are available, but they significantly vary across countries.*

5.3 Developments with respect to the iMONITRAF! target indicators

To establish a stronger link between the iMONITRAF! monitoring activities and the policy pathway, iMONITRAF! agreed on a new set of target indicators in 2022. For the work programme 2023-2025, the target indicators are now an integral part of the Annual Report. The target indicators strengthen the fact-based approach of iMONITRAF! as they show if developments are in-line with the target paths or if additional action is necessary. Results can be seen as “early-warning”. If developments are not in line with the target path, joint efforts need to be improved.

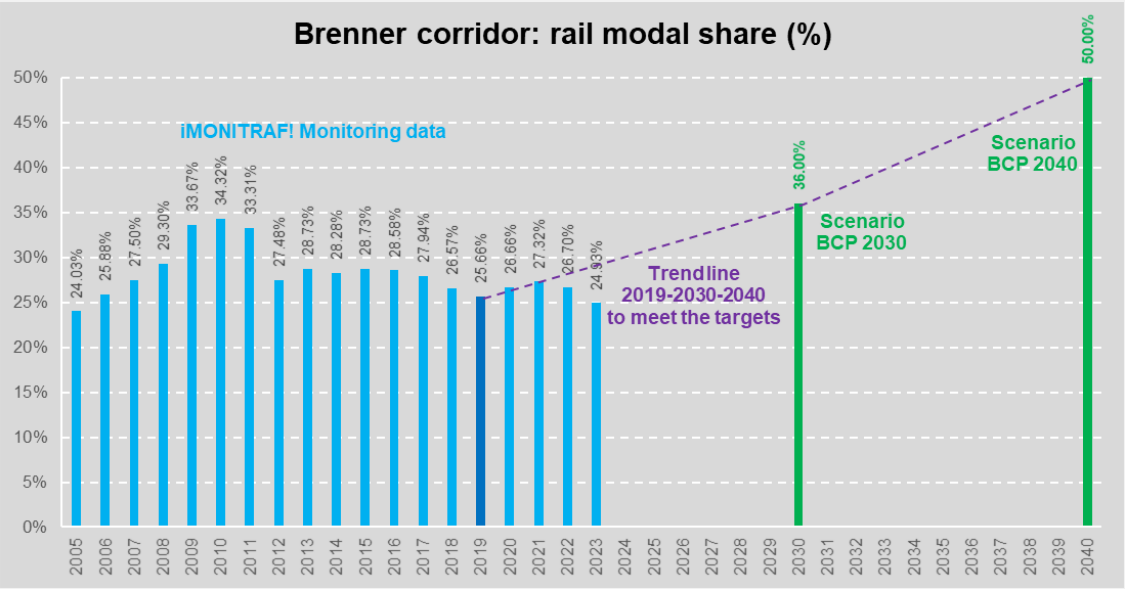
Progress in reaching the modal split target indicators

Modal split targets were defined on the basis of existing strategies and frameworks of the iMONITRAF! regions. For the Brenner, the path leads to the target of a 50% share of rail transport in 2040, assuming that the Brenner Base Tunnel (BBT) and its access tracks are in full operation at this point in time. As intermediate target, a modal split of 36% shall be reached by 2030.

For the Swiss corridors, a modal split of 83.7% is envisaged for 2030. After that, the additional potential is very limited.

The following Figure 21 displays the available modal split data for the Brenner and Swiss corridors (Gotthard, San Bernardino and Simplon) and put them in comparison with the rail modal split targets for 2030 and 2040.

Comparing the 2023 monitoring data with the target paths, it can be seen that developments both on Brenner and the Swiss corridors went into the wrong direction in 2023: on the Brenner, the modal split of rail declined quite considerably by two percentage points from 26.7% to 24.9% - leaving a considerable gap to the target path. On the Swiss corridors, rail modal share also decreased by one percentage point. This means that also in Switzerland developments are no longer in line with the target path.



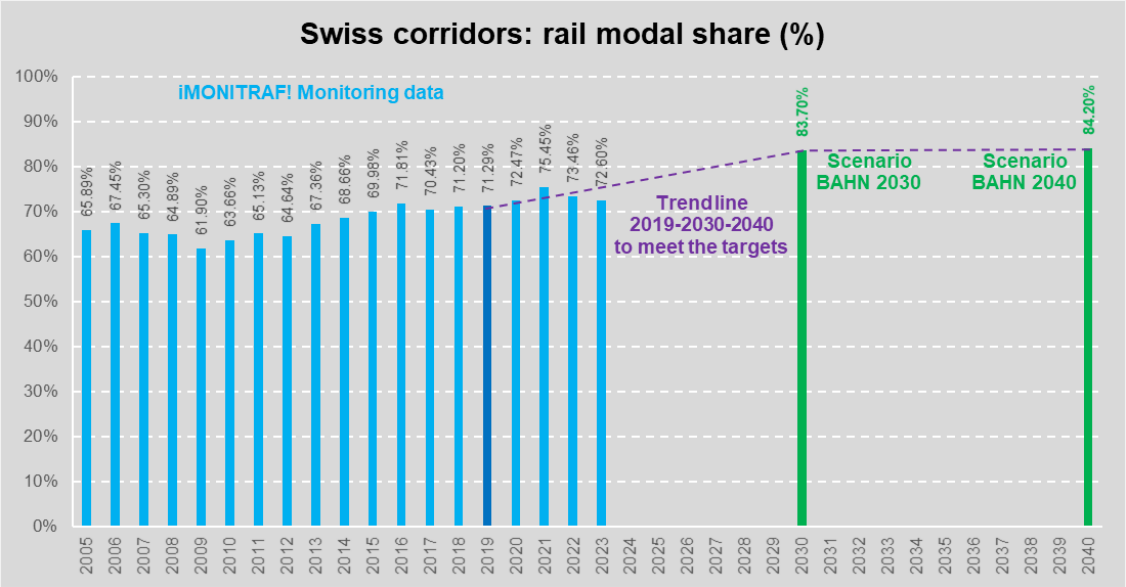
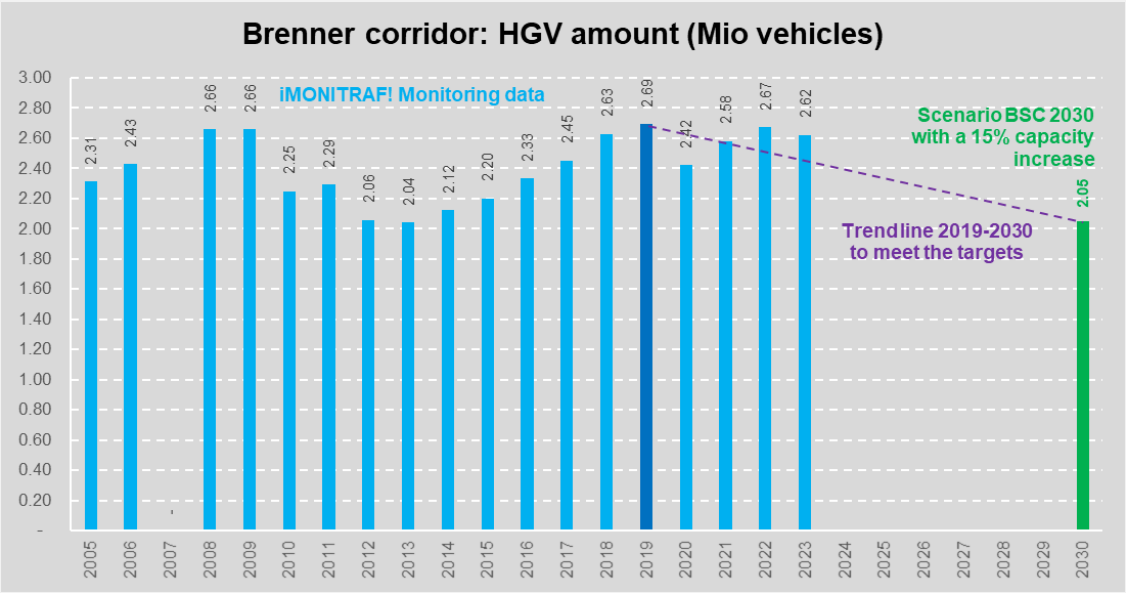


