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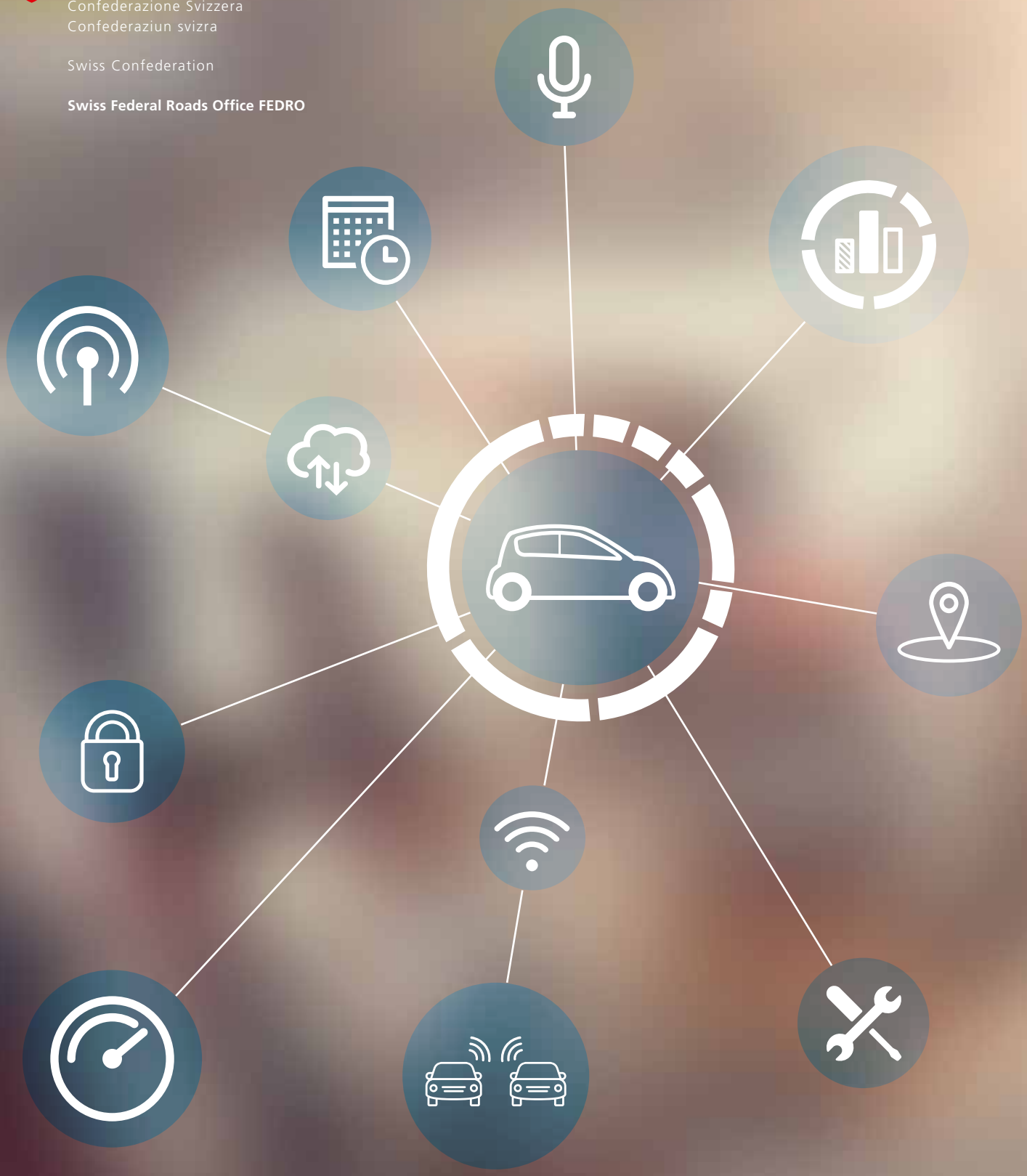


FEDRO 2016 | Developments, facts and figures

Roads and Traffic

Contents

Cover illustration

FEDRO is addressing the topics of intelligent mobility and autonomous vehicles at several levels: it is monitoring developments relating to vehicle technology and evaluating the various impacts and potentials with respect to future traffic management, while at the same time it has to take account of the changes that will have to be made to the existing legislation and traffic regulations, as well as to the road transport infrastructure.

Facts, figures and statistics

Dear Reader,

As all of us are aware, the volume of traffic on Switzerland's roads is growing rapidly. Expanding the infrastructure is a matter of urgency, and we are pushing ahead with the implementation of the necessary projects. But constructing more roads will not be sufficient on its own for handling the traffic volume of the future. We therefore need to find ways to use the existing road networks more efficiently, more intelligently and more intensively. In addition to the temporary use of emergency lanes and other traffic management measures, mobility pricing is an instrument we aim to use in order to ease traffic congestion across the board during peak periods and thus achieve a more balanced burden on transport infrastructure. The Department of the Environment, Transport, Energy and Communications (DETEC) has analysed mobility pricing in its recent concept report.

Intelligent mobility is opening up another opportunity that should not be underestimated. Vehicles are already able to autonomously communicate with their environment with the aid of driving assistance systems. Some models already have the necessary technology to enable them to operate autonomously. This year, Postauto AG will be conducting the first trial in Sitten (canton of Valais) with an automated bus along a selected route. DETEC and the Federal Roads Office (FEDRO) are actively participating in this development. In order to exploit the potentials of intelligent mobility, it will be essential to adapt the existing road traffic legislation, which we are working flat out to do utilising our own know-how.

