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Swiss Federal Roads Office FEDRO

FEDRO ANNUAL REPORT

ROADS AND TRAFFIC 2021

Developments, facts and figures

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Cover photo One of the main arteries of Switzerland's motorway/national roads network: view of the A1 near Ittigen to the north east of the city of Bern, in the direction of Zurich.

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Dear Reader,

The mobility sector is currently undergoing some exciting developments. Innovations are being implemented or are imminent across all segments. Electric mobility is a good example: the number of electric vehicles on our roads is rapidly increasing. This represents a challenge for the operators of our road infrastructure, because there is a growing need for fast-charging stations. FEDRO is supporting this trend by installing 400 charging stations at 100 rest areas along the motorways and national roads.

At the same time, new technologies are being rapidly developed, not only for the power units of electric vehicles, but also in preparation for automated driving. Switzerland is among the first countries to amend its legislation in order to make automated driving legally possible at some time in the future. Our goal is to effectively exploit the potentials of digitalisation with respect to safety, compatibility and availability.

Innovations will also be necessary regarding the financing of our road infrastructure. This is currently based on oil tax revenue, but the fact that the proportion of vehicles with combustion engines is constantly declining means we will have to find new solutions for securing the financing of our road infrastructure in the future – for instance, by replacing the present-day fuel levy with a charge per driven kilometre.

With the introduction of the building information modelling (BIM) method in the field of road construction, an innovation is to be implemented that will revolutionise and ultimately enhance the planning and construction processes. Here, digitalisation is opening up entirely new possibilities regarding access to information relating to building processes and objects, as well as the vis-

ualisation of the engineering structures that are in operation. FEDRO is gathering initial findings relating to BIM through numerous pilot projects in which we are working closely with the construction and planning sectors.

The coronavirus pandemic is also giving us a new perspective on road transport. Social distancing and protective measures in the field of public transport have made private transport (both motorised and non-motorised) more attractive again. If this trend persists, the burden on our road infrastructure will become even greater than it was before the pandemic. In view of this, in addition to the planned expansions it will be necessary to use the existing road infrastructure more effectively and efficiently, for example with the aid of traffic management. The pandemic is thus prompting us to take appropriate action.

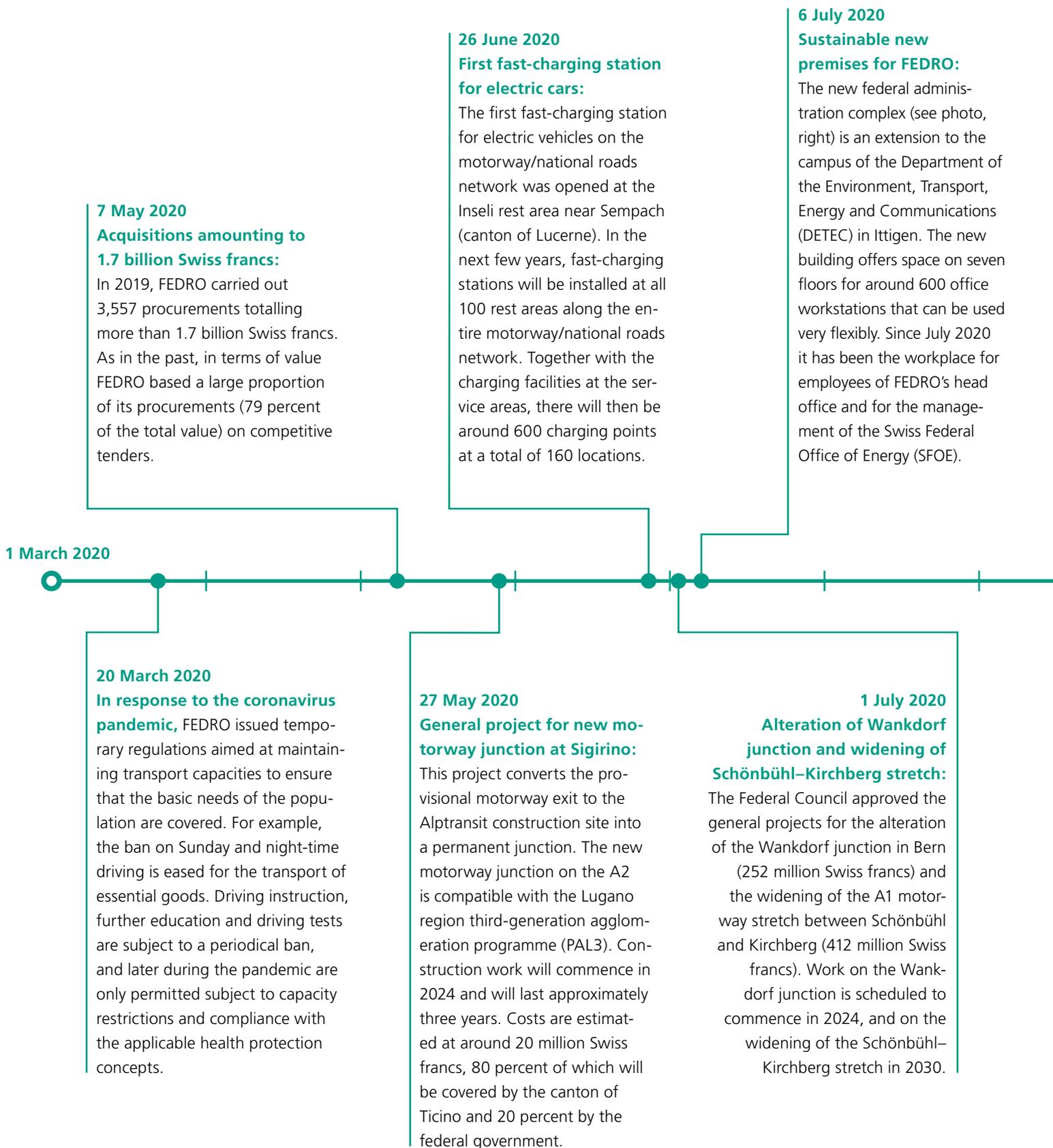
In 2020 it was Switzerland's turn and my privilege to chair the Conference of European Directors of Roads (CEDR), which provides its members with the opportunity to exchange know-how and experiences concerning issues relating to road transport and mobility. This is particularly important in view of the forthcoming innovations.

In "Roads and Traffic 2021" we want to share the above-mentioned aspects of our activities and lots more with you. I trust you will find this edition interesting and informative.

A handwritten signature in black ink, appearing to read 'J. Röthlisberger'.

Jürg Röthlisberger
Director of the Swiss Federal Roads Office (FEDRO)

Overview of the year





1 January 2021

New traffic regulations:

The Federal Council introduced new requirements and regulations. The new requirements applicable in traffic jam conditions stipulate that drivers must form an emergency corridor on motorways and expressways and observe the principle of “zip-merging”. The new traffic regulations include the following: new speed limit of 100 km/h for light motor vehicles with trailers weighing up to 3.5 tonnes; passing on the right-hand side of single traffic queues is now allowed; children up to the age of 12 may cycle on pavements if there is no cycle lane or route; cyclists may turn right at traffic lights on red where a corresponding traffic sign permitting this is posted.

1 April 2021

2 October 2020

Groundbreaking ceremony for the Giornico HGV inspection centre:

In early October 2020, the foundation stone for the Giornico HGV inspection centre was laid. This facility is being constructed on the site of the former Monteforno steelworks. It has been designed as a large-scale facility at which heavy vehicles will be inspected on the south side of the Gotthard tunnel starting in 2022 (the inspection centre on the north side is located at Ripshausen).

11 November 2020

General project for the Rhine tunnel in Basel:

The Federal Council approved the general project for the Rhine tunnel in Basel, which will relieve the frequently congested A2/A3 between the Hagnau and Wiese junctions. Costs are estimated at around 2.36 billion Swiss francs. Work is scheduled to commence in 2029.

3 February 2021

Federal legislation governing pilot projects for mobility pricing:

The Federal Council opened the consultation process concerning draft legislation governing pilot projects for mobility pricing. The aim is to legally facilitate such projects and their financial support. Depending on their nature, these pilot projects will be the responsibility of the cantons and municipalities or other interest groups. Various regions have indicated to the federal government that they want to trial mobility pricing within the scope of a pilot project.

New drive technologies using electricity and hydrogen

FEDRO is striving to make road transport environmentally compatible. It is intensively examining options for increasing energy efficiency in the road transport sector and reducing the level of dependence on oil. One of these options concerns the increased use of alternative electric and hydrogen drive systems.

The federal government wants to foster the use of these new technologies in Switzerland and thus support efforts aimed at achieving the declared climate objectives. The vehicle registration statistics clearly indicate that the demand for electric vehicles is sharply increasing. In 2020, 19,765 new cars with electric drives (excluding hybrid models) were registered in Switzerland. This represents an increase by almost 50 percent versus 2019.

At the same time, the number of newly registered vehicles with combustion engines fell by more than a third, partly

due to the coronavirus pandemic. While the number of newly registered electric cars in 2020 only accounts for around 8 percent of the overall market, the growth rates in recent years were consistently in the double digits. This trend can be expected to continue in the next few years because almost all the leading car manufacturers now include electric vehicles in their product ranges. The introduction of more stringent CO₂ levies at the beginning of 2020 (new limit level, 95 grams per kilometre) and the financial subsidies offered in some cantons are making the purchase of electric vehicles more attractive.



This vehicle's hydrogen tanks are located behind the driver's cabin.

Electric drives: operating distances of around 300 kilometres now possible

Limited operating distance is one of the most frequently cited arguments against the purchase of an electric vehicle. However, a great deal of progress has been made in recent years and operating distances of around 300 kilometres are now attainable. With the distance travelled daily in Switzerland averaging less than 40 kilometres, this means that electric vehicles now offer an adequate reserve.

Pleasing progress has also been made with respect to recharging times. More and more manufacturers are equipping their models with fast-charging systems. This means, however, that sufficient high-performance charging infrastructure has to be available. Here, FEDRO is making a significant contribution (cf. report on page 9).

1,600 hydrogen-powered heavy goods vehicles soon on the road

Hydrogen is gaining in importance as an energy source, especially for heavy goods vehicles. Hydrogen drives offer significant advantages over electric drives due to their suitability for heavier loads and longer distances. Switzerland can justifiably be counted as a pioneer in this field within Europe, thanks to an initiative launched by various representatives of the logistics, retail and energy sectors. They created an entire hydrogen-based mobility system, the first step being the production of electricity, ideally from a renewable source such as hydropower. The electricity produced is used to split water into its two components, hydrogen and oxygen, through the process of electrolysis. The hydrogen is then distributed to filling stations. In a fuel cell in the vehicle, the hydrogen is converted into electricity, which is then used to power the electric motors. The first ten hydrogen-powered heavy goods vehicles were handed over for trialling in October last year, and the aim is for 1,600 hydrogen-powered HGVs to be in operation in Switzerland by 2025.

80 tonnes less CO₂ per HGV

32 kilograms of hydrogen are stored in each HGV at a pressure of 350 bar. Refuelling takes between eight and twenty minutes. The energy density of hydrogen is around 33 kWh per kilogram, i.e. three times higher

Conversion to electric drive

Vehicles with combustion engines can be retrofitted with environment-friendlier electric drives. Such conversions are often carried out on older models, because their less complex technology makes this easier and greater improvements can be achieved in terms of emissions.

Retrofitting a vehicle with an electric motor is in principle possible in Switzerland. It must be reported to and approved by the relevant cantonal road traffic authority. Special attention has to be paid to electrical safety, and the heavy batteries have to be sufficiently anchored. Furthermore, in the event of an accident, protection against possible additional risk due to fire or electric shock must be ensured. It is advisable to discuss any planned retrofitting of a vehicle with the relevant road traffic authority in advance.

The installation of an electric drive to replace a combustion engine is a fairly complex and costly undertaking. In view of this, and given that enough electric cars are now available directly from the manufacturers, this kind of retrofitting has to be classified as a niche product.

than that of petrol. For an HGV with a trailer (total vehicle weight, 34 tonnes) this is sufficient for covering a distance of around 400 kilometres. Given an annual travel distance of around 80,000 kilometres, this results in a reduction of 70 to 80 tonnes of CO₂ per HGV per year.

In the passenger car segment it is primarily Asian manufacturers who are offering the first hydrogen-powered vehicles. Last year, 42 cars with hydrogen as their power source were registered in Switzerland, and as of September 2020, 83 hydrogen-powered cars had been registered here.

New technologies for reducing CO₂ emissions from commercial vehicles

The EU wants to reduce CO₂ emissions from heavy commercial vehicles with the aid of technological measures. It also wants to promote the use of alternative drive systems. The federal government in Switzerland aims to introduce these new technologies here.

Heavy goods vehicles are to be equipped with aerodynamically designed driver's cabins and rear spoilers in order to lessen their air resistance, and more vehicles are to use electric and hydrogen-powered motors. These measures can greatly support efforts aimed at achieving the declared climate objectives. In order to implement the cited measures, the federal government launched a consultation procedure in 2020 regarding the revised Federal Ordinance on Technical Requirements for Road Vehicles, which could enter into force in 2022.

In future, the front of HGVs and articulated vehicles is to be elongated and curved. This will reduce air resistance and fuel consumption. The resulting reduction of CO₂ emissions will be between 3 and 5 percent. The new driver's cabins will be approximately 80 to 90 centimetres longer than they are today. This means that these vehicles are likely to be correspondingly longer in the future, but this must not be allowed to result in an increase in their payload.

An additional reduction of air resistance is to be achieved through the use of spoilers, which will protrude beyond the rear of the vehicle or trailer. Such spoilers will have to be retractable and may only be deployed on roads on which the permitted maximum speed is higher than 50 km/h.

Economic viability must be ensured

Alternative drives are heavier than conventional diesel engines. HGVs and articulated vehicles with two or three axles, and buses with three axles, are already allowed to compensate for the extra weight of alternative drives – their maximum permissible total weight may be exceeded by the additional weight of the alternative drive, up to a maximum of one tonne.

This weight compensation is now also to apply to trailers and semi-trailers. Moreover, for emission-free drives the maximum weight compensation may be as much as two tonnes. This ensures that electric vehicles, for example, will not have to carry lighter loads than similar vehicles with diesel engines due to their heavier batteries. Environment-friendly technologies are only attractive for companies if they do not have a negative impact on profitability.

Construction of fast-charging stations progressing smoothly

At the end of 2018, representatives from the cantons and municipalities, the electricity industry and the mobility sector signed the “Electric Mobility Roadmap” at the invitation of the Federal Department of the Environment, Transport, Energy and Communications (DETEC). One of the measures specified in the roadmap concerns the construction of fast-charging stations at motorway rest areas.

The target set by the involved players is for fully electric and plug-in hybrid vehicles to account for 15 percent of new vehicle registrations by 2022. At the end of 2020, with a share of 14.3 percent, it was clear that this target had almost been reached – two years earlier than planned. In view of this, at a summit held at the beginning of 2021, the representatives of the automotive, electricity, real estate and vehicle fleet sectors, plus the federal government, cantons and municipalities, agreed to raise the target for the proportion of electric and hybrid vehicles to be achieved by 2025.

One of the main prerequisites for accomplishing this higher goal is the availability of a dense network of charging stations. For transit traffic, this means fast-charging stations along the motorways and national roads. In mid-2020, the first of 100 fast-charging stations at motorway rest areas was opened at the Inseli rest area near Sempach (canton of Lucerne). Under the current plans, fast-charg-

ing stations are to be installed at around half the network’s rest areas by the end of 2021. These stations are equipped with all standard connector types and enable charging with up to 150 kW, which means that several vehicles can recharge at the same time with full power.

Handover for operation of fast-charging stations in rest areas:

In operation, A1: Suhr (AG), Lenzburg (AG), Oftringen (AG).

A2: Chilchbuehl (LU), Inseli (LU), Knutwil Nord (LU), Knutwil Süd (LU), Muehlematt Ost (BL), Muehlematt West (BL), Eggberg (SO), Teufengraben (SO). **A3:** Mumpf Nord (AG), Mumpf Süd (AG).

Planned for handover in 2021, A1: Büsisee Nord (ZH), Büsisee Süd (ZH), Stegen (ZH), Wildhus Nord (SG), Wildhus Süd (SG), Sulzberg (SG), Linkolnsberg (SG), St-Prex Jura (VD), Pierre Féline Nord/Jura (VD), Pierre Féline Süd/Lac (VD), Hurst (BE), Walterswil (AG), Hexentobel Nord (TG), Hexentobel Süd (TG). **A2:** Grund (UR), Erstfeld (UR), Personico (TI). **A3:** Aspholz (ZH). **A4:** Gurtellen (SZ). **A9:** Ardon Nord (VS), Ardon Süd (VS), Grand Chavalard (VS), Pierre-Avoi (Nord) (VS), Les Iles (VS), La Biolaz (VS), Pertit Lac (VD), Pertit Montagne (VD). **A12:** La Joux des Ponts Alpes (FR), La Joux des Ponts Jura (FR), La Tuffière (FR), Les Muéses (FR). **A13:** Isola (GR).

Planned for handover in 2022, A1: St-Prex Lac (VD), Lindenrain (BE), Baltenswil Nord (ZH), Baltenswil Süd (ZH).

A2: Lavorgo Ost (TI), Lavorgo West (TI), al Motto (TI), al Sasso (TI).

A4: Chrüzstrass (ZH). **A9:** Les Preyes/Cimes de l’Est (VS), Les Preyes (VS). **A13:** Apfelwuhrr Ost (GR), Apfelwuhrr West (GR), Mesocco (GR).



Fast-charging station on the A1 near Suhr (Aargau).

Impacts of the coronavirus pandemic on road transport

The coronavirus pandemic changed our mobility behaviour. The volume of road traffic decreased, though not as sharply as in the public transport segment.

The basic rules for avoiding COVID-19 infection were social distancing and avoiding gatherings of people. In view of this, the Federal Council called on the population to avoid using public transport wherever possible. However, a major shift in favour of private road transport (it was primarily commuter travel that was affected) did not occur, because the Federal Council also asked people to stay at home.

Following the initial lockdown in mid-March 2020, the average daily distance travelled by car fell by more than 50 percent. But this decrease was not as pronounced as that reported in the public transport sector, where usage fell by between 80 and 90 percent. By contrast, according to a study carried out by the Federal Institute of Technology, Zurich, the average daily distance covered by bicycle increased by more than 125 percent.

As restrictions were eased in spring 2020, the average daily distance travelled picked up again in all segments, but remained well below the previous year's levels. Shortly after the requirement to wear masks in public transport vehicles was introduced at the beginning of July, the average daily distance travelled by car temporarily surpassed the previous year's level by around 5 percent.

In the autumn of 2020, the average daily distance travelled by car remained below the 2019 levels. Then, after the second lockdown at the beginning of 2021, the figures fell again, though not as sharply as in spring 2020. The average daily distance travelled by car decreased by 20 to 30 percent, while the figures for bus, tram and train travel fell by around 60 percent. Due to the cold weather during the second lockdown, the use of bicy-

cles also dropped sharply, but it picked up again when temperatures began to rise in the spring of 2021.

Monitoring on motorways

The figures for motorway traffic present a similar picture. At the beginning of the pandemic, FEDRO designated ten measurement locations within the network at which the traffic counts for 2020 and 2021 were to be compared with the figures for 2019. Traffic counts are published each week on the Internet.