Figure** 21: **Modal split target indicator and target path for the Brenner and the Swiss corridors

The graph shows in blue the monitoring data collected since 2005. In green there are the target indicators for the Brenner and Swiss corridors for 2030 and 2040. The violet dashed line indicates the target path that should be seen in the next years to reach the defined targets (for information on data sources please refer to the Annex).

Progress in reaching the HGV target indicators

Similarly, Figure 22 below highlights the progress in reaching the HGV target indicators. When interpreting the figure, the special effects of the COVID-19 pandemic need to be considered which led to the visible “dip” in HGV volumes in 2020. The figures show the obvious rebound of traffic volumes – both on the Brenner and the Gotthard corridors. Developments on both corridor are no longer in line with the target path as traffic volumes have reached the pre-pandemic levels in 2022 and have stabilized at this level in 2023 – this picture is quite similar on both corridors. Additional efforts are thus necessary to bring the traffic volumes back to the target path.



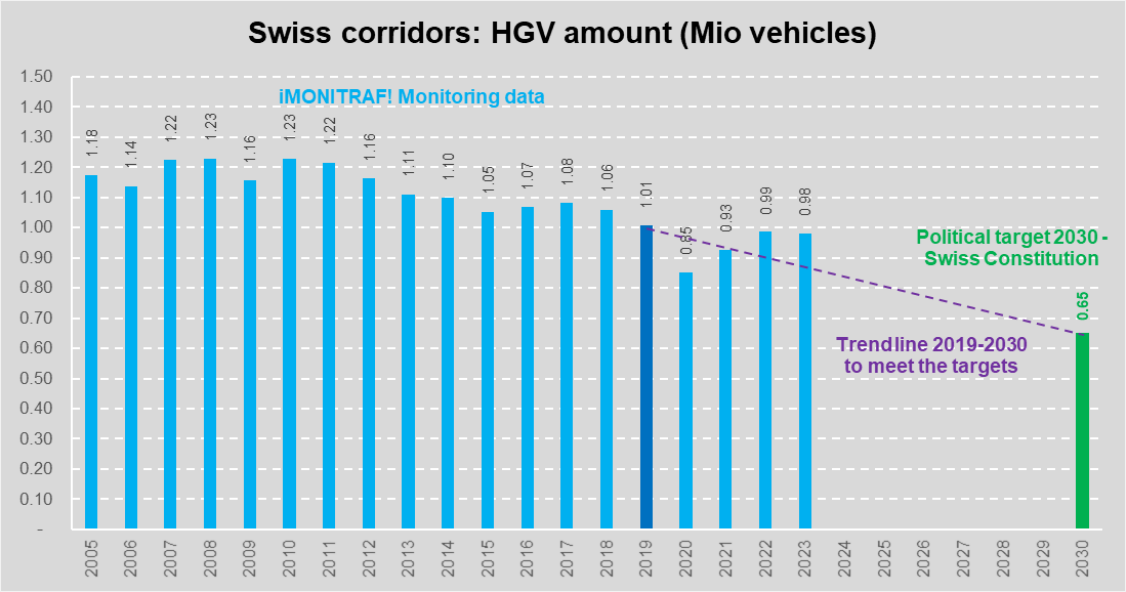


Figure** 22**: HGV target indicator and target path for the Brenner and the Swiss corridors

The graph shows in blue the monitoring data collected since 2005. In green there are the target indicators for the Brenner and Swiss corridors for 2030. The violet dashed line indicates the target path that should be seen in the next years to reach the defined targets.

6 Moving ahead on regional and national level: Update on Best Practices

6.1 Overview on revised and new Best Practices

In 2024, policy measures and frameworks were enhanced and further developed across all iMONITRAF! regions. The compilation of regional measures from iMONITRAF! partners and observers offers valuable insights into recent advancements within the five policy pillars (see table below). As in the previous years, enforcement of existing measures played an important role in pillar 1. Also, the role of coordinated information approaches took was further developed, especially regarding upcoming large-scale construction works on the iMONITRAF! corridors. Regarding pillar 2 with the set of regulatory measures, only few adjustments were reported in 2024, given that the instrument mix in this policy pillar is already very comprehensive and ambitious in most iMONITRAF! regions. In policy pillar 3 which is dealing with modal shift, developments included updates in the pricing frameworks with first implementation steps of the new Eurovignette as well as further developments of key infrastructures. For passenger transport, the iMONITRAF! regions reported several updates on ongoing measures, with a special focus on closing missing links in cross-border public transport services and the improvement of public transport and alternative mobility services through the set-up of mobility platforms/mobility-as-a-service platforms.