FEDRO is also active in other areas of research: on the Kerzers viaduct (canton of Fribourg) we are currently testing six different types of asphalt in order to determine which one absorbs noise the most effectively and at the same time protects the structure against corrosion. In the Lungern tunnel (canton of Obwalden), the focus is on energy efficiency: here we are trialling the use of bright walls and surfaces with the aim of improving visibility in tunnels and significantly reducing the amount of electricity required for lighting.

To secure the long-term financing of the motorways, national roads and agglomeration traffic, the Federal Council has announced the creation at the constitutional level of a special fund for an unlimited duration, namely the Motorway and Agglomeration Traffic Fund. Both existing and new resources are to flow into this fund. In the middle of March this year the Council of States voted in favour of the new fund, and the electorate will have the final say in the referendum on the required amendment to the Federal Constitution.

This edition of Roads & Traffic contains information about these and other important activities of FEDRO. Thank you for your interest. I trust you will find our report interesting and informative.

Jürg Röthlisberger
Director, Federal Roads Office (FEDRO)

2015 highlights

1.1.2015

21 January 2015

Resolution of the Federal Council regarding periodical inspections of cars and motorcycles

Cars and motorcycles have to be periodically inspected. Since these vehicles meet higher standards today, the Federal Council resolves that the first periodical inspection only has to take place five years after initial registration. This amendment will enter into effect in February 2017.

28 January 2015

New FEDRO Vice Directors

Two new Vice Directors are appointed at FEDRO: Jean-Bernard Duchoud and Guido Biaggio take over the management of the reorganised Road Infrastructure Division from Jürg Röthlisberger, who is appointed Director of FEDRO as of 1 March 2015. Jean-Bernard Duchoud was previously a deputy head of division, and Guido Biaggio had been CEO of LGV Impresa Costruzioni SA in Bellinzona (canton of Ticino).

28 February 2015

Federal Council paves the way for a new traffic financing fund

With the adoption of its dispatch to Parliament concerning the proposed new Motorway and Agglomeration Traffic Fund, the Federal Council aims to create a new basis for financing Switzerland's road infrastructure. The aims of the fund are to eliminate structural problems and secure the long-term financing of the motorways/national roads, as well as federal contributions to transport projects in the agglomerations.

1 March 2015

New FEDRO Director takes office

Jürg Röthlisberger takes over as Director of FEDRO at the beginning of March. The 51-year-old engineer was appointed Deputy Director in 2012, and had been in charge of the Road Infrastructure Division for ten years. He takes over from Rudolf Dieterle, who retired at the end of February 2015

3 March 2015

DETEC approves construction programme for 2015

After Parliament had approved the necessary credits in its winter 2014 session, in early March the Federal Department of the Environment, Transport, Energy and Communications (DETEC) adopts the annual construction programme for the motorways and national roads, which encompasses projects totalling 1.95 billion Swiss francs.

15 April 2015

Easing of requirements on certain electric vehicles

The Federal Council adapts the technical requirements and traffic regulations for vehicles such as electric Segway scooters and electric rickshaws. With the eased regulations, the needs of these new types of vehicle can be more effectively taken into account. The amendments to the corresponding Ordinance enter into force in June 2015.

5 February 2016

Breakthrough in the Galgenbuck tunnel

The breakthrough in the Bahntal exploratory tunnel represents a further milestone in the Galgenbuck tunnel project near Schaffhausen. During the official breakthrough ceremony the contractors thanked the excavation crews and all involved companies, engineers and specialists for their excellent work.

28 April 2015

DETEC licences pilot project for trials with an autonomous vehicle

DETEC grants Swisscom a special licence for carrying out trials with an autonomous vehicle. The licence is valid until the end of the year and restricted in terms of location: initial trials are to be carried out in Zurich.

8 January 2016

Heat sensors at the northern entrance to the Gotthard road tunnel

A new heat detection system aimed at preventing vehicle fires in the Gotthard road tunnel is put into operation in Göschenen. The system is presented to the media in the presence of Federal Councillor Doris Leuthard. A heat detection system was installed at the southern entrance to the tunnel in 2013. It is used to detect overheated vehicle components and prevent such vehicles from entering the tunnel.

28 February 2016

Second tube for the Gotthard road tunnel

The Swiss electorate accepts the referendum on the Federal Act on Transit Road Transport in the Region of the Alps by a majority of 57 percent. This paves the way for the construction of a second road tunnel through the Gotthard, which means that the existing tunnel can be renovated without having to cut off road access to the canton of Ticino. After the renovation as been completed, there will be two tubes and, as before, one lane in each direction.

29.2.2106

2 October 2015

Exhaust scandal: ban on registration of new Volkswagen vehicles

FEDRO issues a directive banning vehicles involved in the manipulation of exhaust test readings in the Volkswagen Group from Switzerland's roads. The provisional ban only applies to vehicles that are registered in Switzerland for the first time.

18 December 2015

General project for widening of Härkingen-Luterbach stretch

The Federal Council approves the widening of the A1 motorway between the Luterbach and Härkingen junctions in the cantons of Bern and Solothurn from four to six lanes. At the same time the stretch is to be completely renovated. The project is expected to cost around 818 million Swiss francs.

9 February 2016

Start-up ceremony at the Belchen tunnel

Official start-up of Switzerland's largest tunnel excavation machine at the southern entrance to the Belchen tunnel. The third tube of the Belchen tunnel will be 3.2 kilometres long and will cost around 500 million Swiss francs.

Major projects require conscientious governance

FEDRO is responsible for the maintenance, operation and ongoing development of the motorway and national roads network. Around 550 construction projects are in progress at any given time. To ensure that they can be implemented, FEDRO has to precisely control the construction, financing and administrative processes. The annual investments in the motorway/national roads network illustrate the extent of the tasks involved, and thus the importance of faultless governance.