The decrease in the traffic volume on the north-south axis is particularly noteworthy: during the 2020 Easter weekend, the volume of traffic through the Gotthard road tunnel was around 90 percent down versus the same weekend in 2019. Traffic at the border crossings in Basel and Chiasso was also well below the previous year's level. Thus, the usual Easter weekend traffic jams did not materialise, and during the summer the volume of traffic on the north-south axis never reached the levels recorded in previous years.

In the agglomerations, the decrease in motorway traffic in spring 2020 was between 50 and 70 percent. During the summer holiday period, weekend traffic on the routes to the main holiday destinations in Grisons and the Bernese Alps surpassed that in the previous year by 10 to 15 percent. This indicates that many people in Switzerland chose to spend their weekends and summer holidays here rather than abroad. After the second lockdown in January 2021, the volume of motorway traffic fell again, though only by around 15 to 25 percent below the 2019 levels and thus less sharply than after the first lockdown. The traffic volume at the borders fell by around 45 percent.

Contributing to the national supply of essential goods

The transport of goods by road makes a significant contribution to ensuring Switzerland's national economic supplies. To facilitate the supply of foodstuffs and other goods such as medical products, particularly during the lockdown, in spring 2020 FEDRO eased certain restrictions for the haulage industry. For example, it temporarily suspended the ban on Sunday and night-time driving.

Little influence on construction sites

In the spring, the authorities of the cantons of Geneva, Ticino and Vaud banned all work on road construction sites. In the other cantons, work at FEDRO construction sites was carried out without interruption. However, the companies concerned were required to implement the prescribed protective measures against COVID-19, and in some cases this gave rise to additional costs.

Greater impacts on driving instruction

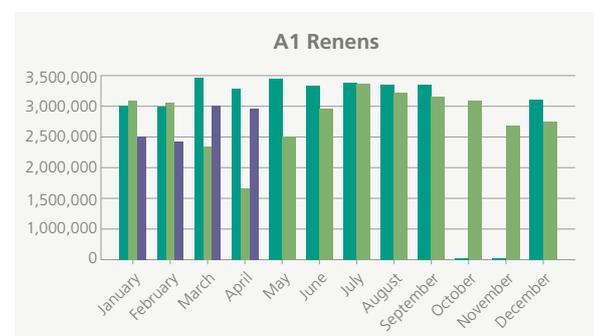
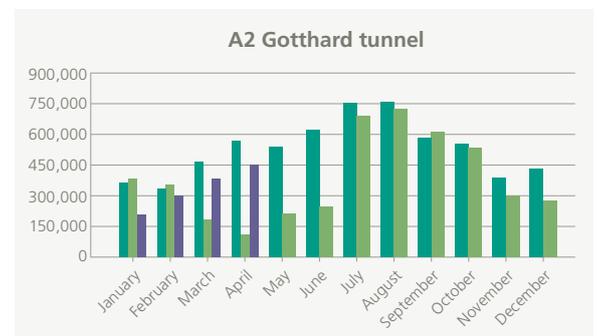
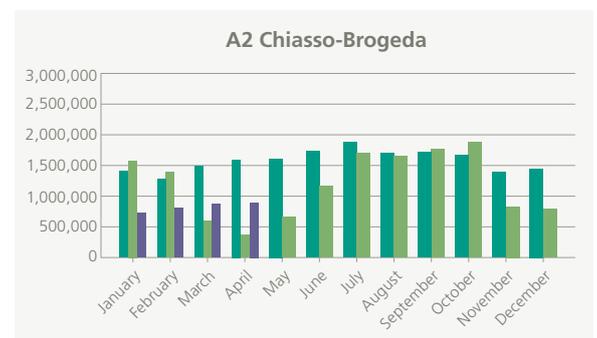
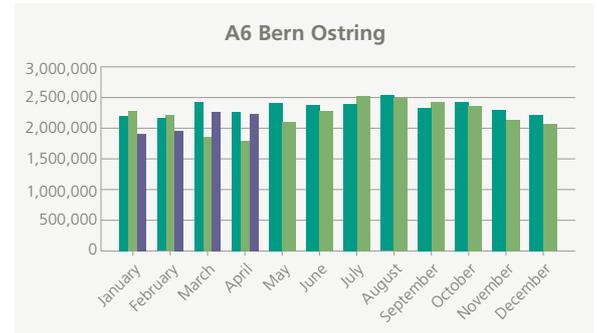
Driving instruction, further education courses and testing also had to be suspended in spring 2020. This resulted in closures of cantonal offices and training and further education institutions. One consequence of this was that holders of probationary driving licences and people in possession of a commercial driver's certificate for the transport of passengers and goods were unable to attend the required further education courses within the specified period. FEDRO therefore extended the period of validity of temporary licences until the end of September 2020. Thanks to the safety concepts put in place and the intensive efforts of all involved personnel, it was possible to resolve the resulting backlogs for the most part and avoid additional closures despite the second COVID-19 wave.

Drop in revenue

Less driving means less refuelling. This means less revenue for the Motorway and Agglomeration Traffic Fund. The drop in revenue from the oil tax surcharge amounted to 7.5 percent versus 2019. The sale of motorway stickers (Vignettes) fell by 12.9 percent. Here, too, the decline was due to the reduced traffic volumes.

Average daily traffic volume, 2019 to 2021

■ 2019 ■ 2020 ■ 2021



Pilot trials and research in the field of automated driving

Various public transport operators have been trialling automated vehicles since 2015. Nine trials have meanwhile been completed and four others are currently in progress.

These trials, which are licensed by the Federal Department of the Environment, Transport, Energy and Communications (DETEC) and supervised by FEDRO, mainly involve driverless shuttle buses on public roads. Initially, just one bus was operated per licensed test stretch, but the complexity of the trials has meanwhile increased sharply and "on demand" services are now also being trialled (by Transports publics genevois TPG, Bernmobil, PostAuto) with multiple vehicles in operation so as to meet user demand more flexibly. To concentrate resources, optimise costs and facilitate the general learning process, public transport operators are participating in joint trials to an increasing extent. The findings obtained from the trials show that Switzerland is among the leading countries in this field.

FEDRO research package

Alongside the cited trials, FEDRO implemented a research package under the heading, "Impacts of automated driving". The results show that automated driving offers significant opportunities, but also goes hand in hand with certain risks.

Here is a summary of the main findings:

- A high degree of fleet penetration with automated vehicles will take decades.
- Automated vehicles can give rise to significantly more traffic, as well as hazardous mixed traffic.
- With automated vehicles, bottlenecks on the motorway/national roads network will continue to exist despite efficiency increases.

- New types of collective mobility services will open up opportunities, but will also create competition with conventional public transport services.
- Ride pooling will gain in importance.
- Additional data will open up the perspectives for optimising traffic management.
- Automated driving will probably not act as a major impetus for increased urban sprawl.

Outlook

Based on the research findings, five areas requiring urgent action have been identified:

- Enabling the introduction of automated vehicles
- Implementing measures to ensure the safe management of mixed traffic and shorten the mixed traffic phase
- Fostering the collective use of automated vehicles and integrating them into the overall transport system
- Securing the efficient use of the roads and infrastructure
- Using new types of services to support conventional public transport

Completed pilot trials:

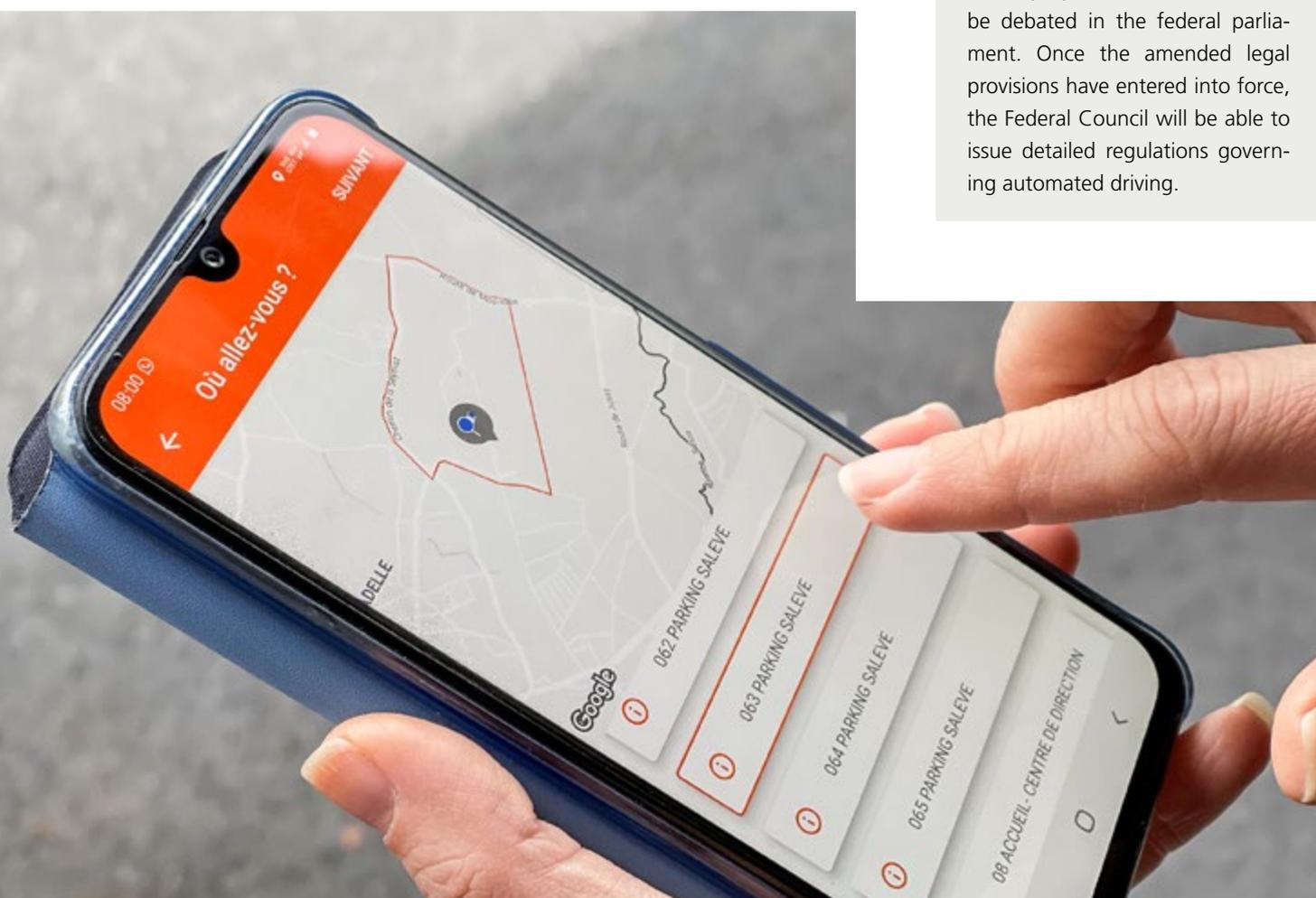
Year	Organisation	Place	Type
2015	Swisscom AG	Zurich	Cars
2016	Post AG	Bern/Solothurn	Delivery robots
2017 to 2018	Post AG	Switzerland	Delivery robots
2016 to 2017	PostAuto AG	Sion	Shuttle bus
2018 to 2020	Verkehrsbetriebe Schaffhausen	Neuhausen	Shuttle bus
2018 to 2019	Swiss Federal Railways (SBB)	Zug	Shuttle bus
2017 to 2020	Transports publics fribourgeois	Marly	Shuttle bus
2017 to 2020	PostAuto AG	Sion	Shuttle bus
2018 to Jan. 2021	Transports publics genevois	Meyrin	Shuttle bus

Ongoing pilot trials

Year	Organisation	Place	Type
2019 to 2021	Bernmobil	Bern	Shuttle bus
2020 to 2022	Transports publics fribourgeois	Marly	Shuttle bus
2020 to 2023	Transports publics genevois	Thônex	Shuttle bus
2021	PostAuto AG	Sion-Uvrier	Shuttle bus

Partial revision of the Federal Road Traffic Act

In the second half of 2020, FEDRO launched the consultation procedure for the partial revision of the Federal Road Traffic Act. The revision includes the proposal to grant the Federal Council the authority to regulate automated driving. In particular, this means empowering the Federal Council to define the extent to which operators of automated vehicles can be released from their obligations and to specify the framework within which vehicles with an automated drive system can be put into circulation. These proposals will also have to be debated in the federal parliament. Once the amended legal provisions have entered into force, the Federal Council will be able to issue detailed regulations governing automated driving.



The project of Transports publics genevois (TPG) in Thônex involves three fully-automated shuttle buses on a defined trial route. The app recognises the location of passengers. After the destination has been entered (photo), the bus drives to each passenger's location. The on-demand system (door-to-door) coordinates each journey via a dynamic routing system.

Signalisation of the added stretches of the motorway network

As of 1 January 2020, FEDRO adopted 413 kilometres of cantonal roads into the motorway/national roads network in accordance with the new federal motorway network resolution. The corresponding signalisation has now been added to these stretches.

The first step was to define their exact starting and end points, so that the respective starting points for indicating the distances could be determined in the second step. On this basis, the distances on the adopted stretches were adapted and the corresponding signs on the category 3 national roads, which accommodate mixed traffic, were modified to match those used on the motorways and national roads. This means that signposts with numbers (white road numbers for national roads against a red background) can now be added to the former cantonal roads.

In addition to the Federal Traffic Signals Ordinance, FEDRO Document 80003 (“Indication of distances on

category 3 national road stretches”) stipulates how road numbers and distances have to be displayed on this category of road. The federal resolution concerning the motorway/national roads network specifies which stretches are classified as national roads and defines the allocated category. As a rule, category 3 national roads are main roads as defined in the Federal Thoroughfares Ordinance. This means they are allocated a number as a national road (from the federal network resolution) and as a main road in accordance with the Thoroughfares Ordinance. These numbers do not necessarily have to be congruent.

Uniform numbering

FEDRO’s documentation ensures uniformity with regard to road numbering and indication of distance for existing as well as the newly adopted category 3 national road stretches. Thus the uniformity of road numbering is assured on all signs and distance indicators, as well as in all orientation aids for road users (maps, navigation devices, etc.).

Road numbering clearly identifies routes and helps road users find their way to their destination. It also plays an important role with respect to various legal and operational issues and services, including rescue organisations, and acts as an identifier for traffic bulletins and for various operational activities.



Stretch between La Chaux-de-Fonds and Le Locle, which was integrated into the motorway/national roads network on 1 January 2020 and now has green road signs.

Traffic data for professionals at one-minute intervals

In a pilot project, FEDRO is supplying traffic data at one-minute intervals. Raw data are being generated from 720 measuring points and made publicly available on a traffic data platform.

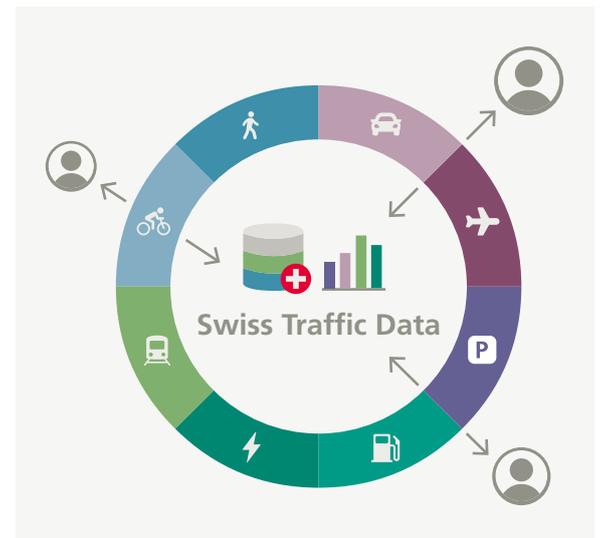
Traffic measuring points have been installed on motorways/national roads and other main thoroughfares. FEDRO operates 440 of these points, and is publishing the collected data together with figures from the additional 280 measuring points installed by the canton of Zurich on its own road network. The data from these 720 measuring points are being constantly posted online to the traffic data platform (www.opentransportdata.swiss) and made available to everyone in accordance with the principle of limited open data. This is a pilot project that will be implemented by FEDRO until April 2023.

Everyone who is interested can download the data and use them for their own purposes. Use of the platform is open to public authorities, planners, media organisations, etc., as well as private individuals. In order to ensure that the platform can represent an enrichment for the entire mobility system, procurers of the data are asked to deliver their data to the platform if they offer a commercial product on the basis of the procured data. The system is based on reciprocity in accordance with the principle of limited open data.

Basis for intelligent mobility services

The goal is to open the platform for other datasets, gain additional data suppliers and thus constantly broaden the circle of users. The intention is to enable public authorities, transport specialists and private individuals to develop intelligent mobility services so that the transport infrastructure can be used more efficiently and more safely, and the introduction of connected mobility can be facilitated at a later date.

Swiss traffic data platform



The aim of Switzerland's traffic data platform is to provide road users with all possible mobility-related information over the long term, including on motorised transport, parking, fuel, fast-charging stations, air travel, rail travel, human-powered mobility.

The pilot project aims to demonstrate the usefulness of such a platform and to pave the way for the exchange of data for the future mobility system. A report will be prepared every six months listing the main findings.



Video camera at the Thun North exit.

Video cameras on Switzerland's motorway/ national roads network

We're all aware of the video cameras installed along the motorways and national roads. These cameras are there to support traffic management, as well as to help emergency crews in the event of an incident.

The Federal Road Traffic Act stipulates that the federal government is responsible for traffic management on the motorways and national roads, on which safety is of the highest priority. Other important tasks include preventing or responding to disruptions to traffic, and informing road users about traffic situations, restrictions and road conditions. These objectives can be achieved in that specially trained personnel at the Swiss traffic management centre use various information sources such as traffic count sensors installed on or above the road surface.

But it is difficult for them to perform their various tasks without the aid of up-to-date video images, and this is why video cameras have been installed throughout the network. The Swiss traffic management centre, FEDRO's regional offices and the cantonal police are able to view the video recordings. However, there is a greater number of video cameras on those stretches where traffic volumes are high or there is a greater risk of accidents, than on less frequented stretches. As a rule, the video

images are recorded in low quality or at correspondingly low resolution. This means it is not possible to record road users' data, and thus the regulations governing data protection are duly complied with.

Exceptions

In accordance with the applicable directive, high-resolution video images are used exclusively for detecting traffic situations and incidents in tunnels, and for the temporary opening of emergency lanes to traffic. FEDRO does not evaluate these video images in personalised form. Images may only be passed on to investigating authorities within the framework of legal proceedings. The use and storage of such images by the police must comply with the data protection provisions in accordance with cantonal law.

The recorded images may also be used by operational units of FEDRO's regional offices, for example for snow and ice clearance.

Legislation for safer bicycle routes

Progress is being made regarding the proposed article in the Federal Constitution relating to the federal resolution concerning cycle routes. The Federal Council has submitted the draft legislation to Parliament.

On 23 September 2018, more than 70 percent of the electorate and all the cantons voted in favour of the federal resolution concerning cycle routes. Thus the way has been paved for placing cycle routes on an equal footing with pedestrian and hiking routes, and the federal government can support the cantons in their efforts to make cycling safer.