OVERVIEW: BEST PRACTICE UPDATE 2024

Policy Pillar	Name of measure	Country/region
Pillar 1: Monitoring, Information & awareness raising	Continuation of monitoring campaigns	All regions
	Extension of HGV control centre Radfeld	Tyrol
Pillar 2: Limiting negative impacts of Alpine transport	Further implementation of noise protection plan, with work on noise barriers along Brenner motorway A22	South Tyrol
	Efficient set of Euroclass driving bans and sectoral driving ban	Tyrol
	Decarbonization initiatives at the Port of Marseille-Fos	Provence-Alpes-Côte-d'Azur
	Information on repair work on Lueg Bridge	Tyrol
Pillar 3: Modal Shift	**Modal shift policy mix and CT**	
	Operational CO_2 charge according to Eurovignette	Austria & Germany
	Adjustment of Swiss HGV charge, adjustment to inflation and charging classes	Switzerland
	Adjustment of train access charges	Switzerland
	Total revision of the Goods Transport Act	Switzerland
	Subsidies for single wagonload rail transport in Tyrol	Tyrol
	Pilot project for rail transport of timber between Bolzano and Tyrol	Tyrol, South Tyrol

Policy Pillar	Name of measure	Country/region
	New Agreement Rail freight transport	Provence-Alpes-Côte-d'Azur
	Infrastructure	
	Brenner Base Tunnel and access routes: milestones	Tyrol, South Tyrol, Trentino
	Lyon-Turin Railway link: Update on construction work	France, Italy
	Flexibilisation of timetable planning for rail freight transport	Switzerland
	New block train connection between Regensburg and Verona with Herom technology:	Bavaria
	Update on Brenner Base Tunnel	Tyrol
Pillar 4: Passenger transport	Euregio Mobility Action Day	Tyrol, South Tyrol, Trentino
	Network expansions in Bavaria continue to progress.	Bavaria
	Missing link in regional railways: Construction of railway variant of the Val di Riga/Riggertal	South Tyrol
	Electrification of Vinschau/Val Venosta railway line – conclusion of safety works	South Tyrol
	New train stop San Giacomo/St. Jakob on the Brenner railway line	South Tyrol
	Cross border mobility - bus connection Mals/Malles – Landeck	South Tyrol
	Extension of passenger transport bus services	South Tyrol
	Network of Regional Metropolitan Express Services (SERM),	Provence-Alpes-Côte-d'Azur
	Strategy to promote active and shared mobility, including infrastructures and campaigns	Provence-Alpes-Côte-d'Azur
Pillar 5: Innovative approaches	"MaaS4SouthTyrol" and "Corporate MaaS"	South Tyrol
	Mobility Platform Bavaria	Bavaria

Table 2: *Source: Compilation of the iMONITRAF! network*

6.2 Best Practices per policy pillar

6.2.1 Pillar 1: Information, monitoring, awareness raising

Overall, **monitoring campaigns** are continued as in previous years and as summarised by the iMONITRAF! monitoring activities (see detailed description in chapter 5). This includes the use of new monitoring station and equipments – as for example the permanent fixed noise measurement station along the Brenner railway line in the municipality of Salorno/Salurn.

E**nforcement of relevant environmental and social legislation and technical controls** of HGV continued both on the Brenner and Gotthard corridors. After a new HGV control centre was taken into operation in Ticino at the end of 2022, the further development of enforcement infrastructures is now also foreseen for Tyrol: In June 2024, it was agreed to extend the Radfeld HGV control checkpoint (twice the size as before) to provide the necessary infrastructure for the increased personnel requirements. The State of Tyrol is investing more than three million Euros in the conversion of the control centre and thus in road safety on Tyrol's roads.

6.2.2 Pillar 2: Limiting impacts of Alpine transport (and safety)

Pillar 2 deals with all regulatory measures that have the direct objective to limit negative impacts of transalpine freight transport, especially regarding air quality and noise.

In 2024, only few measures were reported in this policy pillar – highlighting that this type of measure is very much used to its full potential. Especially in the **State of Tyrol, the Euroclass driving ban and the sectoral driving ban** offer very limited additional potential at the moment, as they have been extended to origin and destination traffic (regional transport) in 2023. The Euroclass driving bans ensure that only the cleanest vehicles (EURO VI) are in operation on the Brenner motorway – in the night even focusing on ZEV only for transit HGV.

The **Brenner motorway company A22** continued to implement the noise protection plan on several sections. Accordingly, the municipalities Chiusa/Klausen, Bressanone/Brixen and Vipiteno/Sterzing benefit and will benefit from new sound-absorbing structures, who are capable to significantly reducing both noise and air pollution. The investment volume totals around 30 mio. Euro.

To reduce the environmental and carbon footprint of freight transport and especially the impacts on ports **Région Sud Provence- Alpes-Côte-d'Azur** is further supporting **decarbonization initiatives at the Port of Marseille-Fos**. Measures aim at increasing the use of alternative fuels such as hydrogen and LNG, extending rail and river connections, and implementing electrified port operations to reduce the carbon footprint of freight transport.

Regarding **safety considerations**, one important aspect that became more visible over the last years and which is viewed with concern by many transport stakeholders is the need for large-scale repair work on the Alpine transit motorways – especially some bridges. One of the largest upcoming repair works will be needed on the **Lueg bridge on the A13 Brenner Motorway** which, after over 55 years of service, requires structural work on its load-bearing structure. As a complete closure of the bridge is not possible, this required the set-up of a smart capacity management: From 1 January 2025, traffic will therefore only cross the bridge in one lane in each direction. This is the only way to ensure that the existing bridge can continue to be driven on safely. To avoid congestion on days of high traffic volumes, the infrastructure operator ASFINAG together with relevant stakeholders and the regions explored a package of measures to allow a use of both motorway lanes for particularly busy days. Vehicles over 3.5 tonnes have to switch to the left-hand lane, i.e. the centre of the bridge, to relieve the pressure on the edges of the bridge. On around 170 days a year, this type of traffic routing will be set up flexibly, depending on demand in the north or southbound direction. A general dual carriageway would massively shorten the service life of the bridge and is therefore not possible from an expert's point of view. In addition, there will be measures such as control systems, additional lorry driving bans, section control, new display boards (including VBA portals) and a Europe-wide information campaign. ASFINAG has

set up its own landing page on which, in addition to real-time information and forecasts, the 2025 driving calendar with all measures and restrictions can be seen.[4]

6.2.3 Pillar 3: Modal shift

Pillar 3 focuses on modal shift measures, including both push and pull measures. It includes policy measures related to modal shift, with a special focus on developments related to the common measures of the iMONITRAF! strategy as well as infrastructure measures. The section on policy measures first highlights pricing measures related to road and rail, then focuses on financial support which is extended to single wagon load transport to make this segment more attractive and then highlights some specific pilot projects.