Professionally organised meetings focusing on audits and the award of mandates are an important aspect of the executive management of FEDRO.

The range of duties of FEDRO is complex and comprehensive, and it encompasses a broad variety of activities. To ensure that traffic on the motorways/national roads can be managed smoothly and efficiently, FEDRO has to secure the maintenance and ongoing development of the infrastructure, the safe operation of the network and efficient traffic management. In the interests of road safety, FEDRO has to ensure that only properly qualified drivers use the roads in vehicles that are safe and meet the corresponding requirements. And looking to the future, FEDRO will have to take account of new forms of mobility, alternative drive systems and intelligent vehicles. The complexity of all these tasks and areas of activity calls for a method of governance that guarantees high quality. Risks have to be reduced to an acceptable level, without hampering efficient activity and innovation.

The Steering and Finance Division is responsible for the principles of good governance within FEDRO, including risk and quality management.

Identifying and dealing with risks

Within FEDRO, risk management is mainly concerned with two types of risk: strategic risks and operational risks. Strategic risks, for which the executive management is responsible, encompass aspects such as corruption, IT problems and personnel shortages. The main task here is to work together with the respective specialists to systematically formulate measures to reduce specific risks. Examples of such measures include improving the provision of information and optimising processes. The implementation of the measures in question is constantly monitored.

It is also essential to be aware of risks at the operational level, i.e. at the level of ongoing projects, and to ensure that these are kept under control. This category applies to all construction projects, where special attention has to be paid to risks in the financially relevant processes. Here, FEDRO uses an internal risk control system, which describes and assesses identified financial risks and specifies detailed measures aimed at reducing them.

FEDRO's ISO-certification confirmed again in 2016

Complying with quality requirements is a permanent task for FEDRO. Since 2000, FEDRO has been using a comprehensive management system in order to ensure that the numerous and often complex activities are carried out uniformly, efficiently and in accordance with the regulations and provisions. This is an instrument that encompasses all the main activities in the form of work processes.

FEDRO's management system was reviewed in 2016 by the Swiss Association for Quality and Management Systems (SQS) and was once again awarded the ISO 90001 certificate.

Fifty audits per year

Every risk and quality management system has to undergo periodical audits. Every year, around fifty external and internal audits are carried out at FEDRO, which closely examine the various processes and compare them with everyday practice. Finances are subjected to special scrutiny, as are the many major projects. The resulting recommendations flow into the ongoing improvement process at FEDRO.

Ombudsperson at FEDRO

As one of the central procurement units of the federal administration, FEDRO already introduced measures to prevent corruption a number of years ago. The measures include a directive on combating corruption and a code of conduct, plus a procurement manual that contains uniform regulations governing the acquisition of goods and services. These are supported by auxiliary measures such as specific training courses, auditing and monitoring activities. Employees who suspect that corruption may have taken place may report this anonymously to a specially designated internal unit (ombudsperson).

Finance inspectorate at FEDRO

FEDRO has its own internal finance inspectorate that carries out some of the approximately fifty annual audits. It is included in the FEDRO organisational chart as a separate division. The basis for its activities is the Federal Auditing Act and the finance inspectorate regulations approved by the directors of the Federal Audit Office and FEDRO. Its audits encompass all activities, including management and monitoring of business and organisational risks. The inspectorate carries out audits in the following five categories: financial results, processes, systems, management and construction projects.

Functions of the Federal Audit Office

The Federal Audit Office is the federal government's highest financial supervisory body. It supports Parliament and the Federal Council, is independent and is governed solely by the Federal Constitution and the relevant legislation. Its duties are specified in the Federal Auditing Act. It carries out a variety of audits within FEDRO each year, based on the criteria of economic viability and effectiveness, and compliance with the applicable regulations and legal provisions.

IT projects

The complexity of the activities of FEDRO calls for comprehensive and specialised information technology. FEDRO currently has around forty specialised applications at its disposal for construction, financial and administrative processes. FEDRO's IT processes and financing are subjected to ongoing controlling and audits, in the same way as construction projects are.

Mobility pricing to reduce peak traffic

Mobility pricing makes it possible to reduce peak traffic and more efficiently utilise the existing road and rail capacities. The Department of the Environment, Transport, Energy and Communications (DETEC) has analysed potential mobility pricing criteria in its recent concept report.

Mobility has increased sharply in Switzerland in the past few decades, and our existing transport system is facing ever more difficult challenges. Capacity limits are increasingly being reached during peak periods, and at the same time the demand for mobility is constantly growing. According to models developed by the Federal Office for Spatial Development (ARE), it has to be assumed that the overall traffic volume will increase by around 25 percent between 2010 and 2030. Private motorised transport is expected to increase by 19 percent, and public transport by 50 percent. The sharp increase in mobility demand is associated with three major challenges: capacity problems, rising costs and increasing external effects. It will no longer be possible to overcome these problems in the future with the existing instruments and solutions, but technological developments are opening up new opportunities for responding to these challenges.

Definition and objectives of mobility pricing

In the concept report commissioned by the Federal Council, mobility pricing is defined as "a user-based levy for the use of infrastructure and services in private and public transport". The aim of mobility pricing is to reduce overall peak traffic and bring about a more balanced burden on transport infrastructure. Although there are other challenges in the transport sector such as financing and environmental protection, the main objective of mobility pricing is to overcome capacity problems. In view of this, no new levies are to be introduced, but the existing ones are to be substituted. For the other challenges, the aim is to utilise as many positive knock-on effects as possible. The reasons for focusing on a single objective are twofold: the urgency of finding a solution to congestion on the roads and in public transport and the avoidance of conflicting goals.