Four pillars

The Federal Bicycle Routes Act is based on four pillars. Firstly, it obliges the relevant authorities of the cantons to plan and install a bicycle route network. Secondly, it defines the planning principles for the network, which must be fully interconnected, safe, attractive and direct. However, the legislation grants the cantons sufficient leeway with regard to implementation. Thirdly, it requires the cantons and municipalities to replace bicycle routes, or parts thereof, if they have to be done away with or if the requirements in terms of safety and attractiveness can no longer be met. And finally, the legislation empowers the federal government to publish information and harmonised official basic geodata regarding the quality and availability of cycling infrastructure. This simplifies the planning and maintenance of bicycle route networks and is a major support mechanism for the cantons and municipalities. The federal government may also inform the general public about the importance and fundamental aspects of the planning, construction and maintenance of the networks.

In the consultation procedure carried out in 2020, the majority of statements of position regarding the proposed legislation were positive. Only very few comments were received expressing reservations or opposition to the legislation. The Federal Council submitted the draft legislation to Parliament in spring 2021.

Separation from other traffic

The objective of the Federal Bicycle Routes Act is to create safe and attractive infrastructure for cyclists. This has become necessary due to the constant increase in the use of bicycles in recent years, which has been additionally boosted as a result of the coronavirus pandemic. Furthermore, improved infrastructure for cyclists will help reduce the number of serious accidents involving users of bicycles and electric bikes. The separation of cyclists from other traffic will also contribute towards smoother traffic flow.

Separation at motorway/national road junctions

The safety of cyclists is especially at risk at major road junctions. Potential exists for separating motorised transport and human-powered mobility at motorway/national road junctions, where FEDRO takes its responsibility as role model very seriously. But on category 3 national roads too, where there is a great deal of mixed traffic, FEDRO is also endeavouring to make cycling safer by completely separating it from other traffic. Bicycle routes or lanes such as those that have already been provided on the Gotthard Pass and the Schöllenschlucht (gorge) routes are to be constructed wherever possible.

Vehicles to become ever quieter

The volume of road traffic has doubled over the past 25 years. At the same time, vehicles have become ever quieter, but some road users continue to cause excessive noise. In view of this, more stringent noise limit levels for motor vehicles were introduced in 2016.

The noise limit levels for motor vehicles are specified in the Federal Ordinance on Technical Requirements for Road Vehicles, and have been harmonised with the applicable European regulations on the basis of the bilateral agreements with the EU. Limit levels are being constantly modified with the aim of reducing traffic noise. Throughout their entire period of use, motor vehicles must comply with the noise limit levels that were stipulated at the time of their registration.

Status of technical requirements

The regulations specify noise limit levels and requirements on testing conditions, one of the main elements of which is “accelerated passing”. This involves the simulation of a traffic situation under clearly defined conditions. The noise level recorded in this test forms the basis for the vehicle’s type approval. It may not exceed the threshold specified in the regulations.

The applicable regulations are being constantly adapted and tightened. For example, the 2016 requirements on testing conditions have been revised in that the test cycle has been rendered more demanding. And the new noise regulations now contain the official “Additional Sound Emission Provisions”, which stipulate that no devices may be installed that serve the sole purpose of making the vehicle noisier (e.g. flap systems). These additional regulations are applicable in both the EU and Switzerland. Vehicles approved on the basis of the currently applicable regulations have become quieter over a wider speed range.

However, the more stringent regulations do not apply retroactively. For older vehicles, those regulations continue to apply that were applicable at the time of the vehicle’s initial registration. Here the specified noise limit levels and testing conditions can be less stringent. The

quantity of older, noisier vehicles is of course constantly decreasing as the vehicle park is renewed.

Noise limit levels

The noise level recorded at the time of a vehicle’s type approval is documented for each type of vehicle. These noise levels are passed on to the registration authorities in electronic form. In addition, for each vehicle the manufacturer is required to issue a Certificate of Conformity that contains the relevant data, including its noise level. The following noise limit levels are currently applicable:

- For cars: 75 dB(A)
- For motorcycles up to 80 cc: 75 dB(A)
- For motorcycles up to 175 cc: 77 dB(A)
- For motorcycles over 175 cc: 80 dB(A)

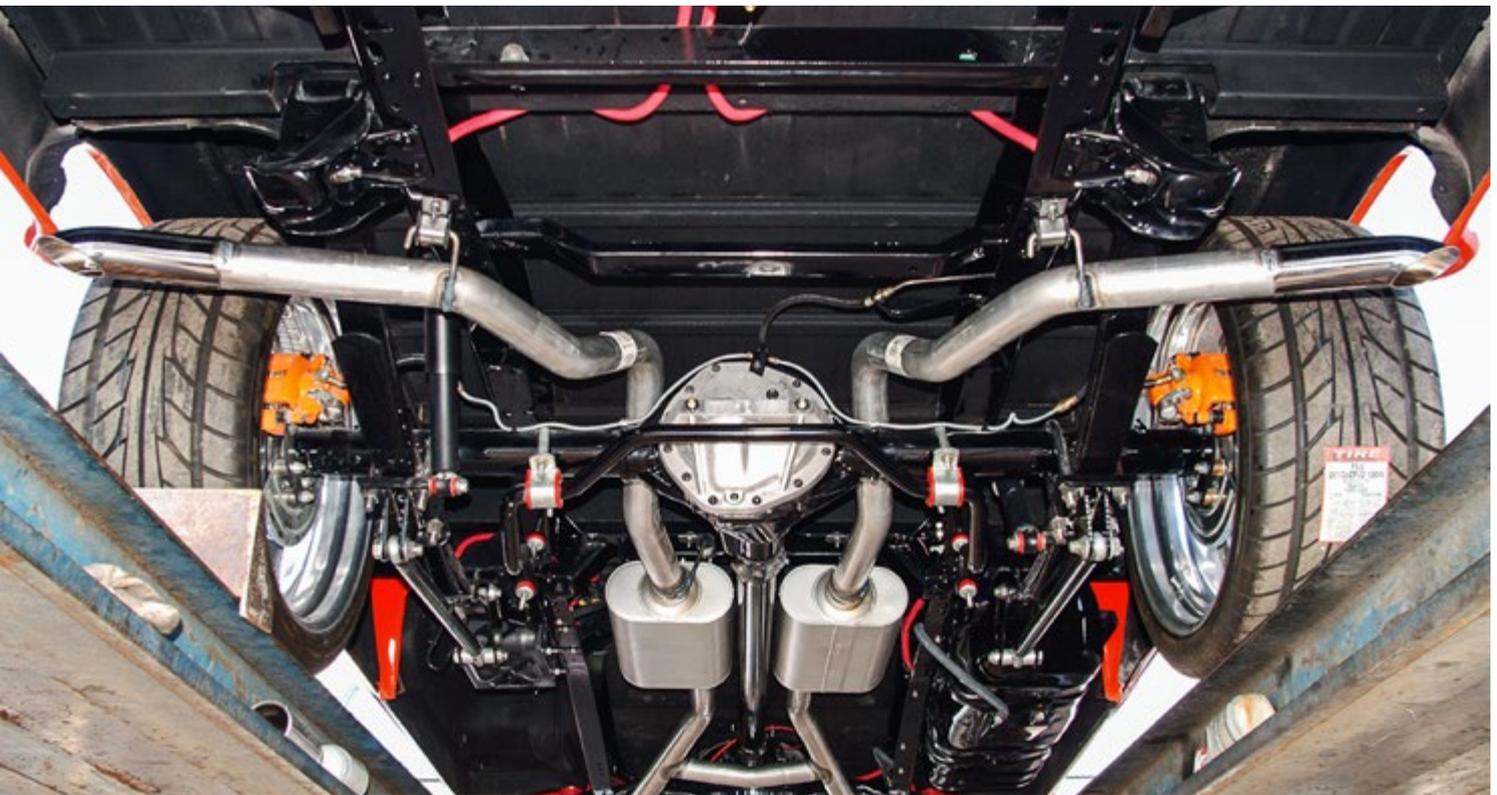
By way of comparison, the noise level in a quiet living room is around 40 dB(A).

Further development of noise regulations

International legal provisions call for a reduction of the noise limit level by 2 dB(A) from 2024 for new EU category M1 vehicles (passenger cars). From 2023, for new EU category L3 vehicles (motorcycles) the conditions for the testing procedure (“Additional Sound Emission Provisions”) will be made more stringent: here the measurement range for motorcycles is to be increased (from 20 to 80 km/h to 10 to 100 km/h). In addition, the testing centre can select and test random measurement points (any speed within the measurement range, any acceleration rate, any moment, etc.).

Driving behaviour regulations

The technically induced noise levels of vehicles only account for a certain proportion of traffic noise. In view of this, traffic rules also contribute towards noise abatement. Road traffic legislation prohibits drivers of motor vehicles from causing any form of avoidable traffic



View of an exhaust system under a car.

noise. This includes revving the engine at high speed when in neutral, unnecessarily driving in low gear and excessively accelerating when starting. Repeated unnecessary driving around localities is also prohibited. Anyone who causes unnecessary noise with their vehicle is subject to prosecution.

Illegally modified vehicles also often cause unnecessary noise, and this is punishable by law. The relevant cantonal authorities are responsible for carrying out inspections and enforcing the applicable regulations.

Valves in exhausts

Motorcycles, sports cars and illegally modified vehicles are particularly conspicuous when it comes to traffic noise. Valves in exhausts can be an integral part of the technology of the overall drive concept. Under the old regulations (i.e. prior to the introduction of the "Additional Sound Emission Provisions"), manufacturers had used loopholes in the legislation in order to optimise their vehicles for the test cycle. They installed exhaust valves that could be closed during the test cycle and thus served the sole purpose of enabling the vehicle to meet the requirements of the "accelerated passing" test.

The currently applicable regulations prohibit systems equipped with electronically controlled exhaust valves if they solely serve to produce more noise.

However, exhaust valves are permissible in principle. The regulations do not prohibit manufacturers from incorporating various drive programmes (e.g. "sport", "comfort") that also influence the vehicle's noise level, for example through the use of exhaust valves. But here it is a prerequisite that these valves are effective not only during the test procedure, but also in normal traffic, and that the vehicle meets the applicable noise limit levels in all selectable drive programmes.

Almost 100,000 vintage cars on our roads

In accordance with road traffic law, motor vehicles that have been in use for more than 30 years can be registered as “vintage” models. To qualify, they have to meet certain requirements in terms of condition and appearance, as well as use. There are currently almost 100,000 registered vintage vehicles of all types in Switzerland and the number is on the increase.



This 1978 Alfa Romeo Alfetta 1.8 is classified as a vintage car. It is equipped with a 5-gear, 4-cylinder 1,799-cc engine with 118 HP.

Older vehicles are often colloquially referred to as classic models, but this does not mean that they also automatically qualify to be classified as vintage models. For a vehicle to be registered as a vintage model, its initial registration must have been made at least thirty years ago. It is not only cars, motorcycles and commercial vehicles that can be classified as vintage vehicles – non-mobile machines, tractors and certain types of trailers can also meet the applicable criteria.

Authenticity and condition are decisive

In addition to a vehicle's age, it is also its condition that is decisive. The vehicle must correspond to its original version and be in perfect condition in both technical and optical terms. Experts from the road traffic authorities use the corresponding FIVA Identity Card to help with their assessment. FIVA stands for Fédération Internationale des Véhicules Anciens. The FIVA Identity Card can be obtained from the Swiss Historic Vehicle Feder-

ation, which is the FIVA's representative organisation in Switzerland.

Less stringent regulations for vintage vehicles

The above criteria are offset by certain less stringent regulations for vintage models. For example, longer intervals of up to six years apply for follow-up inspections, more than two vintage vehicles can be registered with the same licence plate, and these vehicles do not have to be equipped with tachographs and data recording devices. However, they may only be used for private journeys. A vintage car, for example, may not be used as a taxi, nor may a vintage coach carry out journeys on a commercial basis, or a vintage HGV be used for the commercial transport of goods. In addition, the maximum permissible annual travel distance of a vintage vehicle is 3,000 kilometres. This is checked by the relevant road traffic authority during the mandatory follow-up inspections.

Ever more old-timers – with or without vintage status

Of the 98,954 vehicles registered as vintage models as of the end of January 2021, 90,694 were cars, motorcycles or motorbikes with side-cars. The number of pre-1960 vintage cars and motorbikes has increased particularly sharply. Since 1990, the number of cars older than 60 years has doubled to 13,905, while that of motorbikes has almost tripled to 9,247.

Around 90,000 cars in Switzerland are more than 30 years old, and almost 55,000 (or 60 percent) meet the stringent criteria for classification as vintage vehicles. Of the more than 70,000 motorcycles, roughly half are vintage models.

Motorised agricultural vehicles an exceptional case

The service life of tractors and agricultural traction engines is exceptionally lengthy. Of the approximately 140,000 tractors in use in Switzerland, more than 65,000 are older than 30 years. 2,725 of these are registered as vintage models and are thus no longer used as agricultural vehicles. Almost two-thirds of the 32,300 agricultural traction engines have been in use for 30 years, and only 102 of these are registered as vintage models (i. e. less than 0.5 percent of the total number of this type of vehicle).

Number of vintage vehicles as of 31 January 2021

	30 years old*	Number with vintage status**	
01 Cars	92,309	54,963	59.84 %
60 Motorcycles	71,673	34,629	48.38 %
43 Agricultural tractors	65,381	2,725	4.18 %
90 Trailers for goods transport	25,950	427	1.66 %
81 Agricultural traction engines	20,233	102	0.51 %
94 Work trailers	17,447	10	0.06 %
30 Delivery vehicles	7,656	2,259	29.72 %
83 Single-axle agricultural vehicles	6,513	156	2.40 %
10 Light motor vehicles	5,808	399	6.91 %
92 Caravans	4,388	82	1.87 %
93 Sports equipment trailers	3,641	5	0.14 %
80 Traction engines	3,345	77	2.31 %
51 Carts	2,184	11	0.51 %
50 Work machines	1,786	130	7.41 %
63 Motorcycles with side cars	1,782	1,102	61.98 %
61 Motor scooters	1,629	926	56.84 %
35 Heavy goods vehicles	1,492	293	19.76 %
52 Agricultural carts	1,157	5	0.43 %
85 Agricultural trailers	588	1	0.17 %
42 Tractors	442	87	19.68 %
95 Semi-trailers for goods transport	431	2	0.47 %
99 Trailers	377	14	3.75 %
67 Three-wheeled motor vehicles	364	188	51.65 %
62 Three-wheeled motorcycles	343	185	54.41 %
11 Heavy motor vehicles	336	21	6.27 %
82 Single-axle motor vehicles	171	5	2.92 %
86 Motorcycle trailers	113	22	19.47 %
20 Coaches	81	56	69.14 %
21 Mini-buses	56	12	21.43 %
38 Articulated vehicles	48	16	33.33 %
68 Snowmobiles	37	1	2.78 %
89 Semi-trailers	34	–	–
98 Work semi-trailers	29	–	–
64 Three-wheeled motor scooters	27	9	37.50 %
84 Combination agricultural vehicles	26	3	11.54 %
66 Small motor vehicles	22	16	72.73 %
02 Heavy passenger cars	20	15	75.00 %
88 Articulated caravans	18	–	–
91 Passenger transport trailers	13	–	–
87 Agricultural work trailers	8	–	–
97 Articulated sports equipment trailers	4	–	–
Total	337,962	98,954	29.39 %

* Age based on initial registration (rounded up/down to nearest year)

** Defined as "vintage" vehicles registered for special use (section 17 in the vehicle licence)

Ground-breaking for second Gotthard tube in autumn 2021

The preliminary construction work for the second tube of the Gotthard road tunnel commenced in spring 2021. The first step was to relocate the accesses to the safety shaft. The official ground-breaking ceremony will take place in the autumn.



(1) Northern portal of the existing Gotthard road tunnel near Göschenen. (2) Location of the future second tube.

The service and infrastructure shaft – which is also referred to as the safety shaft because the escape routes from the tunnel indicated with green signs lead into this shaft – runs parallel to the tunnel on the eastern side. Work on the entrances to this shaft commenced in spring 2021. The first step involved relocating the existing accesses in Airolo and Göschenen. In Göschenen the access is to be relocated to the depot site, while in Airolo it will be situated above the tunnel portal alongside the ventilation plant. Blasting and the use of construction machinery will be required in the loose rock in order to facilitate the shift over a distance of around 300 metres. This work is scheduled to be completed by autumn 2022.

Auxiliary shafts to access a fault zone

Between April 2021 and August 2023, special auxiliary shafts with a diameter of seven metres each will be drilled on the north and south sides. This involves the construction of a tunnel with a length of more than five kilometres to provide access to a geological fault zone. Due to the geological structure of the terrain it is not possible to use excavation machines. Thus in order to save time, access is to be gained through blasting.

Excavation machines with a diameter of 12.7 metres

The construction of the second tunnel tube itself is scheduled to commence in mid-2022. The first step will be to construct the excavation machines and subsequently transfer them in segments to the site. This phase will take around 18 months and is expected to be completed in October 2023. The machines will then be assembled

so that the excavation of the second tunnel tube can commence in both Airolo and Göschenen in mid-2024. Excavation machines with a diameter of 12.7 metres will proceed from both ends and each excavate around half of the 16.9-kilometre tube. The new tube will be linked with the existing safety shaft at intervals of 250 metres. 62 of these intersections will be accessible on foot and six will be accessible to vehicles.