Policy measures

To provide additional incentives for modal shift and for the uptake of zero-emission technologies, both **Germany and Austria** decided to make use of the **new provisions of the Eurovignette with the CO_2-charge.** In Germany, the new CO_2-charge came into force in December 2023, in Austria in the beginning of 2024 – thus leading to a new road pricing framework for the Brenner motorway. The increase in prices is visible in the results as displayed in the monitoring chapter (see indicator 5, figure 16).

In 2024, also in **Switzerland the framework for the Swiss HGV fee (LSVA)** was further developed. It was decided that rates shall be adjusted to inflation with an average increase of rates by 5%. Also, it was agreed that exemptions for zero-emission HGV will be phased out at the end of 2030. From 2031 onwards, the HGV fee will also apply to full electric HGV. The Federal Council wants to ensure that the HGV fee continues to cover the costs caused by heavy goods traffic and that freight transport by rail is promoted. In order not to slow down the modernisation of the lorry fleet, the Federal Council envisages support measures for electrically powered lorries.

Pricing measures have not only been adjusted on the road but also related to trail track pricing. In Switzerland, the Federal Office of Transport is **increasing the train path price for rail transport** by 2.1% from the beginning of 2025. With this measure, the FOT takes account of the legal requirements for cost recovery. Overall, train path prices cover around a third of the costs of the railway infrastructure in Switzerland. With the adjustment of the basic price for wear and tear by up to 9%, freight transport in particular is affected.

Subsidies for combined transport were also continued in 2024, for example the subsidies for combined transport in the **Autonomous Province of Bolzano-South Tyrol** were maintained. This subsidy focuses on the section Brenner-Salorno/Salorno-Brenner for Accompanied Combined Transport (ACT) or Unaccompanied Combined Transport (UCT) (similar to the years before).

To provide additional incentives for shift from road to rail, **the State of Tyrol has extended its financial support from CT to single wagon load transport**. The objective is to strengthen the share of single wagon load transport (which has been on the decline over the last years but remains the most efficient rail transport segment). Funding is available for single rail freight wagons transported between 1 April 2024 and 31 October 2024. The start and end point of the single wagon must be within the territory of the State of Tyrol. The subsidy is provided for the additional number of single wagons transported compared to the same period in the previous year. The

[4] ASFINAG information portal: A 13 Brenner motorway Construction on the new Lueg Bridge
https://www.asfinag.at/en/construction-maintenance/construction-projects/a-13-brenner-motorway-lueg-bridge/

funding amount is up to 200 € per single wagon transported, with a maximum limit of 15,000 € per recipient. This subsidy will be available again in 2025, covering the entire year, with a total budget of 250,000 €).

Also in Switzerland, the role of single wagon load and its support needs was discussed in the frame of a political motion and consultation. Overall, the Federal Council wants to **strengthen regional rail freight transport and freight shipping**, especially with a modernisation of the concept of single wagon load. The process has led to a **revision of the Goods Transport Act** which is the main legal framework in Switzerland that governs organisation and financing of freight transport. The revision foresees that, for a transition period, financial support is also to be provided for single wagonload transport. Furthermore, the revision foresees a financing of the introduction of digital automatic coupling in rail freight transport. This should make the entire freight transport system more efficient and ensure security of supply in all regions. The revision is not yet fully finalized but still debated in the Swiss Parliament.

The **Autonomous Province of Bolzano and the State of Tyrol** continue its **pilot project for regional transport of timber**. Since spring 2023, timber from Pustertal to Zillertal is transported by rail instead of road. The construction of a loading terminal in Jenbach in 2021 and the necessary conversion of the railway platform in Bolzano in 2022/2023 enable the transport of timber from Bolzano to different destinations in Tyrol. The logs are loaded onto special freight wagons on a newly built loading track at Bolzano station. The transport is organised in cooperation between Rail Traction Company (RTC) and the Austrian Rail Cargo Group (RCG).

In **Provence- Alpes-Côte-d'Azur a new agreement to significantly increase rail's share of freight transport** has come into force. Efforts include a doubling of combined rail-road transport capacity, optimizing freight logistics in metropolitan areas (e.g., Marseille and Nice) and digitizing scheduling systems for greater efficiency. These measures should reduce dependence on road freight and make a significant contribution to emission reduction targets.

Infrastructure measures and services

In **Switzerland**, the new NEAT infrastructures are under full operation again. After a freight train derailed in the Gotthard base tunnel in August 2023, services especially for freight trains were reduced. After a nearly one-year repair work, the tunnel was reopened again on 2nd September 2024 and both passenger and freight trains can use it again without restrictions.

However, numerous constructions on the European north-south corridor through Switzerland are currently hampering rail freight transport. During a roundtable, decision makers and relevant rail stakeholders discussed options to manage the situation as well as possible. It became clear that a **more flexible timetable for freight transport** is needed to deal with challenges related to repair work. In addition, it should be possible to route goods trains from north to south and vice versa on free train paths through Switzerland at short notice. Rail freight transport should remain competitive despite the challenging construction site situation; this is also in the interests of Switzerland's modal shift policy.

For the **Brenner Base Tunnel**, some further milestones could be reached in 2024. The completion of the Sillschlucht construction section marks a significant milestone for the Brenner Base Tunnel project. Located at the northern portal in Innsbruck, this challenging €60 million project involved building a 600-meter stretch with innovative anchoring systems, constructing two railway bridges, and creating a concrete tunnel. Environmental restoration was a key focus, ensuring harmony with the surrounding landscape. Finished on schedule and within budget, the northern portal is now fully operational, underscoring the project's commitment to excellence and sustainability. Restoration efforts are underway, and public access to the area will resume by spring 2025.