Basic principles of mobility pricing

According to the concept report, mobility pricing is to be based on the following principles:

- Pay as you use, i.e. use-related prices for products and services instead of indirect taxes, levies and standard tariffs. The aim is to provide transport users with an incentive to behave in a cost-aware manner.
- Compensation: Mobility is not to cost more, but is to be paid for in a different way. Mobility pricing is thus intended to (gradually) replace the existing levies.
- Social-political structure: Tariffs are to be structured so that mobility will remain affordable for everyone.
- Intermodality: Mobility pricing is to apply to road and rail transport.
- Modular structure: The concept of mobility pricing is modular in nature. This will permit a step-by-step introduction of the various measures.
- Data protection: Data protection is a central issue in the planning and implementation stage, as well as in the operational phase. The use of data must be clearly stipulated in the relevant legislation.
- Transparency: Mobility pricing must be transparent and comprehensible for all users.

The mobility pricing concept is intended to apply to all forms of road and rail transport.

Model variants

The concept report contains a variety of model variants. These are modular in structure, i.e. they follow a development path that extends from spatially limited models through to a fully comprehensive model. They incorporate motorways, national roads, cantonal roads and roads in agglomerations, as well as public transport by road and rail. In each case the following questions are examined: Who pays? Where is payment made? When is payment to be made? How is the collected amount to be compensated? What are the associated strengths and weaknesses? All the model variants for private motorised and public transport have one thing in common, namely that they envisage the introduction of a user-based levy and the full or partial compensation of existing fees and levies.

Consultation procedure with 90 statements of position

On 27 May 2015, the Federal Council formally acknowledged the draft mobility pricing concept and opened a consultation procedure on the same day. A total of 90 statements of position were submitted by cantons, cantonal conferences, political parties, national trade and industry associations, transport organisations and various other associations, organisations and interest groups. These were analysed by the Federal Roads Office (FEDRO) and the Federal Office of Transport (FOT) and evaluated and summarised in the report on the results of the consultation procedure concerning the mobility pricing concept report. They range from full acceptance through to complete rejection, though the former outweigh the latter.

Infrastructure is paid for by those who use it

Mobility pricing is a "user-pays" concept for charging for the use of infrastructure and services in private motorised and public transport with the objective of influencing mobility demand. The aim of mobility pricing is to reduce overall peak traffic and bring about a more balanced burden on transport infrastructure. Here the reduction of peak traffic and a more balanced utilisation of transport infrastructure among users have to be harmonised. This means that mobility pricing is essentially an instrument for tackling capacity problems, not for financing transport infrastructure. By contrast, road pricing is a concept for user-based charges that apply exclusively to private motorised transport with the principal objective of financing road infrastructure.

Legal framework

With respect to road transport, the following points should be noted: according to Article 82, paragraph 3, section 1 of the Federal Constitution, the use of public roads is free of charge. However, certain exceptions apply: the Federal Constitution also stipulates that, with regard to object levies, the Federal Assembly may grant exceptions to the free use of public roads (Article 82, paragraph 3, section 2). One such exception applies to the Grand St Bernard between Switzerland and Italy. The Federal Constitution would have to be amended for all the model variants proposed in the concept report, regardless of whether they apply to all transport and road networks or only to certain ones (e.g. motorways).

Origin of traffic bulletins

Around 30,000 traffic bulletins are issued each year to users of the motorway/national roads network. They are transmitted via radio, navigation systems or smartphone apps. Their origin can vary enormously, and a large number of entities are involved.

Radio is the most important medium for the transmission of national traffic bulletins. These bulletins are received directly by drivers without the need for them to take any specific action. The value of this medium will be even higher when the use of digital technology (DAB+) permits even faster transmission of information. The transmission of traffic bulletins via standard navigation systems and smartphone apps is also gaining in importance.

Sources of information

All traffic bulletins relating to the motorways and national roads are prepared by operators at the FEDRO Traffic Management Centre in Emmenbrücke and passed on to the Viasuisse traffic information centre in Biel for distribution. But the actual sources of the information can vary enormously, because there are a variety of players who can trigger a traffic bulletin.

One of the most important sources is the police: cantonal police patrols report accidents, breakdowns, hazards, wrongway drivers, people or objects on the road, etc., to their operations centre, which passes on the details to the Traffic Management Centre, which in turn forwards them to Viasuisse.

Employees of motorway depots are another source of traffic bulletins. They, too, issue reports, normally concerning short-term maintenance and roadwork projects. Reports relating to large-scale roadworks that last several days or weeks are entered in the system by the Infrastructure Division of FEDRO. The Traffic Management Centre is responsible for quality control, approving short-term roadworks and formulating a corresponding bulletin. Information about roadwork projects is distributed in the same way as other traffic bulletins.

Not every traffic jam can be recorded

Traffic bulletins are still an inexact science. Entering the details of an incident from beginning to end is difficult, and it is not yet possible to draw a complete picture of the traffic situation on the entire motorway/national roads network. This means that not every traffic jam is recorded and reported, and in some cases a traffic jam may be reported that has meanwhile already cleared.

The quality of traffic bulletins depends directly on the options for recording and monitoring the current traffic situation. Stretches in the agglomerations along which congestion occurs on a daily basis are equipped with a large number of cameras and traffic counting stations. A total of 1,200 cameras on the motorways and national roads provide a direct overview of the traffic situation. The images can be used to verify reports or determine the length of a traffic jam. The traffic counting stations are equipped with special meters. Induction loops are installed on the road surface and record the number of vehicles and current speed of traffic flow on the stretch concerned. Disruptions to traffic flow (and their termination) are reliably recorded on these stretches. FEDRO is constantly expanding its network of monitoring devices.