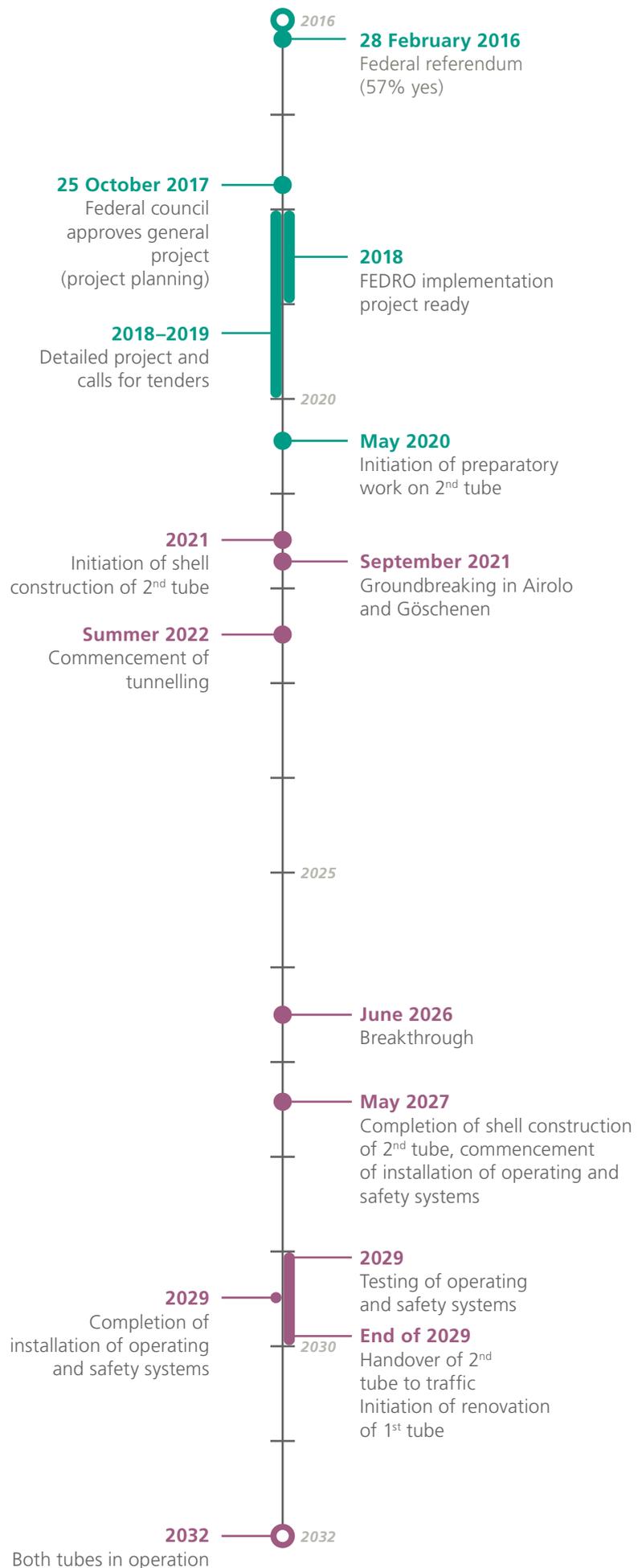
Secondary projects in Airolo and Göschenen

In addition to the tunnel construction, various secondary projects will also be initiated in Airolo and Göschenen. To create sufficient installation space, various demolition operations will be carried out at Airolo railway station. Work will also commence on the railway and loading facilities: here, new points will be installed, lines will be lengthened and pits will be excavated for the transfer of the excavated material. Temporary work site and motorway access roads for the exclusive use of construction and material transport vehicles will ensure that the burden on cantonal and municipal roads will be kept as low as possible. At the southern end the excavated material will be temporarily stored at various sites (including the cable car base station and the Gotthard-South motorway service area). This material will subsequently be used for the one-kilometre-long enclosure of the motorway ahead of the village of Airolo.

At the northern end the excavated material will be transported by rail to Flüelen, where it will be used for the ongoing renaturalisation of the shallow water zones in the Urner Lake. In addition, accommodation for the construction crews will be built in Göschenen and work will be carried out on the railway and loading facilities for the excavated material.

Information centres in Airolo and Göschenen

FEDRO will be setting up an information centre at both ends of the Gotthard tunnel in order to keep the public informed about the construction of the second tube. Multimedia exhibitions providing background information and including interactive programmes for people of all ages will be established at Göschenen and Airolo railway stations. The two information centres will be opened at the beginning of August 2021.

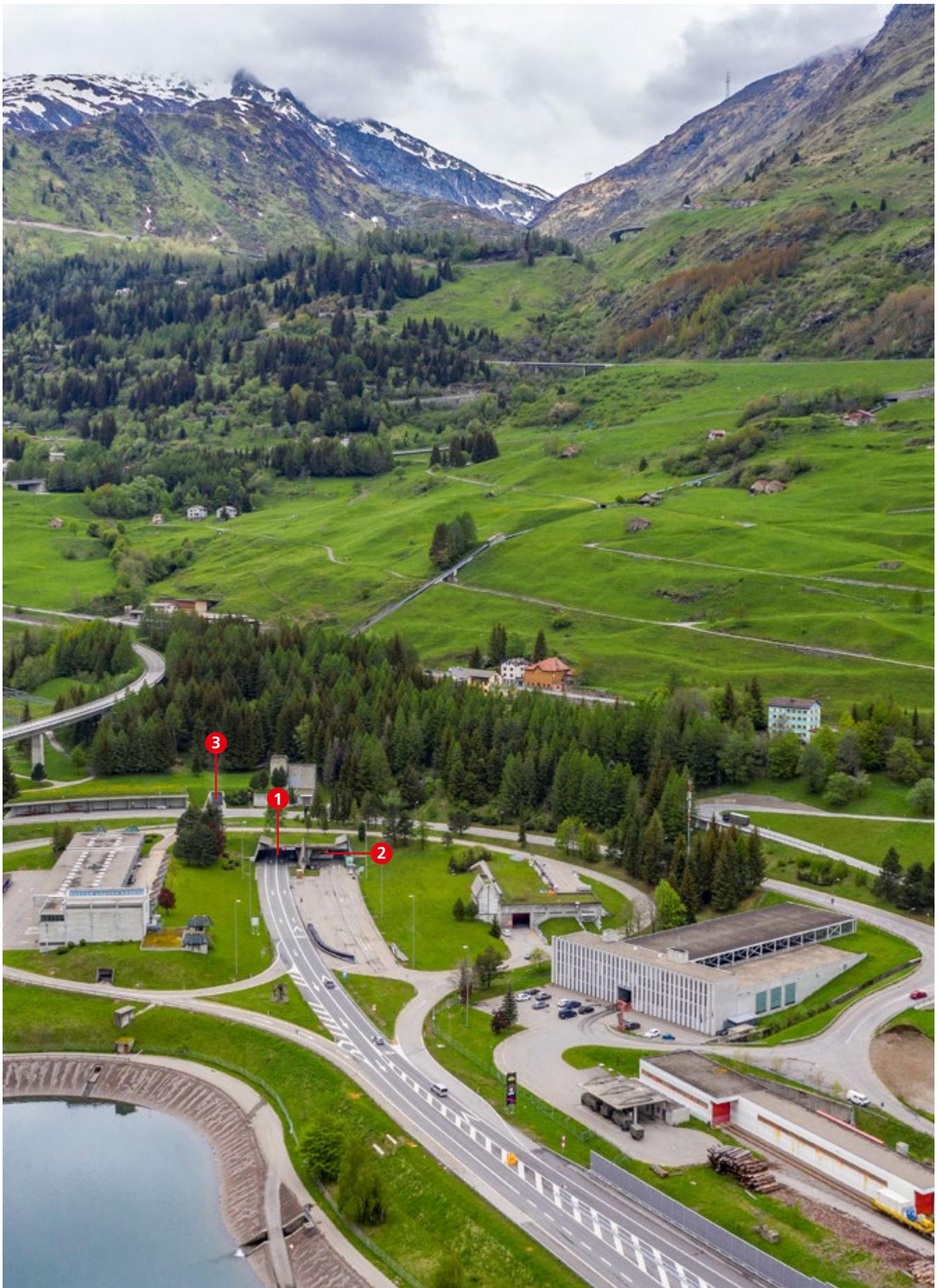




Preliminary construction work for the relocation of the service and infrastructure shaft at the northern portal near Göschenen.



Drilling of boreholes into rock in preparation for blasting operations at the northern portal near Göschenen.



(1) Southern portal of the existing tube of the Gotthard road tunnel near Airolo (Ticino). (2) Entrance to the existing safety shaft that is to form the portal of the second tube. (3) New location of the safety shaft.



Noise abatement barrier on the A1 (Bern eastern bypass).

Noise abatement at a cost of 3 billion Swiss francs

As the owner of the motorway/national roads network, FEDRO is making intensive efforts to reduce traffic noise. During construction and maintenance work on the network, it is implementing measures aimed at reducing noise levels for nearby residents.



The motorway/national roads network encompasses 2,288 kilometres, including entrance and exit roads. On 2,129 kilometres, noise abatement measures have already been implemented or are unnecessary, while measures have yet to be implemented on the remaining 159 kilometres.

The need for noise abatement is being constantly assessed along the entire network. As of the end of 2020, noise abatement measures had been implemented at a cost of around 3 billion Swiss francs. Noise prevention barriers or embankments account for 73 percent of this figure, while the remainder was spent on other measures including low-noise road surfaces. To date, low-noise surfaces have been installed on approximately 555 kilometres, and it is planned to install these surfaces



Noise abatement measures implemented by 2020

	Noise abatement barriers		Noise abatement barriers		Category III surfaces		Category I surfaces		Other
	m ²	Million Swiss francs	m ²	Million Swiss francs	m ²	Million Swiss francs	m ²	Million Swiss francs	Million Swiss francs
Added cantonal roads	57,358	80	13,764	10	3,474	0	62,885	0.06	0
Total	1,447,656	2,032	332,481	234	2,950,872	17.7	10,866,947	11.0	822

Planned noise abatement measures

km	Noise abatement barriers		Noise abatement barriers		Category III surfaces		Category I surfaces		Other
	m ²	Million Swiss francs	m ²	Million Swiss francs	m ²	Million Swiss francs	m ²	Million Swiss francs	Million Swiss francs
2,288	366,929	624	9,047	9.0	218,689	1.3	12,054,085	12.1	160

No. of residents and buildings exposed to traffic noise

Status as of 2030	Without implemented measures		With measures implemented to date		With already implemented + planned measures	
	Buildings	Residents	Buildings	Residents	Buildings	Residents
All stretches	29,624	236,992	16,170	129,360	10,376	83,008

on a further 491 kilometres. On sustainability grounds and to keep costs within reasonable bounds, the installation of these surfaces mainly takes place within the scope of normal maintenance projects.

Planned measures for 800 million Swiss francs

Without noise abatement measures, in view of the anticipated volume of traffic, in 2030 a total of around 220,000 people would be exposed to noise levels above the specified threshold. Thanks to the measures that have been implemented to date, this figure has been reduced

by around 50 percent. And with the planned additional measures it will be possible to further reduce the number so that around 70 percent of the people originally exposed to excessive noise levels can be protected. The budget for the planned additional measures is around 800 million Swiss francs, of which 300 million will be spent on retrofitting projects.

Current situation

The results of an assessment of the network, including all the additional stretches adopted from the cantons as of 1 January 2020, are as follows:

- On 2,129 kilometres (90 percent of the overall network), noise abatement measures have already been implemented.
- On 1,491 kilometres (65 percent), no additional measures are required until approximately 2030.
- On 112 kilometres (5 percent), the implemented measures are not sufficient over the long term.
- On 526 kilometres (23 percent), the implemented measures are already no longer sufficient today.
- And on 159 kilometres (7 percent), no noise abatement measures have been implemented to date.

Noise abatement measures

Noise prevention barriers can be up to 6.5 metres high and reduce noise levels by up to 15 dB(A).

Noise prevention embankments are usually lower than barriers. They reduce noise levels by up to 10 dB(A) and take up more space than barriers, which is often problematic when existing installations need to be renovated.

Low-noise surfaces reduce noise by at least 3 dB(A) compared with conventional motorway surfaces.

Other structural measures: These include galleries, enclosed stretches, and sound-absorbing cladding on retaining walls and tunnel portals.

Legally speaking, **sound-insulating windows** are not regarded as noise abatement measures and are therefore not included in the current programme. They are merely designed to protect people inside buildings if the applicable noise limit levels cannot be complied with at source or along the propagation path with the aid of other noise abatement measures.

Application of “building information modelling” by FEDRO

In the framework of digitalisation, BIM opens up new opportunities. With “digital twins” on a smartphone or pc it is possible to obtain a simplified image of a building thanks to structured data. Data can also be combined from various technical disciplines in order to produce a complete picture. Thus “digital twin” technology facilitates specialised depictions by means of diagrams, lists and in 3D geometry. One advantage this technology offers is that an initial impression of the specific operational and safety equipment in a tunnel can be obtained without having to close it to traffic. Thus a given project can be analysed readily and more comprehensively.

Specific pilot projects are taking FEDRO’s practical activities a step further and facilitating the achievement of its strategic objectives associated with BIM, as well as the implementation of the Digital Switzerland Action Plan and the Federal Council’s 2020 information and communication technology masterplan.

Utilising innovations

In its 2016 strategy, FEDRO declared BIM as an innovation to be considered. And in 2019 it initiated its BIM@FEDRO programme. In addition to data, the core of the BIM method includes the work processes of participants in projects. Until now, although no building measures were specifically carried out using BIM, it is being applied in project planning.

- For example, a trial planning of an operations centre for the second tube of the Gotthard road tunnel was carried out using BIM.
- And a second pilot project using BIM concerned the Bern-Bümpliz motorway junction.

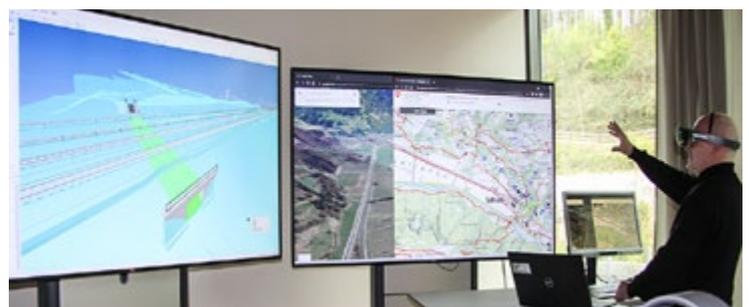
These projects have already yielded valuable findings which in terms of content and organisation are influencing FEDRO’s specific fields of action relating to the implementation of BIM. The findings also pointed to the need for FEDRO to provide clearer explanations regarding its data policies. It also became apparent that the technical fundamentals for the comprehensive use of BIM are still undergoing development.

FEDRO has been applying the data-based working method, “building information modelling” (BIM) since 2017. Within the scope of digitalisation in construction projects, this method provides access to location-independent information and simplifies activities.

FEDRO has defined 20 projects for 2021 based on BIM, including:

- The Schiers wildlife corridor in Grisons, concerning which the incorporation of the local population is to be improved through visualisation, and the quantities of primary materials (soil, concrete) are to be evaluated more precisely using 3D geometry;
- The third tube of the Rosenberg tunnel in St Gallen, concerning which a data-based simulation of its impacts on the surroundings is to be obtained.

FEDRO does not plan and build on site itself. It outsources these tasks to planners and construction companies. Thus the exchange of data with companies and public authorities is a central task when working with BIM. FEDRO is already well prepared for its fundamental implementation in projects in that it is applying a clear ordering structure, which it is harmonising with the Coordination Conference of Public Construction and Property Authorities and other entities. It also corresponds to the system of BIM standards (SN EN 19650). FEDRO expects to activate specific and promising aspects of BIM in its maintenance, operation, planning and construction projects by 2025.



At FEDRO’s BIM laboratory, construction projects are visualised.

Uniform safety standards on the motorway/ national roads network



Drainage water treatment facility on the A1 Zurich northern bypass near Büssisee rest area, Affoltern (canton of Zurich).

An extraordinary occurrence on a transport route or in a pipeline system that can cause severe harm to the population or the environment is considered to be a major incident. So that it can respond to such incidents, FEDRO has maintained uniform safety standards on Switzerland's motorway/national roads network since 2008.

The Ordinance on the Prevention of Major Accidents is based on the principle of precaution. For FEDRO this means the need to manage the network in such a way as to minimise the risk of severe harm or damage in the case of road accidents involving hazardous goods transport. Two guidelines drafted by FEDRO in 2008 govern safety measures to reduce the risk of major incidents. They define the methods to be adopted both for the network and with regard to the protection of hazardous goods in the event of a serious incident.

The practical application of these guidelines over the past ten years has contributed decisively to the implementation of uniform safety standards across the entire motorway/national roads network. Already at the project stage the risks on the stretches of road concerned are identified and suitable risk-reducing measures adopted in the planning stage.

High level of safety

One example of a very effective measure is the limitation or ban on the transport of hazardous goods through long road tunnels, such as the Gotthard or San Bernardino. Accident prevention measures reduce the risk of serious incidents, thus increasing safety, as do structural measures such as drainage systems and retention basins, usually installed in roadside zones for the purpose of containing or diverting hazardous substances released as a result of an accident. Equally important

are all ways and means to enable road users to escape accident scenes and open up space for emergency services to carry out rapid interventions.

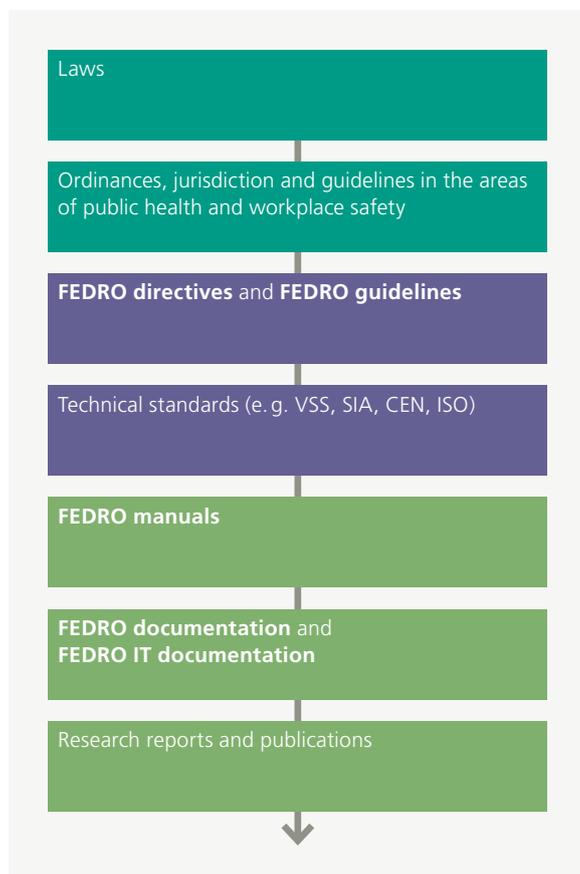
Nowadays, the highest risks for road users are in tunnels with high traffic volumes or limited escape possibilities. The risks on open stretches of road – including those that transit densely populated agglomerations – are now considered to be at an acceptable level.

From the environmental perspective, approximately half of all defined risks are now at, or close to, an acceptable level. Factors determining residual risks include direct channels in ground water zones lying in close proximity to roads. Since 2008, numerous risk-reduction measures have been implemented as part of road maintenance operations. As a result, the level of risk for road users, including vehicle occupants, and of risks related to bodies of surface water, has approximately halved. Risks for groundwater have been reduced by around 25 percent. Less than one percent of the road network is considered to pose an unacceptable level of risk.

Principles for construction, maintenance and operation of the motorway/national roads network

Who decides what type of surface is laid on a particular stretch of motorway? Do guidelines exist that determine what noise-abatement measures are applicable on the network? What requirements are to be taken into account in the construction of an avalanche protection gallery? In addition to its general rulings, FEDRO’s standards govern the technical details for the motorway/national roads network.