Also, the tunnel drilling machine ‘Flavia’ has excavated the majority of the main west tunnel on the Italian side and there is only 1 km left to the state border with Austria. The blasting work in the window gallery for the southern BBT access route Fortezza/Franzensfeste-Ponte Gardena/Waidbruck has started. With ongoing construction work being in time, the opening of the Brenner Base Tunnel is still foreseen for 2032.

Construction is also continuing for the **Lyon-Turin railway link**. At the end of 2024, underground excavation work has reached nearly a quarter of the 164 km of tunnels to be built for the Lyon-Turin base tunnel. Over the last few months major progress has also been made in the above-ground works in France and Italy. In France, the laying of the new railway viaduct over the Arvan River began on 10 December. The viaduct in the plain of Saint-Jean-de-Maurienne is part of the works for the railway interconnection with the historic line.

Regarding rail services, a **new transalpine block train connection** on the Brenner can be reported. In cooperation with bayernhafen, Helrom GmbH has created a new transalpine block train connection between Regensburg and Verona with initially four departures per week in each direction. This will utilise the horizontal loading technology developed and patented by Helrom: The trailer is uncoupled from the tractor unit, the Helrom trailer wagon folds open sideways, the trailer is pushed onto the wagon and the wagon folds closed again. Once it arrives at its destination, it is unloaded in the same way, coupled to a tractor unit again and transported the last mile to its destination. A loading terminal, crane or craneable semi-trailer is not required.

6.2.4 Pillar 4: Passenger transport

In 2024, all iMONITRAF! regions have continued to pioneer new solutions to increase attractiveness of public transport. Information and ticketing solutions as described in detail in the Annual Report 2022 and 2023 were further continued – e.g. with the different Euregio tickets.

To incentivize public transport across borders, the European Region Tyrol-South Tyrol-Trentino organised the Euregio Mobility Action Day in May 2024. Under the motto ‘Overcoming borders: From Kufstein to Borghetto for free’, all holders of a valid EuregioFamilyPass and a season ticket or annual or semester ticket for regional public transport in Tyrol, South Tyrol and Trentino were allowed to use public transport throughout the Euregio free of charge. The Mobility Day intended to provide incentives for sustainable leisure mobility and users can try out how travelling across borders is possible.

The **expansion of local public transport** is an important building block on the road to climate-friendly mobility. Comprehensive network structures are a necessary prerequisite for the structural strengthening of local public transport. However, there are still some areas in **Bavaria** outside of the urban centres that are not covered by public transport networks. The Free State of Bavaria supports districts and independent cities that are not part of a transport network with a funding programme on their way to becoming part of a transport network. This has made it possible to reduce the number of non-associated municipalities in Bavaria from 47 to the current 29. The successful accession of the districts of Bad Tölz-Wolfratshausen, Miesbach, Rosenheim, Weilheim-Schongau and Landsberg am Lech as well as the city of Rosenheim to the Munich Transport Network (MVV) are positive examples of successful network integration in the foothills of the Alps. On 1 January 2026, another important Upper Bavarian tourist region will join the MVV with the planned accession of the district of Garmisch-Partenkirchen. Passengers will benefit from a networked service, attractive network tickets, standardised passenger information and digital ticket sales.

Infrastructures and services for public transport and cycling

To further develop public transport and to improve its quality, several milestones could be reached in relevant infrastructure works. Several projects were already illustrated in previous Annual Reports and have reached new milestones in 2024:

- **Missing link between Brenner railway and Val Pusteria/Pustertal railway:** The construction of the infrastructure project of the Val di Riga/Riggertal has been launched in 2023. The 3.8 km long Riggertal loop enables a direct train connection from the Brenner railway line in Bressanone/Brixen to the Val Pusteria/Pustertal railway line. The railway loop will bring a reduction in journey times as well as more frequent connections. A modal shift with a reduction in motorised traffic is also expected. From 15th Dec 2024, the line will be closed by sections for approx. one year. A replacement bus service is set up.
- **New train stop on the Brenner railway line**: Also, construction has started for the new train stop in the district of S. Giacomo/St. Jakob (municipality of Laives/Leifers) along the Verona-Brennero railway line, with connections every 30min. The stop will become a mobility hub while also serving Bolzano Airport. The project is almost entirely financed by the European Union via the Fund for Development and Cohesion. According to calculations, the stop will be used by 185,000 passengers a year.
- **Electrification of railway lines in the Autonomous Province of Bolzano-South Tyrol: Works** for the electrification on the Vinschgau/Val Venosta railway are progressing. 2024 was mainly dedicated to the positioning of a total of 1,500 masts for the overhead line. As a next step the introduction of modern safety and signalling systems (ETCS) is planned. Due to these important interventions, and for the approval and prescribed test runs with new electric and converted diesel multiple units, the railway line will have to be closed by sections for around a year from February 2025. A replacement bus service is set up.
- **Cross border mobility by bus** between Mals/Malles and Landeck: Introduction of an express bus connection between Mals/Malles in South Tyrol and Landeck in Tyrol. The service offers connections every hour.
- With decision no. 153/2024, the provincial government of South Tyrol decided to strengthen the so-called **'supplementary bus services'**. Following the decision some supplementary bus services were converted into regular scheduled services and incorporated into the year-round timetable. Higher subsidies were also planned for specific ski and summer bus services.
- **Région Sud - Provence-Alpes-Côte-d'Azur** has started to implement the concept of **Regional Metropolitan Express Services (SERM)**, focusing on creating a network of high-frequency regional express trains to better connect major metropolitan hubs, including Aix-Marseille Provence, Nice Côte d'Azur, Toulon Provence Méditerranée and the Greater Avignon conurbation.
- Also, Provence-Alpes-Côte-d'Azur has the objective to **better promote active and shared mobility solutions** – supported by infrastructure improvements, development of multimodal hubs and awareness raising campaigns.