During periods of heavy traffic, such as depicted here on the Bern – Neufeld stretch, traffic bulletins can help reduce congestion in that road users have an opportunity to choose another route or postpone their journey.

350 traffic counting stations on the motorways

Another source of traffic bulletins exists directly on the motorways. Around 350 traffic counting stations constantly monitor the traffic situation on the entire network. They record the number of vehicles travelling in both directions, the proportion of heavy goods vehicles and the speed at which traffic is flowing. Cameras are also used for monitoring and recording the traffic situation. As soon as the speed of traffic flow on a given stretch falls below a predefined limit during a specific period of time (see boxes below), the operators at the Traffic Management Centre issue a corresponding traffic bulletin. Finally, road users themselves help ensure that traffic bulletins are up to date and of high quality. Using their mobile phone they can indirectly pass on warnings to one another about hazards, traffic jams, etc. All these reports are used by the Traffic Management Centre in Emmenbrücke to draw a picture of the traffic situation on the motorways and national roads. The operators collect incoming reports, carry out the corresponding quality control and pass on the details to Viasuisse in Biel.

What is a traffic jam?

For the purposes of a traffic bulletin, a traffic jam is deemed to exist when on a high-capacity road or a main road outside a built-up area the traffic flow speed falls to below 10 km/h for at least a minute and traffic frequently comes to a halt. Similarly, a traffic jam exists when in the vicinity of junctions or bottlenecks on main roads in built-up areas the loss in travel time exceeds five minutes.

For the purposes of traffic bulletins, congestion is deemed to exist when the traffic flow speed outside a built-up area falls below 30 km/h for at least a minute and/or briefly comes to a halt. For the recording of traffic disruptions, in the applicable Swiss standard a distinction is made between traffic jams and congestion, but FEDRO does not make this distinction and regards both situations as congestion. The reason for this is that, from the point of view of road users, such a distinction is irrelevant – it is the loss in travel time that is of relevance to them. Furthermore, the necessary network-wide, dynamic traffic volume and flow data are not yet available for making such a precise distinction.

Managing traffic at the northern entrance to the Gotthard

Congestion statistics paint a clear picture: the most severe traffic jams occur daily in Switzerland's major urban centres. At the Gotthard tunnel, they occur intermittently and often attract excessive media attention because they take place on public holidays or during holiday periods.

The most severe congestion on Switzerland's motorway/national roads network occurs in the major agglomerations. In 2015, FEDRO recorded around 3,000 traffic jam hours on the Zurich–Winterthur northern bypass, 2,400 hours in the Gubrist tunnel in Zurich, and 1,900 hours in the vicinity of Baregg. By comparison, the figures for the Gotthard road tunnel were fairly modest: around 200 hours were registered at both the northern and the southern portal.

For the following reasons, the loss in travel time at the Gotthard is easier to calculate than on other motorway and national road stretches:

- The capacities of the tunnel are well documented. A maximum of 1,000 vehicle units are permitted to drive through the tunnel per hour (a heavy goods vehicle is equivalent to three units). The interval feed system that was introduced in response to the fire that occurred in 2001 controls the frequency at which HGVs enter the tunnel and maintains the distance between HGVs at 150 metres.
- In addition, the number of vehicles currently on the approach roads and in the holding zones is recorded, and this means that the loss in travel time can be precisely determined. A one-kilometre traffic jam at the Gotthard corresponds to a waiting time of around ten minutes.
- For the calculation of the length of a traffic jam, the fact that the Gotthard stretch is susceptible to rockfalls and avalanches, especially on the northern side, has to be taken into account. For this reason, lines of vehicles are not allowed to queue on two stretches from Amsteg with a total length of 7 kilometres, and instead are halted before they reach that point. The effective length of a traffic jam is calculated by adding together the various queues.

Unchanged traffic jam data since 2010

If a waiting time of 10 minutes is registered at the Gotthard, a corresponding report is sent out to the radio station via Viasuisse. The situation is then continuously monitored so that road users can be kept informed about the waiting time.

Since 2014, reports have been transmitted concerning traffic jams longer than one kilometre on the access roads to the Gotthard. Previously, traffic jams had to be longer than two kilometres before the police sent a report. As a consequence, the traffic bulletins for the north portal of the Gotthard have changed. Between 2012 and 2014, the number of reports of traffic jams increased from 4 to 195, while in the same period the number of reports regarding congestion fell from 368 to 201.

The recorded traffic jam hours encompass periods with heavily congested and halted traffic flows. At both portals, the number of traffic jam hours and days has changed very little since 2010. This resulted in an average traffic jam duration of 6.5 hours (northern portal) and 7 hours (southern portal) on peak days.

Experience has shown that waiting times in traffic jams on the Gotthard route during holiday periods can be calculated fairly reliably, and these are thus integrated into traffic bulletins. For the past three years, a pilot trial has been carried out for the entire motorway/national roads network with the aim of monitoring current travel times and delays on individual stretches.