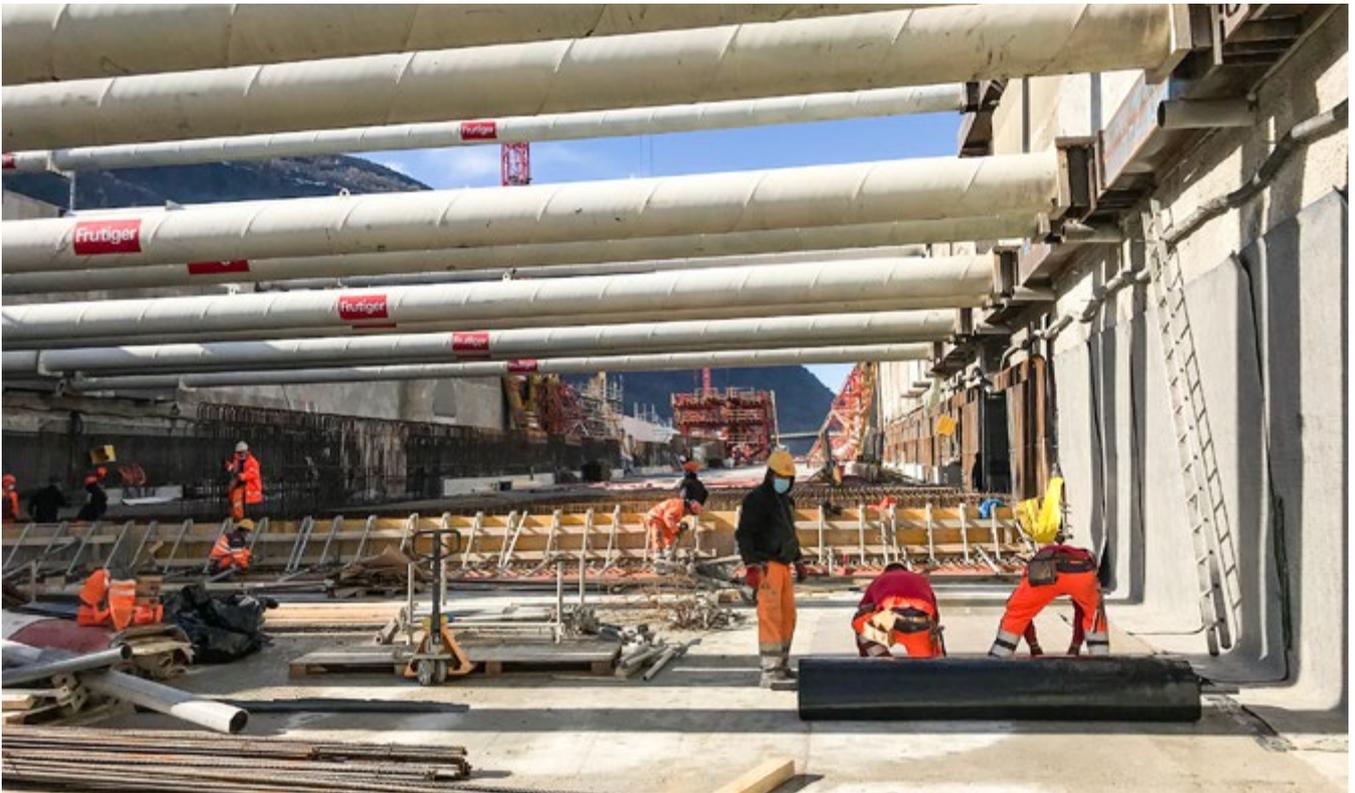
Hierarchy of standards



In Switzerland, FEDRO is responsible for the construction, maintenance and operation of the motorway/national roads network. To perform its mandate, a number of principles have to be adhered to. These involve legislative and legal requirements, on the one hand, and technical norms and standards on the other. While norms are defined by the Swiss Association of Road and Traffic Experts (VSS) and the Association of Swiss Architects and Engineers (SIA), the standards are specified by FEDRO.

Types of standards and their binding nature

FEDRO’s technical standards supplement and refine the overarching norms. They define the principles for ensuring the efficiency and safety of the network, to which they apply exclusively. These technical standards are binding for FEDRO’s employees and contractors. They raise work efficiency, since it is not necessary to “re-invent the wheel” for every new project, and enhance predictability, transparency and reliability, which is very important for engineering companies and industry.



A9 near Raron (canton of Valais): the applicable standards also have to be complied with for the construction work on this 900-metre covered stretch.

The standards have been published on the FEDRO website in the following documents:

- Directives: Mandatory provisions of an administrative and legal nature
- Guideline: Mandatory provisions for the purpose of determining a technical standard and a uniform approach
- Manual: Guidelines for describing projects and implementing directives, guidelines and norms
- IT documentation: Guidelines for the use and management of FEDRO's IT applications
- Documentation: Description of methods, examples and studies
- Research reports: Presentation of the results of specific research projects on roads

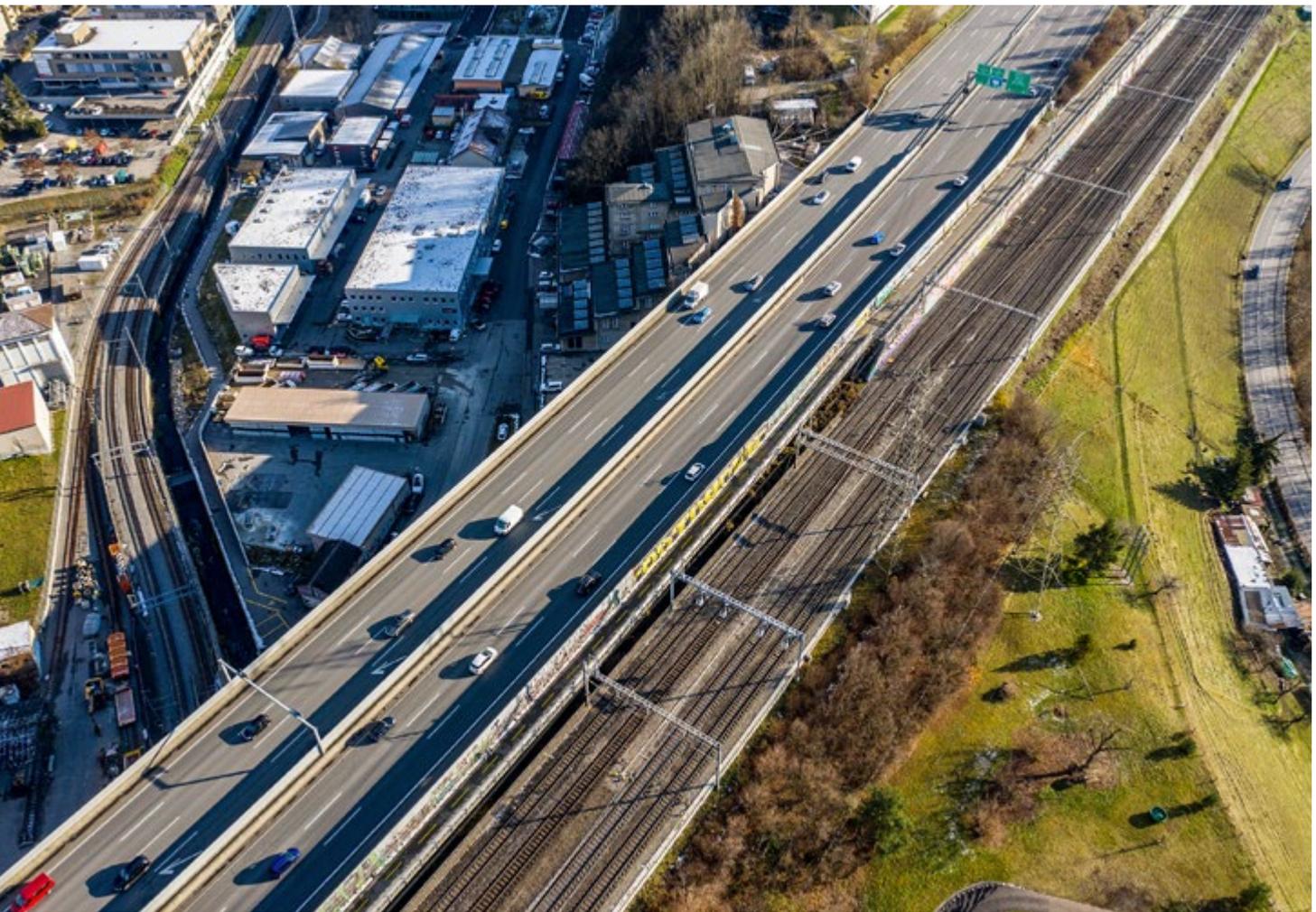
Subject areas

The range of areas in which the standards apply is as diverse as the scope of FEDRO's activities. Technical standards cover various aspects of infrastructure, including road planning and construction, engineering

structures and tunnels, as well as operational and safety equipment. FEDRO's standards also define guidelines on traffic management and the operation of the motorway/national roads network, including determining safety standards in tunnels, service facilities at rest areas, the standard road profile on the network, measuring the impact of natural hazards such as avalanches or rockfalls on galleries, and video surveillance. Lastly, the standards also govern risk and safety management.

Regular audits

Compliance with FEDRO's standards is verified by means of periodical internal audits. The need for any possible adjustments is also assessed in this context. Standards are updated to correspond with current developments and technologies on an ongoing basis. For example, the guideline on "operational safety" takes into account the latest findings on ensuring a uniform level of safety for users, operators and people working on projects on the network.



The A1 to the east of Bern in the direction of Zurich.

From a “per litre” to a “distance-based tax”?

A distance-based tax on road vehicles could replace the current oil tax and oil tax surcharge. The aim is to secure the long-term financing of road infrastructure. On the instructions of the Federal Council, the Federal Department of Finance (FDF) and FEDRO are currently working on a suitable concept.

The following two sources of funding are currently available to the federal government to fulfil its obligations with regard to road transport: the Fund for the Special Financing of Road Transport and the Motorway and Agglomeration Traffic Fund. The overview of the financial flows on pages 52 and 53 shows that the oil tax and oil tax surcharge on motor vehicle fuels are the main sources of revenue for these funds. A significant drop in revenue from the oil taxes is to be expected in the long term since motor vehicles are becoming increasingly fuel efficient and the number of vehicles powered by alternative means, such as electricity or hydrogen, will steadily increase. This underpins the Federal Council's objective to ensure that Switzerland is carbon neutral from 2050. This trend presents the future financing of the motorway/national roads network with a major challenge: it is expected that during the second half of this century the time will come when it will no longer be possible to fund the network via the current system.

For this reason, in December 2019 the Federal Council instructed the Federal Department of the Environment, Transport, Energy and Communications (DETEC) and the FDF to develop a concept for replacing the oil tax and the oil tax surcharge for the purpose of securing the long-term financing of the road infrastructure. In addition, work is being undertaken to assess whether other vehicle-related taxes, such as the motorway sticker (Vignette) or vehicle tax, should be replaced. FEDRO has taken on the mandate to develop a concept and is expected to submit a proposal to the Federal Council by the end of 2021.

Already today, however, those who travel more pay more. While taxes are currently levied on fuels (e.g. on petrol at 76.82 cents per litre), in future a new tax would be levied on the distance travelled. The change in system can be summed up as a transition from a "per litre" to a "distance-based" tax.

Two advantages of a distance-based tax

The distance-based tax is unrelated to the different fuels cars use, whether petrol, diesel, electricity, hydrogen, gas, liquefied petroleum gas, biogenic/renewable or synthetic fuels. The more diverse fuels become in the future, the more difficult and complex it will become to levy a tax on them. Furthermore, a distance-based tax is directly related to road use.

HGV fee as an example

It is in principle feasible as can be seen today with the distance-related heavy goods vehicle fee (HGV fee) which is already charged in Switzerland. The development of a concept for an overall distance-based tax for all vehicles raises many questions, however. Within the framework of this project, the following questions need further clarification:

- Would all vehicles be taxed at the same per kilometre rate?
- Should a distinction be made between types of vehicle, i.e. passenger cars, delivery vehicles, motorcycles, heavy good vehicles, etc?
- Within the individual categories of vehicles, should the distinction be made on the basis of size, for instance between small and large cars?
- If such distinctions were to be made, how should a model using different per kilometre tariff levels be structured?
- How would a tax be levied in Switzerland where there are more than six million vehicles on the roads, and how would payment be made?

“Thanks to the CEDR, FEDRO is optimally networked in Europe.”

In 2020, it was FEDRO director Jürg Röthlisberger’s turn to chair the Conference of European Directors of Roads (CEDR). In our interview he takes stock of his term of office.

The Conference of European Directors of Roads (CEDR) was founded in 2003. It is a private-law association based in Brussels and provides the national road administrations of European countries with a platform for exchanging information, experience and know-how. As of October 2020 it numbered 29 members from 28 countries. Following a proposal by Switzerland, Liechtenstein acceded to the CEDR in 2020.

Jürg Röthlisberger, you have completed your year as chairman of the CEDR: could you briefly summarise it for us, please?

It was a thoroughly challenging year during which, of course, lots of things didn’t go as originally planned. But it was very pleasing to see how everyone demonstrated a great deal of commitment so that we were able to work together to bring about significant improvements. We succeeded in achieving the necessary harmonisation in the fields of digitalisation and automation, decarbonisation of drive systems and road traffic safety. We were also able to decisively strengthen and further develop the organisation. We adopted groundbreaking resolutions to secure the successful future of the CEDR, including its financing. And I was especially pleased to welcome the Principality of Liechtenstein as a new member of the CEDR family last year.

Why is international cooperation between road directors so important?

In Europe, we are all facing similar challenges, so it clearly makes sense for us to discuss them with one another and share best practices. A good network of contacts is essential, especially in extraordinary circumstances, as it allows us to benefit immediately from the experiences of other members. This clearly proved to be the case during the coronavirus pandemic. Cooperation and exchanges of experience are not limited to the executive level, but also involve specialists when issues such as intelligent mobility, road traffic safety and research are on the table. This facilitates know-how transfer, which is so important, as well as harmonisation of regulations and standards among the various road construction and traffic authorities.

What is the CEDR able to achieve in practical terms? Which specific instruments for taking action does it have at its disposal?

Thanks to the CEDR, FEDRO – and thus Switzerland – is optimally networked in Europe. It is an essential platform for road directors and in particular provides a means of engaging in informal exchanges. The CEDR prepares comments and statements of position regarding issues that concern the various tasks and activities of the national road directors. These position statements incorporate the experiences and know-how of the various member states, and this means that as a member

FEDRO is actively involved in the following international bodies:

CEDR: Conference of European Directors of Roads – www.cedr.eu

PIARC: World Road Association – www.piarc.org

OTA: Overland Transport Agreement EU-CH.

Suivi de Zurich: Functions as a formal platform for transport ministers for dealing with safety and transport issues in the alpine region and for fostering the transfer of goods transport from road to rail

CCAM Platform: EU Platform for Cooperative Connected and Automated Mobility

EU high-level dialogue on connected and automated driving: Semi-annual meetings of transport ministers and experts. Dialogue on connected and automated driving

European ITS Committee: Intelligent transport systems

UN ECE: United Nations Economic Commission for Europe. Convention on cross-border road traffic Agreement on the carriage of dangerous goods by road – www.unece.org

D-A-CH cooperation on research: For the implementation of infrastructure research projects

European GNSS programmes: Switzerland participates in the European satellite navigation programmes, Galileo and EGNOS – www.gsa.europa.eu

CARE: Switzerland is actively represented on road safety issues at the European level and has access to the European accident database

IRTAD: Road safety issues at the international level



The interview with FEDRO director Jürg Röthlisberger was held on the terrace of the new FEDRO building in Ittigen.

of the CEDR we have important and broad-based fundamentals at our disposal that facilitate opinion-forming and decision-making processes at the national level. In addition, the road directors in the organisation enjoy direct access at the ministerial level, which enables them to incorporate developments within the EU Commission directly into the CEDR, and vice versa.

The CEDR has a strategy plan which it updates each year and which defines and evaluates the objectives of the activities of its various work groups. Furthermore, the CEDR provides us with the opportunity to implement joint and large-scale projects which one country on its own would not be able to accomplish. In other words, the necessary resources can be pooled.

When you took over as chairman for 2020, you cited “efficient use of the existing infrastructure” as your thematic priority. How were you able to implement this?

Today, road directors are no longer concentrating solely on the construction of new roads. Instead, their focus has shifted towards the interaction between infrastructure, road users, vehicles, data and financing. And this broad approach is of course crucial if we want to make better use of the existing infrastructure. We all want to ensure that our roads are used more efficiently. This





issue was well received by our members and there is widespread agreement throughout Europe regarding the declared objective. In terms of the practical measures undertaken, there are naturally some differences: some countries are prioritising measures relating to infrastructure components or targeted expansion, while others are focusing more strongly on automation and traffic management. By way of summary, however, I can state that all countries are pursuing the strategy of getting one thing done without ignoring the others – if with differing degrees of priority.

Which findings from your year as chairman can you incorporate into FEDRO?

The network of good relationships that I have been able to build up with my European colleagues over the last few years has greatly simplified our direct communication through electronic means. Thus, despite the pandemic, I was able to lead the CEDR effectively, even remotely, by organising virtual meetings. At the end of my year as chairman, as a Swiss national I am very pleased to be able to state that Switzerland continues to enjoy a very positive image in Europe and that its input and opinions are well respected. As far as content is concerned, I can report that, in the road transport sector, Switzerland is at least able to keep pace with Europe re-

garding all relevant strategic and operational areas and developments. It is important for us to ensure that this remains the case in the future.

Mobility is in the throes of a fundamental transformation, and there is an increasing focus on the potential use of automated vehicles. To what extent was this addressed during your meetings?

The automation of road transport was and remains a major topic for the CEDR. A very active work group is addressing this and associated issues. FEDRO is represented in this work group, to which it is an active contributor. In the course of my chairmanship last year, the CEDR joined the CAD (Connected Automated Driving) platform, where the EU Commission and representatives of the industry and European organisations can exchange views on issues concerning automated road transport in the future and set research priorities. I would like to thank all my colleagues at FEDRO for their valued participation in the CEDR work groups.

Interview: Guido Bielmann

Facts, figures and statistics

602 employees



People

Tunnels: 280

Construction projects: 785

Connections: 480

Heavy vehicle inspection centres: 6

9 FEDRO locations



Data

39 IT systems

Rest areas (picnic): 122

Replacement value of motorway/national roads network: 94 billion Swiss francs

Expenditure: 3.47 billion Swiss francs

Traffic counting stations: 320

Concluded contracts in 2020: 3,662

Investment in infrastructure:
2.23 billion Swiss francs

Finance



Bridges: 4,400 (main axes and overpasses)

HGVs via main transalpine routes: 862,000

Service areas (restaurants): 49 (ownership by cantons)



Infrastructure

Junctions: 52

Vehicle kilometres on the network: 25 billion

Drainage water treatment plants: 152

Large-scale wildlife corridors: 41

Vehicles



2,254.5 kilometres Length of motorway/national roads network

Highest average daily traffic volume: 125,000 vehicles (Wallisellen)

No new stretches of the network to be opened this year

No new stretches of the motorway/national roads network are scheduled to be opened in 2021. A 3.4-kilometre stretch of the A9 in the canton of Valais is to be completed in 2022.