6.2.5 Pillar 5: Innovative approaches and political initiatives

Several iMONITRAF! regions currently explore the use of digital mobility platforms for providing seamless and user-friendly alternative mobility solutions. "Mobility as a Service (MaaS)" combines mobility services such as long-distance and suburban trains, buses, e-scooters, bike/car sharing, etc. in one app. This allows travellers to get from A to B sustainably and to plan, book and pay flexibly. MaaS solutions thus bring together the idea of an integrated information and ticketing platform for all sustainable transport modes.

The **“MaaS4SouthTyrol”** project belongs to the national plan “MaaS4Italy” (December 2023 to June 2026). The project is managed by two in-house companies of the Autonomous Province of Bolzano, namely STA (South Tyrolean Transport Structures) and NOI Techpark. The aim of the project is to create a digital platform providing information and ticketing options for traditional public transport services and complementary services such as on-demand transport, car sharing, bike sharing and parking lots at railway stations. As first pilot step, STA has developed a MaaS application for companies called **“Corporate MaaS”**. This allows testing the MaaS potential with a controlled number of users (i.e. the employees of selected local companies).

Also in Bavaria, a new mobility platform is currently developed as part of the Public Transport Strategy 2030. The DEFAS background system and the MoBY app together form the **Bavarian Mobility Platform**. The mobility platform is the core of the digitalisation and digital networking of publicly accessible mobility in Bavaria. The aim is to give people in Bavaria easy access to all mobility services via smartphone and app. We call this mobility-as-a-service app.

The integration of electronic sales with plans for a Bavaria-wide check-in/be-out system is a new feature, and passenger information is also being further improved, for example for barrier-free travel chains. In addition to public transport, this also includes the integration of supplementary mobility services, i.e. sharing offers and on-demand transport services.

Furthermore, the platform is expanding to include real-time travel information, supporting multi-modal mobility by connecting users to a variety of transport modes like car-sharing, bike-sharing, and e-scooters. This seamless integration of transport options allows users to plan and pay for their entire journey, from start to finish, with ease. The introduction of digital identity solutions and the integration of ticketing systems will ensure a more streamlined, secure, and efficient travel experience for all users across the region.

7 Outlook 2025 and beyond

The year 2025 will become a decisive year for iMONITRF! as it is the final year in the 2023-2025 work programme. It will be important for the network to highlight again its value added for the regions and to show the effectiveness of the common voice – both on national and European level. Yet, the political framework conditions are not easy at the beginning of 2025 – sustainable development and climate action are losing political priorities and iMONITRAF! with its network partners will face the challenge to develop new narratives and to highlight the value added of the modal shift approach for regional development. Not only at national but also European level, uncertainties around policy priorities are intensified through tightened public finances – which might hamper the necessary investments in modal shift infrastructures, services and related coordination activities like iMONITRAF!.

Considering this starting point at the beginning of 2025, the network will put the following activities in the focus:

- Political networking: Both within the network and with network partners at national and European level, iMONITRAF! aims at an intensified networking to strengthen the coordination efforts and identify joint challenges. A networking event will take place in Erstfeld (Central Switzerland) in April 2025, an outreach event in Brussels is foreseen in spring/early summer.
- Update of iMONITRAF! policy pathway: Over the last two years, iMONITRAF! has developed insights for finetuning the policy mix: in 2022, a joint overview on capacity management was developed and regional measures to support the uptake of alternative technologies for road freight transport were summarized. With the additional work of 2024 on Combined Transport and Rail Efficiency, the network has a lot “food” for finetuning its policy mix. In 2025, these insights these will be merged in a dynamic adjustment of the policy pathway.
- Activities at national and European level: Based on its knowledge pool, iMONITRAF! will continue its networking ambitions at national and European level, especially with a view to ongoing discussions around the dossiers of the Greening Freight Package.
- Link to EUSALP Mobility Conference: The EUSALP co-presidency of Austria and Liechtenstein will be used to raise mobility transition on the political agenda – iMONITRAF! will use this opportunity to highlights its activities and expertise.

As the ongoing partnership agreement is limited to the period 2023-2025, iMONITRAF! will also have to work towards the continuation of the partnership agreement. This will include the development of new strategic priorities for the time beyond 2025 and the positioning of iMONITRAF! within the sphere of Alpine transport networks and initiatives.

Annex: Monitoring indicators – methodological explanations

iMONITRAF! partners', observers' and stakeholders' contribution

The monitoring data presented in this report derives from a data collection process involving the iMONITRAF! partners and observes, as well as external stakeholders supporting iMONITRAF! on yearly basis. Their contribution is essential to guarantee a consistent and exhaustive monitoring activity every year. In this regard, **a special thanks goes to**: 5T Torino, ARPA Valle d´Aosta, ARPA Friuli Venezia Giulia, ARPA Piemonte, ARPA Liguria, Rete Ferroviaria Italiana (RFI), Interbrennero SpA, A22 Autostrada del Brennero, the Swiss Federal Office of Transport (FOT), and ATMO Auvergne-Rhône-Alpes.

Indicator 1: Road traffic volumes

Road traffic volumes can be measured in different ways, depending on the measuring stations and the counting systems considered. As for the **measuring stations**, for Fréjus, Mont Blanc, San Bernardino and Gotthard data regards the stations at the entrance of the tunnels. For Brenner and Tarvisio, the data stems from the Austrian stations of Brennersee and Maglern, which are the closest ones to the Italian-Austrian border at the time being. Finally, for Ventimiglia, the Italian toll station of Ventimiglia (that is the closest to the FR-IT border) is considered. Regarding the **counting systems**, Brenner and Tarvisio adopt the Austrian classification for road detection, as provided by ASFiNAG: all vehicles below 3.5 t are counted as light vehicles, whereas those above 3.5 t are classified as heavy vehicles. For Swiss corridors, the official classification adopted by the Federal Office of Transport (FOT) is considered: vehicles belonging to classes 1-3 (passenger cars, motorcycles and light commercial vehicles) are counted as light vehicles; those belonging to classes 4-7 (buses, coaches, HDV trucks, HDV truck trailers and HDV articulated trucks) as heavy vehicles. Finally, vehicles along Italian-French corridors are reckoned according to the system used by the Italian highways: the light vehicle category consists of vehicles belonging to class A (height below 1.3 m), while the heavy vehicle category includes those means belonging to class B (height above 1.3 m) and classes 3, 4, 5 (according to the number of axles). This methodological approach implies some **limitations** that are worth mentioning. In particular, the selection of a single measuring station to represent the flows along each corridor implies that flows may be either underestimated or overestimated compared to specific corridor sections. To understand the variability of flows among different sections, interested readers are invited to consult the WebGIS platform, where data is provided for more measuring stations along each corridor. Some **limitations regarding the 2023 data** must be mentioned. Due to maintenance works, the data for the Mont Blanc tunnel is not available for the whole month of November. Therefore, the average daily traffic volumes are calculated on 355 operative days (rather than 365). This makes the daily average less reliable but comparable with the figures of the other corridors. As for the Brenner, data of the monitoring station of Brennersee/A13 (AT) shows a slight decrease of overall traffic flows in 2023 compared to 2022 (-0.05%). This decrease is not registered for the other Brenner monitoring stations observed by the iMONITRAF! network in Italy and Germany, which instead register a slight increase of flows (ca +3% for most stations; WebGIS platform). Therefore, Brenner data must be interpreted by taking into account the variability of traffic conditions among different sections of the corridor in Italy, Austria and Germany.