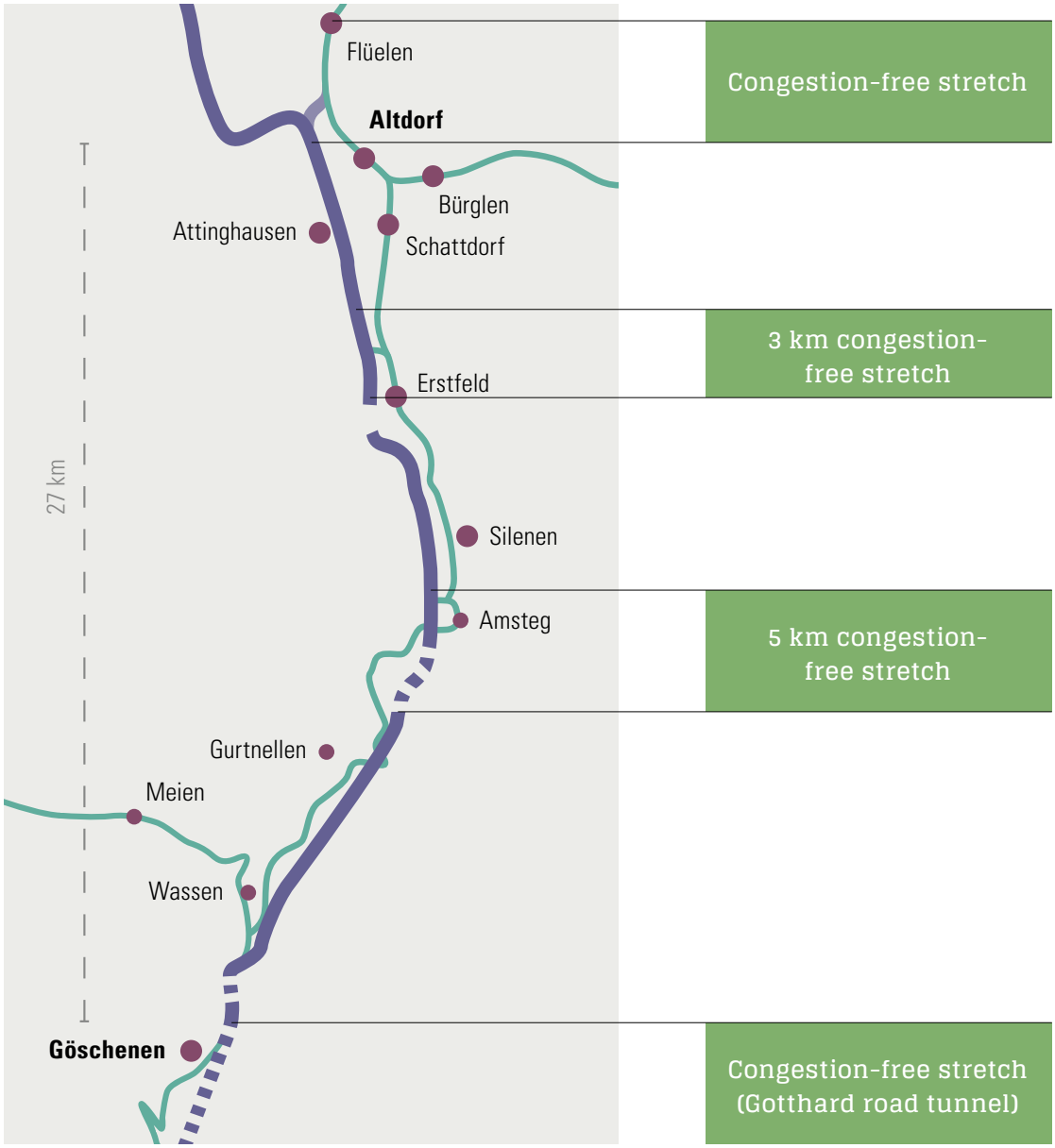
Traffic jam data at the Gotthard

Gotthard northern portal		
	Traffic jam days	Traffic jam hours
2014	149	934
2015	135	883

Gotthard southern portal		
	Traffic jam days	Traffic jam hours
2014	179	1,197
2015	189	1,330

Congestion-free stretches before the north portal

On the route to the north portal of the Gotthard in the canton of Uri, major traffic jams occur during holiday periods or before long weekends. The sensitive stretch between Flüelen and Göschenen is 27 kilometres long. If traffic comes to a standstill on this stretch, however, this does not mean that the queue is the same length, because there are sections along this stretch on which vehicles are not allowed to come to a halt (shown in green in the diagram). The reasons for this are the presence of tunnels and the existence of natural hazards such as rockfalls and avalanches. The two average congestion-free stretches total five to seven kilometres in length, depending on the weather conditions or traffic situation. This means that if a traffic jam forms 27 kilometres from the tunnel portal, the actual length of the queue is around 19 kilometres.



In a special study, Mercedes-Benz presented a concept for the future development of an autonomous car.

Unimagined possibilities of intelligent mobility – potentials and challenges

Fewer accidents and traffic jams, less harm to the environment, greater comfort: the hopes being placed in intelligent mobility and automated driving are diverse. It is becoming increasingly likely that cars will one day operate autonomously – the only question is when. FEDRO is committed to resolutely facing this new challenge.

Major automobile manufacturers and equipment suppliers, along with IT companies, are currently developing and testing technologies that could have direct consequences in the next few years for the entire land transport system in Switzerland and throughout the world. Opinions regarding the timing and extent of the introduction of highly-automated driverless vehicles onto the market vary and are influenced by marketing deliberations. The questions now are not so much whether, but rather when and how, such vehicles will become a part of everyday life.

Merger between private motorised transport and public transport

It is widely anticipated that driverless vehicles will enhance the level of road safety by eliminating the risks associated with human error. The use of such vehicles is also expected to increase the efficiency of the infrastructure, reduce environmental pollution, lead to greater comfort and create scope for new mobility solutions. All these aspects will also influence mobility demand.