The cantons are responsible for completing the motorway/national roads network, while FEDRO acts as the federal supervisory authority. The focus is currently on the following stretches:

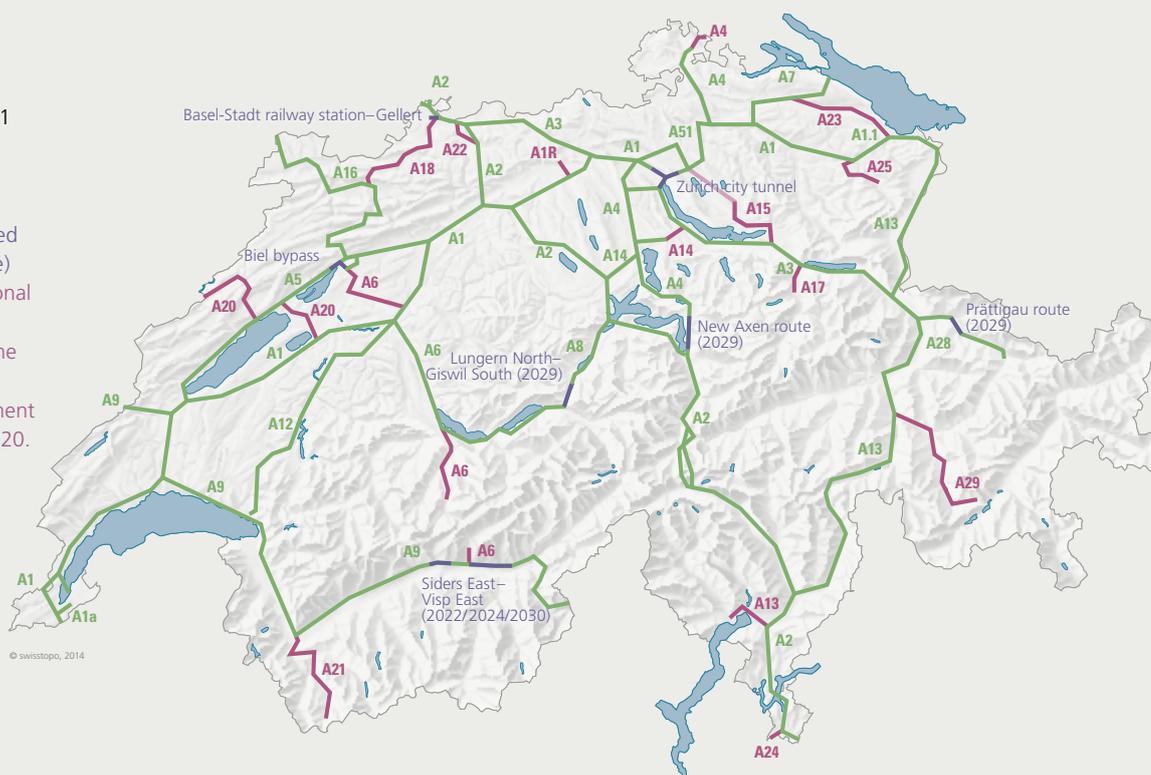
- A9 in the canton of Valais;
- A8 in the canton of Obwalden (Lungen-North to Giswil);
- A4 in the cantons of Uri and Schwyz (Axen route).

The western link project in Biel was cancelled at the request of the canton of Bern. However, the canton wants the access road on the right bank of the Lake of Biel to proceed as planned. It will also determine whether this project can be integrated into the motorway/national roads network. The decision is pending.

The 3.4-kilometre stretch of the A9 from Gampel/Step East to Raron is scheduled for completion in 2022.

Status, January 2021

- Completed
- In the project or construction stage (anticipated completion date)
- Motorway/national road stretches adopted from the cantons by the federal government on 1 January 2020.



The Swiss motorway/ national roads network

Total length by road category (km) – Status: 31 December 2020

	8-lane	7-lane	6-lane	5-lane	4-lane	3-lane	2-lane	Mixed traffic	Added to network on 1.1.2020*	Total
	<i>in use</i>	<i>in use</i>	<i>in use</i>	<i>in use</i>	<i>in use</i>	<i>in use</i>				
Aargau		1.2	14	1.7	86.9		2.1		6.7	105.9
Appenzell AR							11.2		11.2	11.2
Appenzell IR							4.2		4.2	4.2
Basel-Landschaft			9.5	3.3	30.8		25.1		41.1	68.7
Basel-Stadt			3.5		6					9.5
Bern			13.2	3.1	160.4	1.1	72.1	34.7	62	284.6
Fribourg					84			5.5	5.5	89.5
Geneva					27.2					27.2
Glarus					16.6		9.8		9.8	26.4
Grisons					43.6		100.7	81	56.1	225.3
Jura					35.4		11.8	7.3	7.3	54.5
Lucerne			2.6	2.7	53.2					58.5
Neuenburg					46.1	2.2	17.8	1.9	29.6	68.0
Nidwalden					22.9		2.9			25.8
Obwalden					1.8		22.3	13.3		37.4
St. Gallen				4.3	144.9		13.4		20.9	162.6
Schaffhausen							12.3		7.1	12.3
Schwyz				2.7	40.5		2.2	4.3		49.7
Solothurn			6.5	5.4	31.9					43.8
Thurgau					45.1		33.5		35.7	78.6
Ticino			7.3	18	81		40.6	16.1	26.9	163.0
Uri					37.1		16.3	16.1		69.5
Valais					71.6	6.7	17.7	66.6	47.3	162.6
Vaud	0.6		2.8	5.7	183.4		12.8			205.3
Zug			6		15.9		1.5		4.1	23.4
Zurich	1.2		31.3		131.4	1.9	21.2		38.2	187.0
Total	1.8	1.2	96.7	46.9	1,397.7	11.9	451.5	246.8	413.7	2,254.5

* On 1 January 2020 the federal government integrated 413.7 kilometres of cantonal roads into the motorway/national roads network in accordance with the new Federal Motorway Network resolution.

Motorway/national roads network by road category

Category	Description	Km
Category I	Motorways	1,313.5
Category II	Expressways and motorways with reduced speed limits	574
Category III	Mixed-traffic roads	367
Total		2,254.5

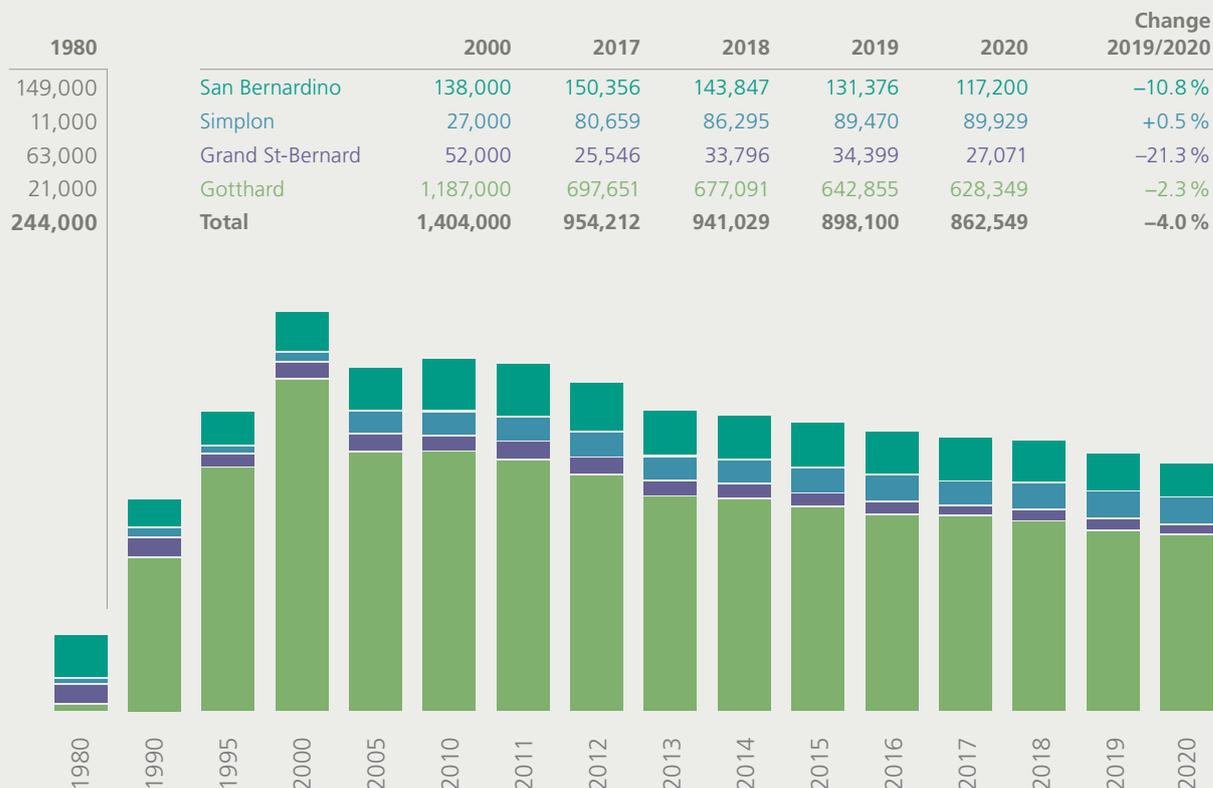
Volume of heavy goods vehicles crossing the Alps down by 4 percent

The coronavirus pandemic only had a limited influence on transalpine heavy goods traffic because the supply of essential goods to Switzerland and its neighbouring countries had to be maintained. On average, the volume on the four main transit routes through the Alps fell by 4 percent in 2020 versus 2019 (see graph below). The volume on the San Bernardino and Grand St-Bernard routes decreased by 10.8 and 21.3 percent respectively, while on the Gotthard route it fell by only 2.3 percent. Thus the Gotthard route, which has by far the highest traffic volume compared with the other transit routes, brought the overall average decrease down to around 4 percent.

Transalpine goods traffic reached its peak in 2000 with a total of 1,404,000 vehicles. Since then the number has been falling steadily. Roughly a quarter of the total transalpine goods transport (including rail haulage) is carried out by road. As in the past, the Gotthard and San Bernardino are the most heavily frequented routes.

In spring 2021, preliminary work commenced on the construction of the second Gotthard road tunnel. The construction work to be carried out in the coming seven years (cf. page 22) will not influence traffic flow.

Total number of heavy goods vehicles crossing the Alps



Source: Federal Office for Transport (FOT)

Traffic volume on the motorways/national roads down by 17.6 percent

For the first time in many years, both the volume of traffic and the accumulated distance on the motorways and national roads decreased. Due to the coronavirus pandemic, the volume fell by 17.6 percent.

The comparison of the accumulated distance travelled on the motorways and national roads between 2019 and 2020 has to be differentiated not only in the context of the coronavirus pandemic. As of 1 January 2020, 413 kilometres of national road were integrated into the network. This move was made in accordance with the new federal resolution concerning the motorway/national roads network. It meant that the total length of the network increased to 2,254.5 kilometres and resulted in a correspondingly higher traffic volume.

In order to make a direct comparison with 2019, we have to use the figures excluding the new stretches. The result is a coronavirus-related decrease by 17.6 percent in 2020 versus 2019, or 22.91 billion vehicle kilometres versus 27.79 in 2019. This was the first ever reduction in the traffic volume on the network. If we include the new stretches the resulting decrease was 8.7 percent. The comparison of traffic jam hours between 2019 and 2020 also has to be qualified due to the pandemic. The decrease on the overall network (including the added stretches) was 25 percent. From the table of the highest average daily traffic volumes (no. of vehicles) we can see that the measuring station at Wallisellen recorded the most traffic with approximately 125,000 vehicles, compared with 144,000 prior to the pandemic.

Accumulated vehicle-kilometres on the Swiss motorway/national roads network

Year	Billion km	+/- (in %)	Heavy goods transport (billion km)	+/- (in %)
2014	25.415	+1.0	1.541	+2.3
2015	26.485	+4.2	1.544	+0.2
2016	27.131	+2.4	1.567	+1.4
2017	27.680	+2.0	1.591	+1.6
2018	27.696	+0.1	1.598	+0.4
2019	27.799	+0.4	1.649	+3.9
2020	22.910	-17.6	1.431	-13.2
2020*	25.381	-8.7	1.524	-7.6

* Including the integrated stretches of cantonal roads

Number of traffic jam hours on the Swiss motorway/national roads network*

Causes	2018	2019	2020**	+/- (in %)
Congestion	23,854	26,832	20,144	-24.9
Accidents	2,815	2,835	2,204	-22.3
Roadworks	419	245	138	-43.8
Other	318	319	90	-71.8
Total	27,406	30,230	22,575	-25.3

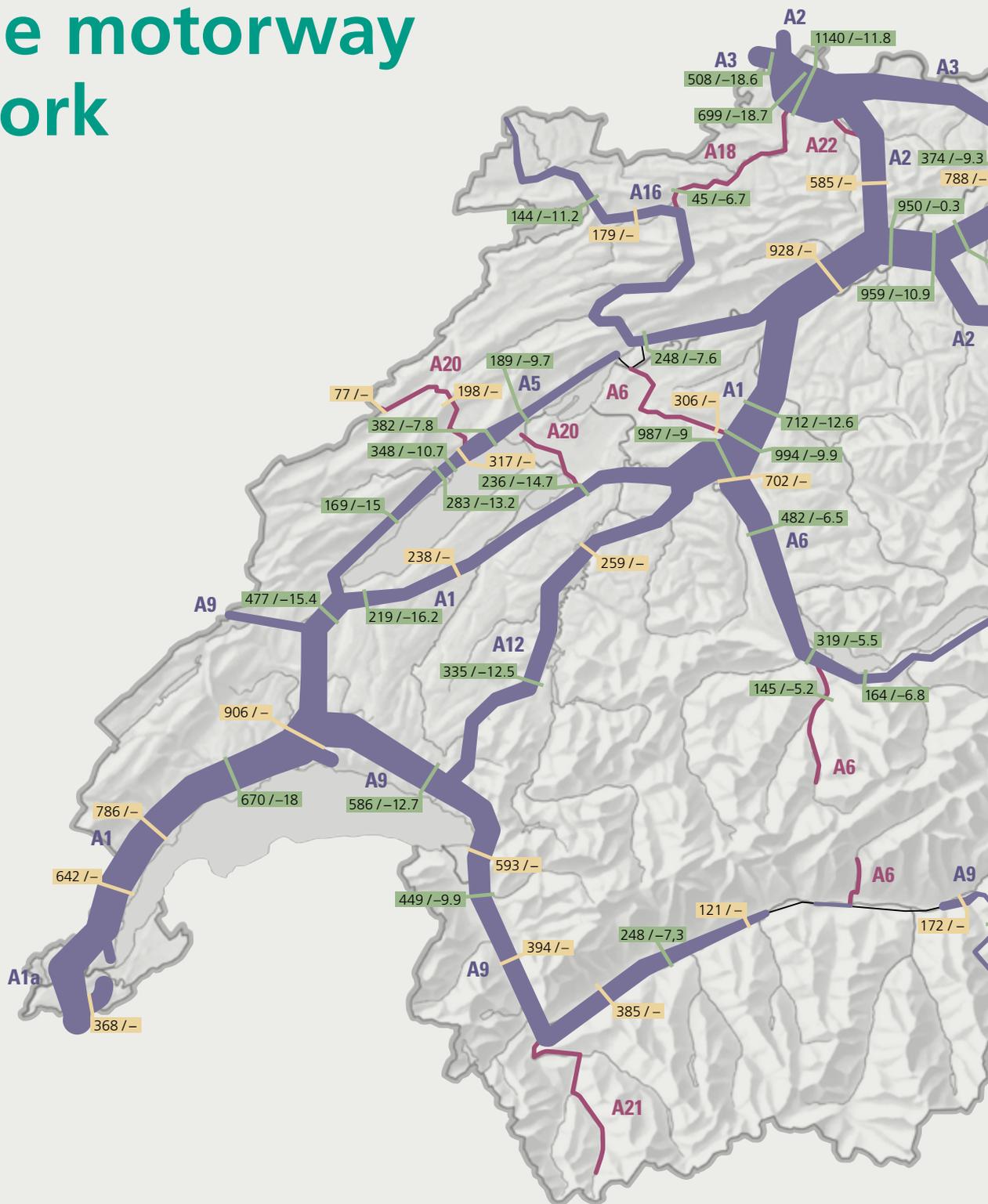
*Traffic-jam data were calculated with the aid of a new method, including for 2018 and 2019. ** 2020: including integrated cantonal road stretches

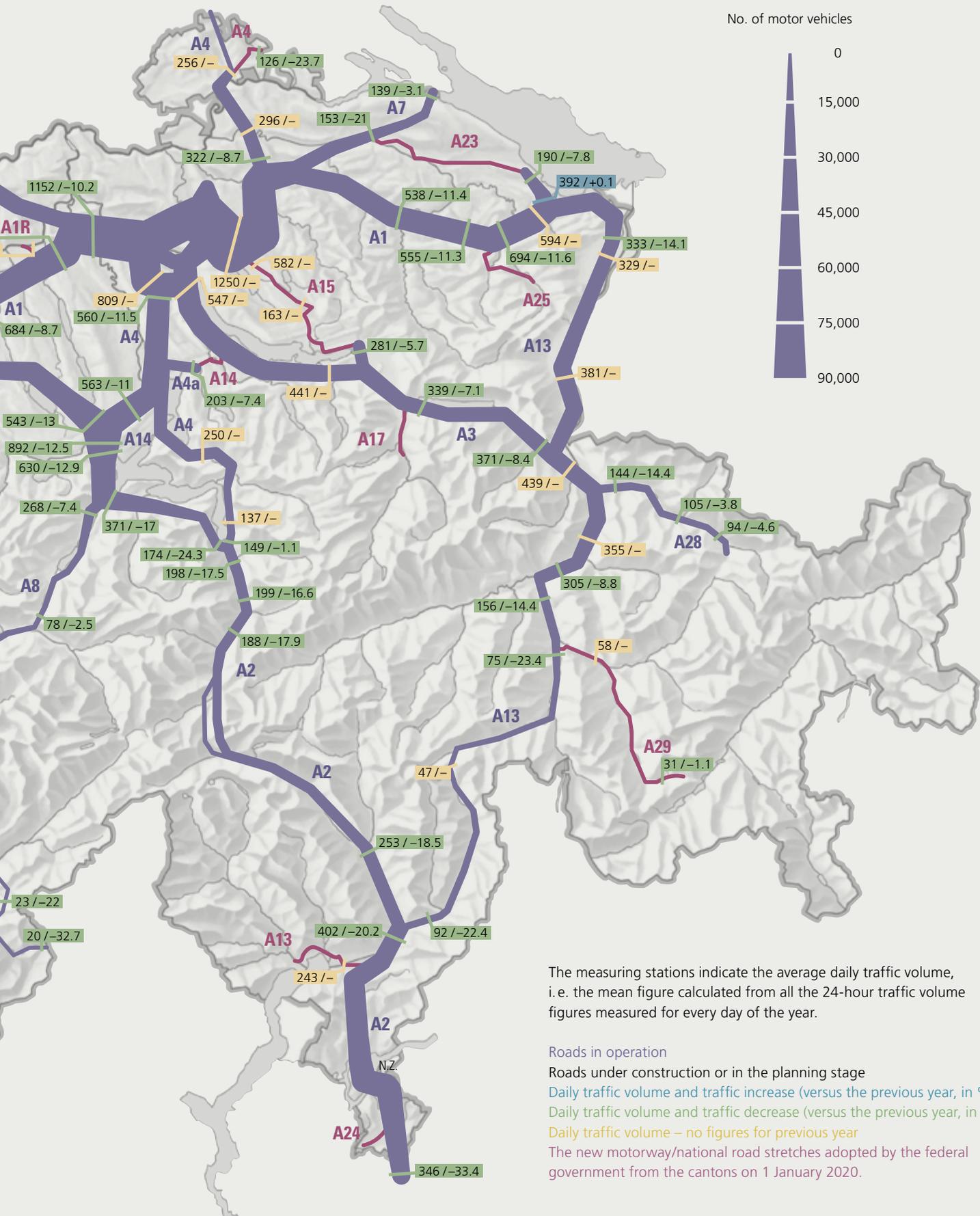
Highest daily traffic volume (DTV)

Top ten DTV* measuring stations	DTV* 2020	Share of heavy vehicles (%), 2020	DTV* 2019	Share of heavy vehicles (%), 2019	Change in DTV* (%) 2019/2020
Wallisellen (ZH)	125,747	5.3	-	-	-
Wuerenlos (AG)	115,203	7.1	128,277	6.5	-10.2
Muttenz (BL)	114,047	6.7	129,306	6.3	-11.8
Schoenbühl, Grauholz (BE)	99,408	6.6	110,386	6.2	-9.9
Bern Forsthau (BE)	98,682	5.2	108,422	4.8	-9.0
Bern, Felsenau Viaduct (BE)	97,169	6.4	107,530	-	-9.6
Brütisellen Nord (ZH)	96,481	6.5	-	-	-
Oftringen/Rothrist (AG)	95,880	10.1	107,644	9.5	-10.9
Renens (VD)	90,647	3.6	-	-	-
Lucerne, Reussport tunnel (LU)	89,176	4.2	101,866	4.1	-12.5

* DTV = average daily traffic volume; Owing to road works, the measuring stations at the following locations have been temporarily deactivated: Wallisellen (A1, Zurich), Baden-Baregg tunnel (A1, Aargau), Neuenhof (A1, Aargau), Weiningen-Gubrist (A1, Zurich), Zurich-Affoltern bypass (A1, Zurich).