Indicator 2: Transported tons and modal split

The analysis of the tons transported per year is largely affected by the difficulties in finding reliable and consistent data. However, thanks to the information collected and provided by the Swiss Federal Office of Transport - Observatory for Road and Rail Freight Traffic in the Alpine Region (France, Switzerland, Austria; FOT), data for all corridors has been collected until 2023. The FOT

report with the 2023 figures is expected to be available online at: https://www.bav.admin.ch/bav/de/home/verkehrsmittel/eisenbahn/gueterverkehr/verlagerung/berichte-und-zahlen.html (German version).

Indicator 3: Concentration of air pollutants

Some details regarding the measurement stations have to be mentioned. First, the South Tyrolean station of Velturno/Feldthurns was deactivated at the end of 2016 and the station of Bressanone sud/Brixen süd (located 1.5 km northward from Velturno/Feldthurns, south of Bressanone/Brixen) has replaced it since 2018. South Tyrol is thus described by the stations of Velturno/Feldthurns (years 2005-2016), Bressanone sud/Brixen süd (years 2018-2021) and Ora/Auer (years 2007-2021). On the Austrian side of the Brenner, the station of Mutters in not active anymore since 2022. The new station of Vill/Zenzenhof A13 replaces it with data starting from 2021. Since NO_2 is not monitored at Tolmezzo since 2019, it is flanked with the station of Ugovizza-Tarvisio. This station was activated at the end of 2014 and data is available from 2015. Finally, data for the station of Vallée de la Maurienne is not available since 2019 and from that moment replaced by Maurienne Trafic.

Indicator 4: Exposure to noise

The data regarding noise exposure is regularly provided by several stakeholders collaborating with the iMONITRAF! team every year. They include ARPA Valle d'Aosta and ARPA Friuli Venezia Giulia. A comparison between the values (L_{den} and L_{night}) registered in different corridors may be not appropriate due to different distances between the microphones and the streets. However, the variations along the individual corridors are consistent throughout the years. Gotthard and Mont Blanc are the only corridors with continuous data collection for the period 2005-2023 (measuring stations of Camignolo, Reiden and Courmayeur), whereas noise is not monitored along Brenner and Ventimiglia. Only partial data is available along San Bernardino (Rothenbrunnen), Tarvisio (Camporosso), Fréjus (Bardonecchia) and Mont Blanc (Châtillon). Regarding the first station, data collection started in 2012 and is currently ongoing; in Camporosso and Bardonecchia, updated values are not available. In Châtillon, data collection is available for 2010-2023. Some **limitations regarding the 2023 data** must be mentioned. In particular, the data at the Mont Blanc measuring station (Courmayeur La Palud) refers to two phonometric measurements out of the three performed in 2023. The third measurement is excluded since it took place in autumn 2023, during the closure of the Mont Blanc tunnel (thus representing a bias).

Indicator 5: Toll prices

The origins and destinations for the calculation of toll prices are defined as follows:

- Ventimiglia: from Marseille (FR) to Genova (IT) via Ventimiglia (381 km)
- Fréjus: from Lyon (FR) to Torino (IT) via Fréjus road tunnel (298 km)
- Mont Blanc: from Bellegarde-sur-Valserine (FR) to Ivrea (IT) via Mont Blanc road tunnel (228 km)
- Simplon: from Brig (CH) to Gravellona Toce (IT), via Simplon pass (99 km)
- Gotthard: from Basel (CH) to Chiasso (CH) via Gotthard road tunnel (288 km)
- San Bernardino: from Chur (CH) to Chiasso (CH) via San Bernardino road tunnel (169 km)
- Brenner: from Munich (DE) to Verona (IT) via Brenner pass (415 km)
- Tarvisio: from Salzburg (AT) to Udine Nord (IT) via Villach (313 km)

The calculated prices refer to the prices for a single passage (in direction north-south). The direction is relevant because different VAT are applied to the prices for the passage across the IT-FR tunnels depending on the direction. This approach holds for the Fréjus and Mont Blanc tunnels, the Austrian highway vignette and the separate Brenner highway toll on the A13 in Austria as well

as for the Swiss highway toll (passenger cars). For these corridors, return tickets and yearly subscriptions are also available, which would lower the cost for a single passage. For Switzerland, only a yearly ticket is available for passenger cars, meaning that only the first passage costs, while all subsequent passages within the same year are free.

Indicator 6: Fuel prices

The fuel-prices values are the annual averages of the values officially registered in every country on four days in all seasons (15th Jan, May, Jul, Oct). Data is provided by ÖAMTC for Austria, the Federal Statistical Office for Switzerland SFSO, ISTAT for Italy, INSEE for France and ADAC for Germany. Swiss values are converted from CHF to Euros based on the exchange rates applied on the 15th Jan, May, Jul, Oct of the relevant year. Therefore, variations is Swiss prices are partially determined by variations in the CHF/€ exchange rate.