It is conceivable that autonomous vehicles could be used collectively, which would result in an even greater change in the existing mobility system. The vehicle stock would diminish and private motorised transport would merge with public transport. In view of this, close coordination between the various forms of transport will become increasingly important.

For the authorities responsible for the planning and construction of road infrastructure the question arises as to how the existing infrastructure can and should be optimally utilised, maintained and sustainably developed with a view to the impending introduction of autonomous vehicles. All the involved players will have to redefine their role in the rapidly changing environment.

In addition there are also various technical, legal and market-related influencing factors to be considered, which will not only have a social and financial impact but could also alter mobility behaviour in both passenger and goods transport, and thus affect the entire economy.

The role of the federal government

FEDRO wants to lose no time in addressing and drawing attention to the main issues associated with intelligent mobility, and is thus pursuing intensive exchanges of knowledge with the business sector, scientific circles and expert groups, and systematically acquiring and disseminating this know-how. For this purpose, FEDRO is participating in a variety of international EU bodies in order to represent Switzerland's interests.

It has also launched a research initialisation project in which Switzerland's most important future research requirements are to be identified and closely examined. An interim report is scheduled to be published at the end of 2016.

A variety of legislative amendments are likely to be required. This represents an additional challenge for FEDRO as the authority responsible for traffic law, but new fundamental questions relating to data protection and liability will also have to be addressed.

Networking vehicles with infrastructure

In order to ensure that autonomous vehicles can operate safely and use the infrastructure efficiently, they need to be networked with one another as well as with the infrastructure. To ensure that the exchange of data and management of forms of transport function properly, a shared virtual infrastructure will be required. This will not only have to keep drivers informed or transmit digital signals, but will also need to manage map updates and provide an "experts system" that registers the experiences of the vehicle operator and proposes potential reactions based on these. The aim behind this system is to prevent autonomous vehicles from behaving like overcautious learner drivers who learn little or nothing in addition.

Potential solutions already exist. Switzerland possesses efficient mobile phone networks for the transmission of data. With its SA-CH (System Architecture Switzerland), FEDRO is working on the creation of a future IT framework, and its MISTRA road infrastructure platform already contains a stock of basic data.

Two pilot trials in Switzerland

A number of trials with autonomous vehicles are already being carried out, including in Switzerland. In 2015, Swisscom tested an autonomous vehicle in and around Zurich for the first time. With the aid of a variety of sensors and smart cameras, a Volkswagen Passat was able to identify the road as well as both static and dynamic objects, and thus to autonomously drive through the existing traffic. For Swisscom, the findings obtained from this trial are a key factor for gaining a better understanding of the challenges relating to future mobility and for developing its mobility services in a targeted manner.

Since December 2015, PostAuto Schweiz AG has been the first transport service provider in Switzerland to test automated driving in the canton of Valais with two minibuses. The first series of trials is being carried out on private land. In the second stage, the aim is to deploy autonomous shuttles on public roads and also transport passengers. The two vehicles communicate with one another in order to prevent them from impeding one another on narrow stretches of road, for example. As a provider of complete mobility solutions, PostAuto wants to determine whether, and how, these intelligent vehicles can facilitate new forms of mobility, and thus how it can improve its regional operations.

New guidelines for the maintenance of areas of greenery along motorways/national roads

There are 4,236 hectares of greenery along the 1,820 kilometres of motorways and national roads in Switzerland, and FEDRO is responsible for their upkeep. New guidelines regarding the care and maintenance of these areas of greenery were introduced on 1 January 2016 with the aim of ensuring that they are properly and sustainably maintained.

The greenery along Switzerland's motorways and national roads covers an area of 4,236 hectares, which is larger than the canton of Basel-Stadt. Most of the greenery is in the form of embankments, hedges, meadows near entrance and exit roads, play areas at service stations and other open spaces. They form elements of the landscape, but are also essential for the operation of the motorways: hedges stabilise embankments, groundcover plants prevent erosion and trees provide natural protection against avalanches as well as shade at service stations.

Areas of greenery are ecologically valuable both as habitat and as interlinking elements. In intensively developed landscapes, the embankments along the motorways/national roads provide habitats for a variety of flora and fauna. Significant potential in this respect exists wherever large areas of greenery are part of the perimeter of a road or a maintenance zone.

Tree felling promotes a stable forest perimeter

For stretches of motorway/national road that run close to forests, the new guidelines more clearly define the requirements placed on tree felling. The structure of forest perimeters should be layered and made stable in order to prevent trees or branches from falling onto the road. Here, too, a distinction is made between two zones: the first, intensive maintenance zone is ten metres wide and may only be planted with stable trees and shrubs, while the second extensive zone is ten to thirty metres wide. Here, only limited intervention is required.

New guidelines to ensure sustainability

New specific guidelines governing the areas of greenery along the motorways and national roads were introduced on 1 January 2016. Thus, for the first time, concise criteria have been specified for defining design objectives while taking account of the various requirements relating to the landscape, biodiversity, drainage, safety and economic viability. The new guidelines also close gaps with regard to safety zones, invasive flora (neophytes) and wildlife fencing, as well as giving greater consideration to maintenance requirements in the planning of greenery.