Map of traffic volume on the motorway network





The measuring stations indicate the average daily traffic volume, i.e. the mean figure calculated from all the 24-hour traffic volume figures measured for every day of the year.

Roads in operation

Roads under construction or in the planning stage

Daily traffic volume and traffic increase (versus the previous year, in %)

Daily traffic volume and traffic decrease (versus the previous year, in %)

Daily traffic volume – no figures for previous year

The new motorway/national road stretches adopted by the federal government from the cantons on 1 January 2020.



80,879 more motor vehicles in Switzerland

2020 inventory of motor vehicles in Switzerland

	Motor vehicles (total) 2020	Motor vehicles (total) 2019	Change versus 2019	Cars 2020	Petrol 2020	Diesel 2020	Hybrid 2020	Gas 2020
Total*	6,241,141	6,160,262	1.31 %	4,658,335	3,087,390	1,379,077	133,708	11,413
Lake Geneva region	1,146,403	1,132,660	1.21 %	863,064	595,032	230,606	27,884	1,848
Vaud	543,109	535,684	1.39 %	420,332	287,138	112,870	14,806	1,320
Valais	298,242	293,414	1.65 %	223,780	149,861	67,567	4,487	214
Geneva	305,052	303,562	0.49 %	218,952	158,033	50,169	8,591	314
Central plateau	1,406,280	1,388,722	1.26 %	1,034,033	702,897	295,170	25,300	2,453
Bern	763,059	754,390	1.15 %	541,507	359,487	163,351	12,762	1,505
Fribourg	249,555	244,983	1.87 %	190,922	131,751	51,565	5,816	276
Solothurn	211,262	208,333	1.41 %	160,717	110,135	45,482	3,313	413
Neuchâtel	123,666	122,957	0.58 %	96,835	69,261	24,457	2,335	152
Jura	58,738	58,059	1.17 %	44,052	32,263	10,315	1,074	107
Northwest Switzerland	811,473	800,189	1.41 %	619,268	412,505	181,280	17,381	1,834
Basel-Stadt	85,030	85,723	-0.81 %	64,504	41,463	19,872	2,162	349
Basel-Landschaft	197,987	195,220	1.42 %	150,347	102,394	41,647	4,233	477
Aargau	528,456	519,246	1.77 %	404,417	268,648	119,761	10,986	1,008
Zurich	970,446	959,484	1.14 %	745,059	480,776	226,214	25,663	2,059
Eastern Switzerland	947,714	931,753	1.71 %	690,624	440,986	226,146	15,482	1,373
Glarus	32,690	32,168	1.62 %	24,008	15,158	8,094	515	66
Schaffhausen	64,572	63,313	1.99 %	46,634	31,043	13,934	1,040	140
Appenzell Ausserrhoden	44,351	43,888	1.05 %	32,161	21,011	10,046	756	46
Appenzell Innerrhoden	14,671	14,412	1.80 %	9,937	6,409	3,192	228	7
St Gallen	386,499	379,922	1.73 %	286,099	181,925	94,317	6,498	625
Grisons	162,452	160,267	1.36 %	114,824	66,452	45,026	2,305	104
Thurgau	242,479	237,783	1.97 %	176,961	118,988	51,537	4,140	385
Central Switzerland	654,716	642,609	1.88 %	483,896	306,800	156,207	13,771	1,288
Lucerne	304,656	300,642	1.34 %	219,577	142,608	68,742	5,630	453
Uri	28,182	27,907	0.99 %	20,337	12,660	7,218	340	13
Schwyz	139,503	136,531	2.18 %	104,485	68,972	31,288	2,820	174
Obwalden	32,843	32,398	1.37 %	23,117	14,338	7,918	593	27
Nidwalden	36,700	36,059	1.78 %	27,310	17,748	8,422	813	29
Zug	112,832	109,072	3.45 %	89,070	50,474	32,619	3,575	592
Ticino	304,109	304,845	-0.24 %	222,391	148,394	63,454	8,227	558

In 2020, the number of motorised road vehicles in Switzerland increased by 80,879 (or 1.3 percent) versus 2019. This increase was primarily attributable to fewer vehicles being withdrawn from circulation than in the previous year. In 2019, the

number of vehicles in circulation had increased by 0.8 percent. The increase versus the figure for 2000 was 36 percent. Cars account for around three-quarters of the vehicles registered in Switzerland. Here a trend in favour of hybrid or elec-

* Total; excluding mopeds and fast e-bikes ** Including other vehicles with an electric motor *** No cantonal statistics available
Source: Swiss Federal Statistical Office

Electric drive 2020	Others 2019	Passenger transport vehicles 2020	HGVs, articulated vehicles, semi-trailers 2020	Utility vehicles up to 3.5 tonnes 2020	Agricultural vehicles 2020	Industrial vehicles 2020	Motor- cycles 2020	Mopeds incl. electric bikes 2020	
								Total	of which e-bikes**
43,396	3,268	88,293	53,544	398,642	195,082	75,659	771,586	228,811	***
7,174	515	13,278	7,854	71,745	22,803	11,150	156,509	19,200	***
3,967	227	6,530	3,522	32,266	13,617	4,299	62,543	9,382	4,412
1,535	115	4,009	2,566	20,717	7,672	5,048	34,450	2,458	***
1,672	173	2,739	1,766	18,762	1,514	1,803	59,516	7,360	***
7,482	729	24,725	11,330	91,493	61,415	18,736	164,548	71,273	***
3,994	407	15,772	5,967	52,768	39,159	11,650	96,236	46,126	***
1,409	105	3,464	2,005	14,698	9,952	2,654	25,860	8,763	3,763
1,246	127	2,921	2,087	13,411	5,647	2,318	24,161	12,740	6,056
570	60	1,854	880	6,838	2,911	1,337	13,011	2,328	629
263	30	714	391	3,778	3,746	777	5,280	1,316	203
5,757	486	10,976	8,542	52,181	18,214	7,113	95,179	38,675	-
587	60	1,035	1,298	6,955	155	625	10,458	3,960	2,191
1,490	106	2,563	1,739	13,665	3,955	1,704	24,014	10,546	3,000
3,680	320	7,378	5,505	31,561	14,104	4,784	60,707	24,169	9,392
9,747	567	12,457	6,992	58,054	16,284	11,346	120,254	29,824	16,701
6,100	525	14,143	10,134	62,038	44,242	16,011	110,522	35,913	***
161	14	439	328	2,302	1,421	691	3,501	987	355
413	64	1,163	641	4,064	2,949	846	8,275	2,236	871
275	27	724	269	2,557	2,462	597	5,581	2,055	146
99	2	166	120	956	1,317	308	1,867	781	***
2,509	216	5,318	4,152	24,705	15,850	5,721	44,654	16,239	***
888	49	2,699	2,303	11,874	9,047	4,575	17,130	3,440	***
1,755	153	3,634	2,321	15,580	11,196	3,273	29,514	10,175	3,665
5,447	377	10,053	6,051	41,936	27,983	7,918	76,879	29,173	11,721
1,958	180	4,865	3,307	19,618	15,406	3,432	38,451	15,929	7,657
98	8	520	233	1,641	1,387	579	3,485	1,120	219
1,166	65	1,989	1,107	8,300	5,617	1,998	16,007	5,141	1,415
215	26	553	332	2,092	2,136	544	4,069	2,123	536
267	31	620	208	1,970	1,384	393	4,815	1,896	529
1,743	67	1,506	864	8,315	2,053	972	10,052	2,964	1,365
1,689	69	2,661	2,641	21,195	4,141	3,385	47,695	4,753	296

tric vehicles is becoming apparent. In 2020, a total of 43,396 fully electric vehicles were registered in Switzerland (0.9 percent of the overall passenger car fleet). The canton with the highest proportion of electric vehicles was Zug (2.0 percent).

The number of motorcycles and light goods vehicles also rose sharply, namely by 56 and 74 percent respectively versus 2000.

Registrations of new cars down by 23.7 percent

New registration of motor cars

	2010	2016	2017	2018	2019	2020
Total	296,597	319,331	315,032	300,887	312,902	238,664
Type						
Limousine	199,688	155,175	153,638	141,329	128,686	98,330
Station wagon	88,052	156,642	153,883	153,168	177,713	135,645
Convertible	8,857	7,514	7,511	6,390	6,503	4,689
Engine size (cc)						
Below 999	9,463	27,072	30,582	36,200	37,491	27,452
1,000–1,399	83,629	72,221	69,161	55,858	44,972	31,136
1,400–1,799	77,754	64,217	55,473	56,291	60,295	43,710
1,800–1,999	75,218	98,247	104,003	100,208	116,761	86,803
2,000–2,499	19,358	22,660	19,062	14,899	10,109	6,325
2,500–2,999	19,944	22,966	23,847	23,387	22,635	17,201
3,000 and over	11,030	8,423	7,975	8,633	7,442	6,272
Not specified	201	3,525	4,929	5,411	13,197	19,765
Gear mechanism						
Manual	222,670	112,438	98,793	77,035	65,127	4,0111
Automatic	73,206	205,712	215,241	223,346	247,387	198,338
Unknown	721	1,181	998	506	388	215
Fuel						
Petrol	200,576	178,666	183,637	188,847	192,430	119,097
Diesel	90,547	125,595	113,848	90,360	79,618	51,987
Petrol/elec. hybrid	4,213	7,150	8,186	10,434	18,133	27,423
Petrol/elec. plug-in hybrid	33	2,799	3,378	4,129	4,380	14,245
Diesel/elec. hybrid	4	490	181	794	3,810	5,334
Diesel/elec. plug-in hybrid	0	148	101	75	53	194
Electric drive	201	3,525	4,929	5,411	13,197	19,765
Hydrogen	0	10	2	27	27	48
Gas	721	944	769	805	1,252	571
Others	302	4	1	5	2	0
Drive						
Front-wheel drive	194,929	162,519	151,015	142,069	141,757	112,201
Rear-wheel drive	18,790	15,756	14,504	11,593	10,912	7,859
4 × 4	82,878	141,056	149,513	147,225	160,233	118,604
Output (kilowatts)						
below 60	30,008	18,340	15,290	12,377	11,009	8,145
60,01–80	70,081	40,985	39,543	36,342	33,597	26,224
80,01–100	47,791	68,241	62,412	58,301	54,603	41,013
100,01–120	70,100	63,049	61,483	57,802	61,656	46,026
120,01–140	27,901	56,166	60,050	58,530	63,036	41,966
140,01–160	18,387	19,755	19,628	18,175	18,457	16,295
160,01–180	11,366	11,385	11,327	11,078	15,372	10,717
180,01–200	7,563	10,668	11,342	11,657	10,519	7,372
200 and over	13,386	30,737	33,950	36,621	44,648	40,906
Not specified	14	5	7	4	5	0
CO₂ emissions (g/km)						
0–50	202	5,515	7,202	7,570	15,559	32,041
51–100	3,273	32,722	25,696	20,431	13,028	20,655
101–150	113,349	198,213	194,190	170,331	161,563	110,668
151–200	119,168	67,148	74,275	85,431	99,530	56,361
201–250	20,695	7,351	6,351	9,946	15,882	13,117
251–300	4,076	2,791	2,567	3,344	3,365	3,373
300 and over	1,712	814	805	1,039	1,273	989
Unknown	34,122	4,777	3,946	2,795	2,702	1,460

The coronavirus pandemic hit the Swiss automotive market hard in 2020. A total of 336,841 new motor vehicles were put into circulation throughout the country. This is the lowest number for 24 years and represents a decrease by 17.8 percent versus 2019. Registrations of new cars fell by 23.7 percent.

Despite this historic decline, the number of registrations of new electric and plug-in hybrid vehicles (+49.9 and +225.7 percent respectively) continued to rise in 2020. Thus these two categories combined accounted for 14.3 percent of all newly registered cars.

No. of new vehicles put into circulation (all types)

	2010	2020
Cars	296,597	238,664
Passenger transport vehicles	3,123	7,870
Goods vehicles	27,727	32,430
<i>Utility vehicles</i>	24,154	28,503
<i>HGVs</i>	2,690	2,922
<i>Articulated vehicles</i>	7	8
<i>Semi-trailers</i>	876	997
Agricultural vehicles	3,262	3,252
Industrial vehicles	3,577	4,505
Motorcycles	43,031	50,120
Trailers	19,485	20,631
Total vehicles	396,802	357,472
Total motor vehicles	377,317	336,841

Source: Swiss Federal Statistical Office

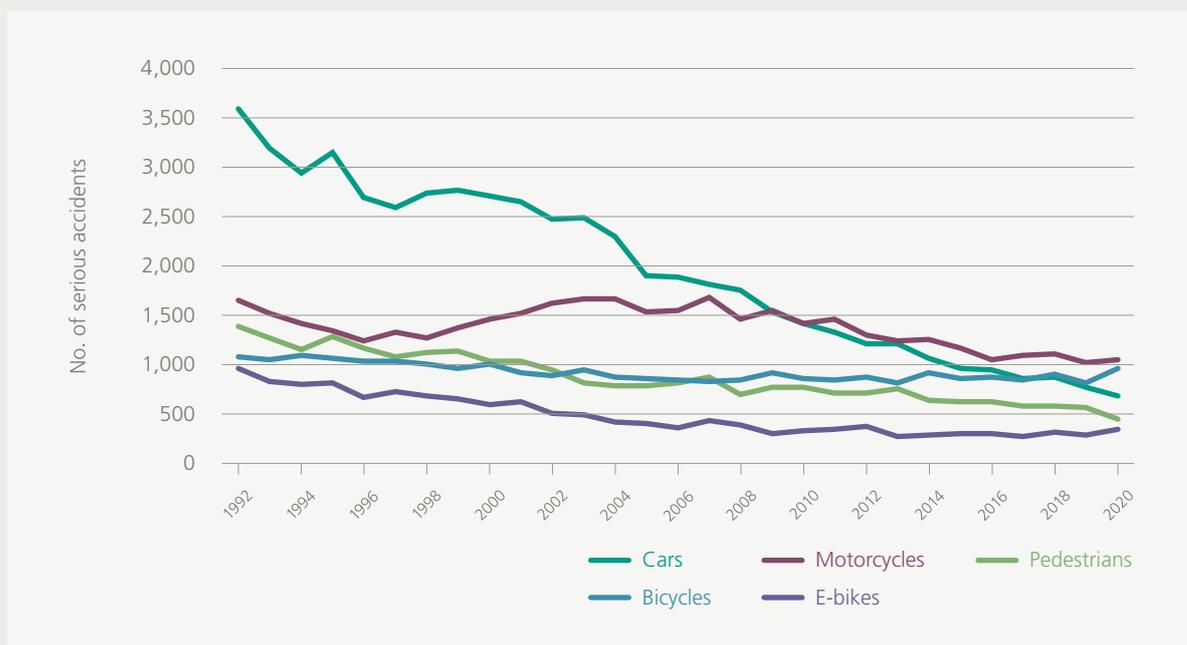
125 accident black spots on the motorway/national roads network

As the owner of the motorway/national roads network, FEDRO is obliged under the Federal Road Traffic Act to deal with aspects of safety in the context of its planning, construction, maintenance and operation, including the analysis of accident black spots.

The total length of the network is 2,254 kilometres. Data relating to incidents and geo-referenced accidents resulting in injuries and fatalities registered by the police in the period from 2011 to 2019 form the basis for the analysis of accident black spots. For the purpose of identifying black spots, the data are classified by severity of accident, road category and location (on a motorway/national road, an urban road or a rural road), and subsequently depicted on a map. A location is designated as an accident black spot if the specified threshold is reached within the defined search perimeter. FEDRO analyses accident black spots in accordance with Swiss Standard 641 724 (road traffic safety; accident black spot management). In the period from 2017 to 2019, a total of 1,013 accident black spots were identified on the overall road network (motorways/national roads, cantonal and municipal roads).

125 of these were on the network for which FEDRO is responsible (excluding the 413 kilometres of cantonal roads incorporated into the motorway/national roads network as of 1 January 2020). Eighty of the 125 black spots were identified at junctions between motorways/national roads and the network of cantonal and municipal roads. However, the black spot at which the highest number of accidents was recorded between 2017 and 2019 is on the open stretch of the A1 in the direction of Zurich between Grauholz service area and Schönbühl junction. A total of 994 accidents with injuries and fatalities occurred at the accident black spots on the motorway/national roads network. Rear-end collisions were the most common type of accident, while collisions at entry and exit roads, as well as skid-related accidents and those not involving other vehicles, occurred at an approximately equal frequency.