Indicator 7: Alternative-fuel refuelling stations

The following alternative fuels (AFs) are considered to map their refuelling stations: electricity (EV), hydrogen (H_2), liquid natural gas (LNG), compressed natural gas (CNG), and liquid petrol gas (LPG). For each corridor, the AF stations located in the service areas and in the parking areas of the toll gates as well as those stations located in the autoports and at the entrance/exit of the road tunnels are identified. However, some methodological differences need to be specified, as well as the sources used to retrieve the data. In detail:

- EV stations: Since 2024, data about recharging stations along the corridors has not being collected from aggregated EU sources, but rather from local portals of the single highways. This allows increasing the accuracy of data collection. According to this source type, only the recharging stations accessible along the highway infrastructure are considered, while those in the nearby are excluded.
- H_2 stations: Since 2024, data is collected from the EU platform “HRS Availability Map” (https://h2-map.eu/). This platform allows a consistent data collection among all the corridors. Given the limited diffusion of H_2 stations in EU, the data collection considers also stations available in a buffer are of 1 km around the highways.
- LNG, CNG and LPG stations: Since 2024, data is collected from the EU platform “TENtec” (https://webgate.ec.europa.eu/tentec-maps/web/public/screen/home). This platform allows a consistent data collection among all the corridors. According to the filters provided by the platform, only the stations located in a buffer area of 1 km around the highways are considered.

The approach and updated sources described above hamper the full comparability of 2024 data with the previous monitoring years.

Indicator 8: Unitary pricing components

Four components are observed for France, Switzerland, Italy, Austria and Germany:

- the *purchase tax*, expressed in % of the one-only purchase cost of vehicle
- the *registration tax*, expressed in Euros, to be paid one time with the purchase of vehicle
- the *ownership tax*, expressed in Euros, to be paid yearly
- the *insurance tax*, expressed in % of the yearly insurance costs

Data sources: Until 2022, the ACEA (European Automobile Manufacturers' Association) released every year the so-called “ACEA Tax Guide”. This document provided a summary of the rules applied in all EU countries for the calculation of the unitary pricing components considered in iMONITRAF!. As such, this was the main data source. However, this document is not realised anymore. Therefore, since 2023 we rely on the online sources and calculators provided by the single countries.

Considered regions: In France, Switzerland and Italy, the unitary pricing components vary from region to region. Therefore, sample regions are considered: the Department 73 – Savoie in France, Ticino for Switzerland, Lombardy for Italy.

Considered vehicles: Additionally, the unitary pricing components depend on the type of vehicle considered and its specific characteristics (like weight, powertrain and CO_2 emissions). Four sample vehicles are thus selected: a petrol car, electric car, diesel HGV, and electric HGV. In particular, we focus on the top-sold car models in EU in the last years (2020-2022), and on the most diffused and typical kinds of HGVs. They are: 1) VW Golf; 2) Tesla Model 3; 3) Volvo FH; 4) Volvo FH Electric. The characteristics of these models are reported in Table X.

Aggregation of the unitary components: The four pricing components are aggregated in order to obtain a synthetic figure of the yearly cost of the purchase and ownership of a vehicle (€/year during the vehicle lifetime). Since the components have different units of measures, a series of information is needed to allow the conversion and aggregation. First, the purchase price of the vehicles is needed for the conversion of the purchase tax. Data is collected from the model producers in each observed country, and an average purchase price is established for each model. Second, the annual insurance premium is necessary to convert the insurance tax. In this case, data is obtained thanks to market calculators in each country and the average is derived. Finally, the vehicle lifespan allows the conversion of the purchase and registration tax. In this case, average data per country is provided by the ACEA, and an overall average across the considered countries is obtained. Table X summarises the conversion factors calculated for each vehicle type (column "Average", cells in light blue), based on the data collected for each country.

Petrol car						
	France	***Switzerland***	***Italy***	***Austria***	***Germany***	**Average**
Model	VW Golf (top sold petrol car in EU in the 3 years 2020-2022: almost 670,000 vehicles)					
Characteristics	81 kW; 110 cv / 1000 cc; 6 Puissance fiscale in France; 122 g CO_2/km; 1,770 kg					
Purchase price	€ 32,195	€ 33,500	€ 29,400	€ 29,776	€ 31,145	**€ 31,203**
Insurance premium	€ 620	€ 265	€ 545	€ 775	€ 535	**€ 548**
Lifespan	10.5 years	12.0 years	12.2 years	8.7 years	10.1 years	**10.7 years**
Electric car						
	France	***Switzerland***	***Italy***	***Austria***	***Germany***	**Average**
Model	Tesla Model 3 (top sold electric car in EU in the 3 years 2020-2022: almost 320,000 vehicles)					
Characteristics	225 kW; 306 cv; 19 Puissance fiscale in France; 0 g CO_2/km; 1,836 kg					
Purchase price	€ 41,990	€ 43,275	€ 41,490	€ 42,990	€ 41,990	**€ 42,347**
Insurance premium	€ 915	€ 310	€ 635	€ 554	€ 730	**€ 629**
Lifespan	10.5 years	12.0 years	12.2 years	8.7 years	10.1 years	**10.7 years**
Diesel HGV						
	France	***Switzerland***	***Italy***	***Austria***	***Germany***	**Average**
Model	Volvo FH (Volvo is one of the five EU most popular players for selling diesel trucks)					
Characteristics	309 kW; 420 cv; 30 Puissance fiscale in France; Euro 6; NA g CO_2/km					
Purchase price	NA	NA	NA	NA	NA	**€ 155,000**[1]
Insurance premium	NA	NA	NA	NA	NA	**€ 5,500**[1]
Lifespan	9.2 years	14.2 years	19.0 years	6.6 years	9.7 years	**11.7 years**
Electric HGV						
	France	***Switzerland***	***Italy***	***Austria***	***Germany***	**Average**
Model	Volvo FH Electric (Volvo is one of the leading companies selling electric trucks. In 2022, Volvo kept the highest market share in EU: 32% of new sold HGVs)					

Characteristics	490 kW, 666 cv, 64 Puissance fiscale in France, 0 g CO_2/km					
Purchase price	NA	NA	NA	NA	NA	**€ 400,000**[1]
Insurance premium	NA	NA	NA	NA	NA	**€ 5,500**[2]
Lifespan	9.2 years	14.2 years	19.0 years	6.6 years	9.7 years	**11.7 years**

Notes:

[1] Country-level data on the purchase price and insurance premium not available. Only average EU values available, derived from non-country-specific sources.

[2] Data on the insurance premium of electric HGVs not available. We assume the same premium as diesel HGVs.

Table X: Factors for the conversion and aggregation of the unitary pricing components (column "Average", cells in light blue), based on country-level data.