Serious accidents by category of road user



Accident statistics 2020 (overall Swiss road network)

All road accidents

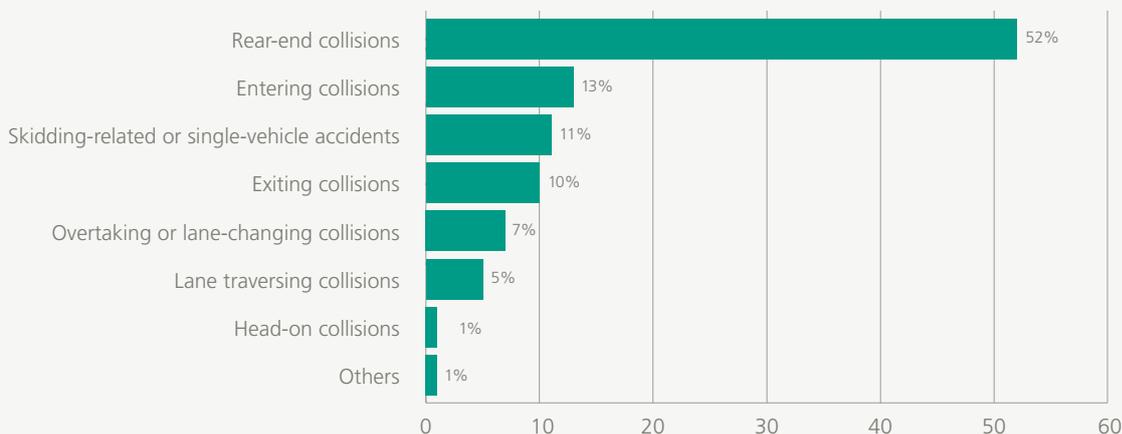
Year	Total no. of accidents
2012	54,171
2013	53,052
2014	51,756
2015	53,235
2016	55,053
2017	56,112
2018	54,378
2019	53,528
2020	48,662

Accidents resulting in fatalities/injuries

	2020	2019
Fatalities	224	179
Serious injuries	3,619	3,454
<i>life-threatening injuries</i>	181	173
<i>severe injuries</i>	3,438	3,281
Minor injuries	13,054	14,128
Total	16,897	17,761

Serious injuries and fatalities	Serious injuries 2020	Fatalities 2020	Serious injuries 2019	Fatalities 2020
by form of transport				
Cars	611	71	706	65
Passenger transport vehicles	32	1	35	1
Goods transport vehicles	47	5	54	10
Motorcycles	998	52	990	30
Motor scooters	92	6	59	5
Electric bikes	521	15	355	11
Bicycles	934	29	802	16
Pedestrians	408	36	524	37
<i>on pedestrian crossings</i>	201	16	234	15
<i>elsewhere</i>	207	20	290	22
Devices similar to vehicles	57	2	39	0
Others	93	10	75	12
Total	3,793	227	3,639	187
by assumed main cause				
Influence of alcohol	401	24	387	21
Speeding	468	41	409	30
Inattention/distraction	531	26	469	18
by type of road				
Motorways and expressways	144	20	204	26

Proportion in percent by type of accident



1.8 percent fewer confiscated driving licences

The number of confiscated driving licences in Switzerland fell by 1.8 percent in 2020 versus 2019. The main reasons for confiscation were speeding and driving under the influence of alcohol.

According to FEDRO's statistics on administrative measures, a total of 78,483 driving licences were confiscated in 2020. This was the second year in succession in which the number remained below 80,000. The number of cancelled provisional licences rose by 9.7 percent to 1,335, while a total of 4,043 learner's licences were cancelled (+15 percent).

In 29,553 cases the licences were confiscated for speeding (+7.8 percent versus 2019); in 11,931 cases for driving under the influence of alcohol (-9.1 percent). In 7,985 cases licences were confiscated for endangering others through careless driving (+1.3 percent). For the second year in succession, this increase follows several years of steady declines.

Fewer cases of non-recognition of foreign driving licences

In 2020, the number of non-recognised foreign driving licences was 18,157, which represents a decrease of 18.7 percent versus 2019. Here, as in the case of confiscation of Swiss driving licences, the main reason was speeding (9,477 confiscations, or -22.3 percent).

More than 30,000 new motorcycle licence holders

As of the end of 2020 there were 4,204,665 holders of a motorcycle licence in Switzerland, which corresponds to an increase by 19,989, or +0.5 percent, versus 2019. The number of new motorcycle licence holders rose sharply to 30,472 (+27 percent). This can largely be attributed to the fact that it was only possible to directly obtain a licence for the highest motorcycle category (A) until the end of 2020, and many people wanted to benefit from this option before it was discontinued. As of the end of 2020, the number of holders of driving licences for cars was 6,055,570, which was more or less unchanged versus 2019 (+1 percent).

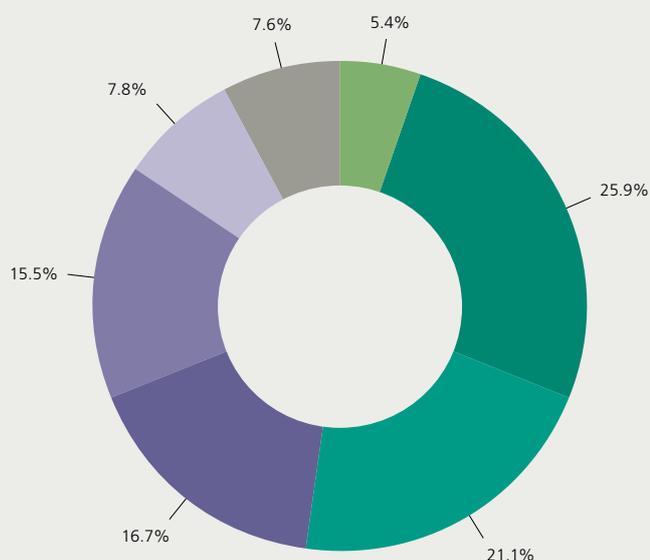
Measures imposed against drivers

	2020	2019	+/- (in %)
Warnings to holders of a learner's licence	317	309	+2.6
Warnings to holders of a driver's licence	48,859	48,068	+1.6
Withdrawal of learner's licence	4,043	3,516	+15.0
Withdrawal of driver's licence	70,671	72,744	-2.8
<i>Of which withdrawal of provisional licence</i>	<i>6,301</i>	<i>5,998</i>	<i>+5.1</i>
Withdrawal of other licences	3,769	3,662	+2.9
Cancellation of provisional driver's licence	1,335	1,217	+9.7
Refusal of learner's or driver's licence	3,094	3,066	+0.9
Refusal to accept a foreign driver's licence	18,157	22,329	-18.7
Instruction in road use	1,783	1,715	+4.0
New driving test	3,003	3,298	-8.9
Examination by specialised psychologists	3,941	4,418	-10.8
Special requirements	6,382	6,726	-5.1

Administrative measures

	2020	+/- (*)
Reasons for withdrawal		
Speeding offences	29,553	+7.8
Drink driving	11,931	-9.1
Inattention	7,985	+1.3
Failure to give way	4,366	+4.3
Failure to observe traffic signals	1,202	-1.3
Unlawful overtaking	1,639	-0.5
Other driving errors	4,310	-5.5
Alcohol addiction	1,349	-6.0
Influence of drugs	4,402	-7.6
Drug addiction	2,170	-12.2
Sickness or infirmity	4,533	-17.0
Other reasons	19,321	-4.0
Duration of withdrawal		
1 month	32,167	+1.5
2 months	1,428	+10.4
3 months	15,628	-0.6
4-6 months	6,997	+1.3
7-12 months	2,159	-2.6
More than 12 months	946	-5.6
Indefinite period	19,139	-9.1
Permanent withdrawal	19	+72.7

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	2020	+/- (*)
Age of persons affected		
Under 20	4,253	+12.4
20 to 24	10,212	+3.5
25 to 29	10,087	-1.3
30 to 34	8,692	-1.9
35 to 39	7,862	-2.1
40 to 49	13,076	-6.0
50 to 59	12,178	-1.7
60 to 69	6,157	+4.4
70 and over	5,966	-14.4

Reasons for withdrawal or refusal of learner's/driver's licence		
Learner driving unaccompanied	376	-5.5
Driving error**	2,672	+23.4
Drink driving	696	-1.0
Driving without a licence	2,766	+9.3
Failure to pass driving test	299	+4.5
Driving despite withdrawal of licence	146	-4.6
Theft	411	+17.8
Sickness or infirmity	101	-22.9
Other reasons	1,925	+2.6

Reasons for warnings		
Speeding	43,033	+0.8
Drink driving (> = 0.050 to 0.079%)	3,577	-25.8
Inattention	3,124	-1.9
Failure to give way	1,771	-7.3
Driving an unroadworthy vehicle	2,466	+0.6
Failure to observe traffic signals	614	-36.1
Unlawful overtaking	282	-9.3
Other reasons	8,371	-7.5

* Change in percent versus 2019
 ** Inattention, failure to give way, speeding, failure to observe traffic signals, unlawful overtaking, other reasons

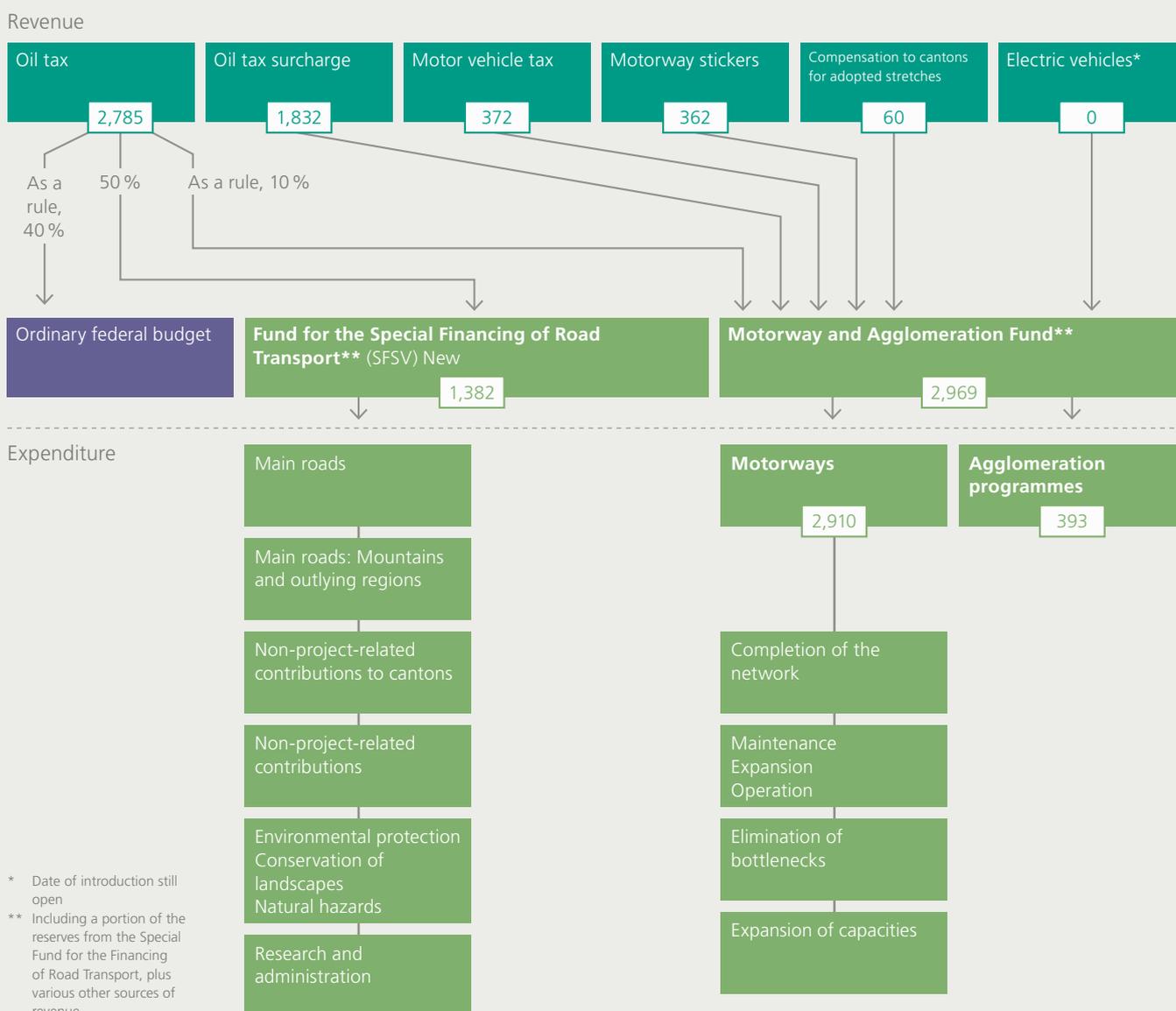
Withdrawn driving licences by age group

- Under 20
- 20 to 29
- 30 to 39
- 40 to 49
- 50 to 59
- 60 to 69
- 70 and over

Finance flows for the two road transport funds

The Motorway and Agglomeration Traffic Fund finances the motorways and major projects in the agglomerations. The Fund for the Special Financing of Road Transport mainly supports cantonal road transport infrastructure.

Flows of funds in 2021 (in million Swiss francs): in accordance with 2021 budget



Figures taken from the federal budget 2021. Amounts in the totals may differ due to rounding up or down of the individual figures.

Expenditure for the motorways/national roads encompasses operation, maintenance, expansion, elimination of bottlenecks, capacity increases, major projects and completion of the network. All this expenditure is financed from the Motorway and Agglomeration Traffic Fund, which entered into effect on 1 January 2018. This move increases the degree of transparency, and also simplifies the short- and medium-term management of credit facilities.

Parliament decides how much may be withdrawn from the fund each year, which is not governed by the federal debt brake mechanism. The balance of any approved funding that is not utilised remains in the fund. This increases its liquidity and the funds remain available for use at a later date. This fund gives rise to greater flexibility and transparency and increases the long-term planning and implementation certainty for FEDRO's large-scale projects.

Composition of deposits:

- Oil tax surcharge (100%)
- Motorway sticker (100%)
- Vehicle tax (100%)
- As a rule, 10% of the oil tax
- Levy on electric vehicles (100% – date of introduction as yet unspecified)
- Compensation from the cantons for the transfer of cantonal roads to the federal government as per the new federal resolution)

Special Fund for the Financing of Road Transport: all transfer payments from a single source

This fund is the single source for all transfer payments in the road transport sector at the federal level, as well as for the administrative and research costs of FEDRO. It is financed from half the revenue from the oil tax and, where necessary, from vehicle tax revenue. As before, it is managed via the ordinary federal budget.

Deposits into the Motorway and Agglomeration Traffic Fund (in million Swiss francs)

	2019 C*	2020 C*	2021 B**
Oil tax surcharge	1,768	1,635	1,832
Vehicle tax	407	331	372
Motorway levy	356	310	362
CO ₂ reduction (passenger cars)	31	80	107
Oil tax (5%)	133	247	275
Temporary deposit from reserve (Special Fund for the Financing of Road Transport)	183	148	0
Revenue from third-party funding	46	47	24
Management income	9	10	9
Deposit from Special Fund for the Financing of Road Transport (contribution to cantons for transfer of roads)	0	60	60
Reductions of deposits into traffic fund as of 2020		-72	-72
Total deposits	2,933	2,795	2,969

Withdrawals from the Infrastructure Fund (from the Motorway and Agglomeration Traffic Fund) (in million Swiss francs)

	2019 C*	2020 C*	2021 B**
Operation of motorways/national roads	371	402	439
Expansion and maintenance of motorways/national roads	1,577	1,628	1,826
Completion of motorway/national roads network	140	146	249
Elimination of bottlenecks	150	134	97
Capacity expansion and other motorway/national road projects	–	75	299
Contributions for main roads in mountainous and outlying regions	180	256	393
Total withdrawals	2,419	2,640	3,303

* Charged ** Budgeted

Due to rounded up or down figures, minor differences may arise in the totals.

FEDRO a role model with respect to energy consumption

In 2020, the electricity consumption for the motorways/national roads amounted to 165 GWh. A further 25 GWh were required for heating in the works depots. The electricity was produced entirely from renewable energy (Swiss hydropower), while 56 percent of the heat originated from renewable sources. Within the frame-

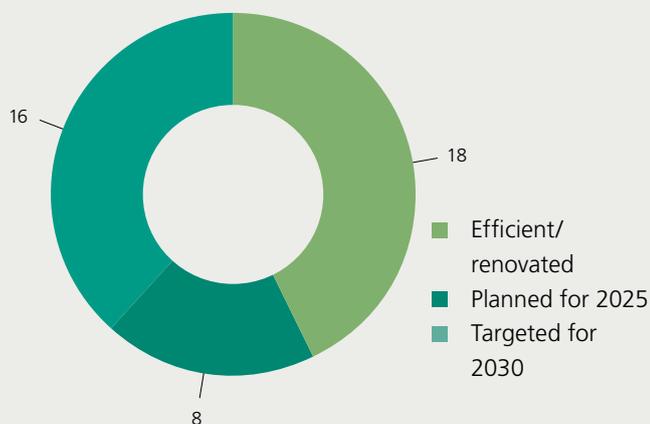
work of the federal administration's "Climate Package", FEDRO aims to optimise its energy consumption still further in order to cut CO₂ emissions. By 2030, it wants to produce 35 GWh per annum of its energy requirement from its own photovoltaic facilities, the first three of which were installed in 2020. FEDRO has set itself the following objectives for 2030:

- To improve the energy consumption of all its buildings;
- To replace all oil-fired heating systems;
- To replace all gas-fired heating systems when they reach the end of their service life;
- To cover 35 GWh per annum of its electricity requirements from its own photovoltaic facilities.

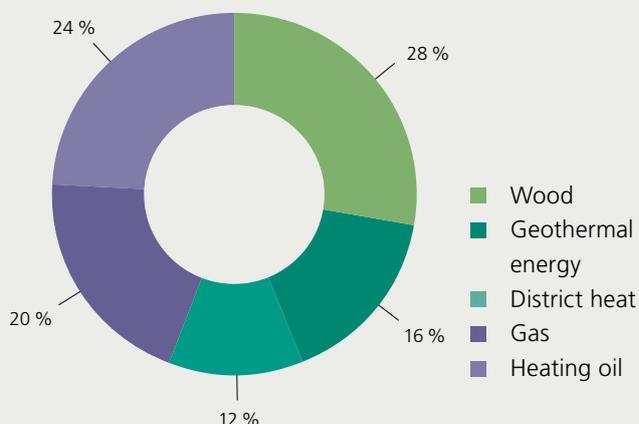
Electricity production – Electricity consumption

FEDRO	Electricity volume per annum
Electricity requirement in 2020	165 GWh
Photovoltaic production in 2020	0.3 GWh (3 facilities)
Photovoltaic production by 2030	35 GWh (90 facilities)
Third-party photovoltaic production in 2020	3 GWh (13 facilities)

Renovation of buildings



Heating in buildings (in percent)



No. of fast-charging stations in rest areas



No. of tunnels with LED lighting



No. of personnel employed by FEDRO in 2020

Trend

Year	No. of employees	Apprentices	University-level trainees
2008	401	–	–
2017	523	19 commercial/2 mediamatics	5
2018	548	19 commercial/2 mediamatics	11
2019	586	19 commercial/2 mediamatics	11
2020	602	17 commercial/2 mediamatics	9

Employees by profession in 2020

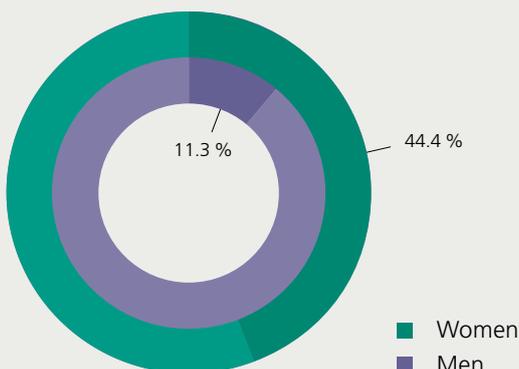
Employees by profession	No. of employees
Engineering	250
Business and finance	100
Law	80
IT	80
Administration	70
Communication, language services	20
Apprenticeships	19

Proportions of employees and their average ages



As of 1 January 2021, 181 women and 421 men were employed by FEDRO.

21.3 percent of the employees work part-time



Employees by nationality in 2020

FEDRO's workforce comprises employees of 18 different nationalities. 88 percent are Swiss. Other nationalities: Austrian, Canadian, Dutch, Ecuadorian, Finnish, French, German, Greek, Hungarian, Italian, Polish, Romanian, Serbian, Slovakian, Spanish, Swedish, Ukrainian.

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