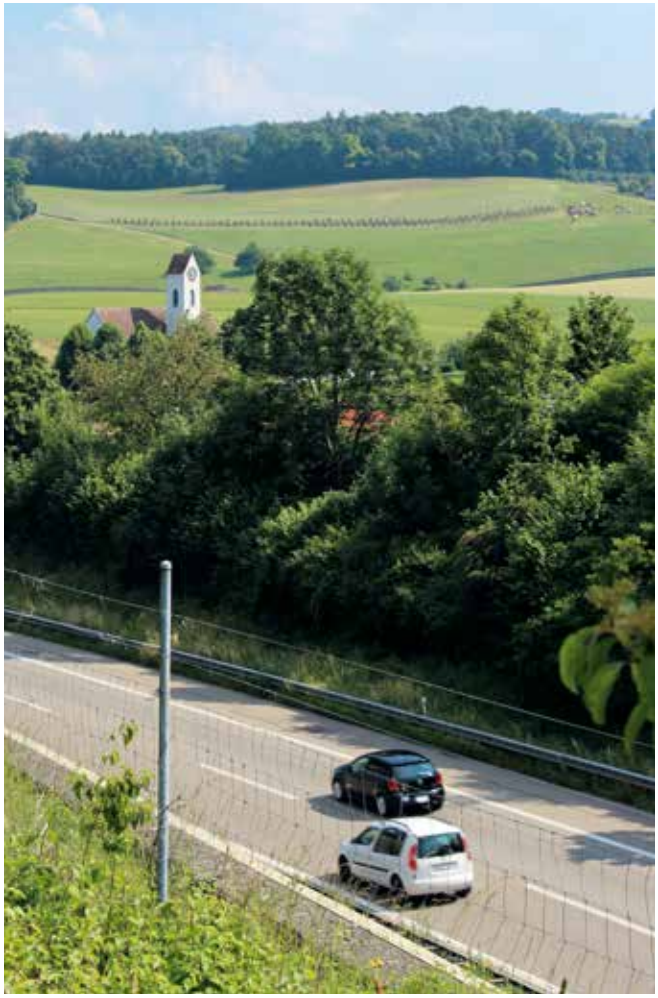
The guidelines specify the following principles for the future design of areas of greenery:

- Integration of motorways/national roads into the landscape.
- Facilitation of interlinking of areas of greenery.
- Definition of biodiversity priorities.
- Ensuring the prevention of the spread of invasive neophytes.
- Design of areas of greenery as buffer zones.
- Securing efficient and effective maintenance.

Two zones with different functions

For maintenance purposes, a clear distinction will be made in the future between two zones. In the first, an intensive maintenance zone which encompasses a strip around ten metres wide from the edge of the road, only grassland may be cultivated. This is the safety zone that has to be intensively maintained. Its design and width had not been clearly defined until now.

In the second, extensive zone, which neighbours on this safety zone, all types of vegetation may be planted. Here, maintenance is extensive instead of intensive, and this permits a certain degree of flexibility. However, when hedges are to be planted, attention should be paid to the required amount of space. A low hedge requires a width of at least three metres. Wherever possible, preference should be given to woody plants that form barriers to protect against particulate matter and glare and prevent the spread of neophytes. High hedges can reduce the number of collisions with large birds since they force them to fly over the road at a greater height.



This hedge helps protect the village against particulate matter pollution.

Hedges reinforce wildlife fencing

The entire motorway and national roads network is secured with wildlife fencing which protects road users as well as wildlife against accidents. Until now the fact that hedges can significantly enhance the effect of wildlife fencing and reduce the risk of fleeing animals leaping onto the road had often been overlooked. For this reason, the new guidelines point out that attention should be paid to the planting of hedges beyond the motorway terrain. Furthermore, hedges planted outside wildlife fencing help steer animals to the next wildlife corridor.

35 million Swiss francs a year for greenery maintenance

The maintenance and upkeep of areas of greenery along the motorways and national roads cost around 35 million Swiss francs a year. Various measures are foreseen for the future that will not only help cut costs, but also promote biodiversity. Where possible, for example, in areas of grassland a mowing height of ten centimetres should be adhered to in order to prevent damage to the ground and harm to small animals. This also reduces the spread of invasive neophytes. In addition, hedges and trees should be trimmed so that they do not interfere with visibility at the edge of the road, and at service areas they should be maintained so that they create pleasant surroundings.

Attractive cycle lanes to ease the burden of private motorised transport

Bicycles have long since become established in agglomerations and are now gaining in importance thanks to the boom in electric bikes. Many Swiss towns and cities are taking steps to increase the proportion of bicycles on the road. This trend calls for new, safe and attractive infrastructure, in particular bicycle lanes and routes.

Alongside public bike hire systems, bicycle lanes are the most important development in recent years for cyclists. These lanes represent attractive, direct, uninterrupted and convenient cycling facilities. These dedicated bicycle lanes are referred to by different names in Switzerland and other countries. The designation to be used in Switzerland will probably be definitively decided in the course of the ongoing research of the SVI (association of Swiss traffic engineers and experts).

Why are cycle lanes necessary?

Cyclists want to reach their destination quickly and safely and without too much effort. Here, it is not speed that counts, but rather the ability to complete the journey with as few interruptions as possible. This shortens the journey and means they can be certain of reaching their destination within a certain period of time. This certainty makes planning simpler and more reliable. With the sharp increase in the use of electric bikes, cyclists are now also travelling longer distances. In order to exploit the potential of this new environment-friendly form of mobility, an attractive and safe infrastructure is required that enables cyclists to travel with as few stops as possible. It is not only cyclists who benefit from such facilities, but also the overall transport system, thanks to the resulting easing of the burden on road traffic and public transport, specifically during peak periods. In the Netherlands, dedicated cycle lanes were already introduced in 2006 in order to reduce congestion on the motorways.

Cycle lanes as a new level in the network hierarchy

In line with the target groups, the cycling traffic network is divided into everyday and leisure-time facilities. Cycle lanes are primarily intended for everyday use, but they can also be used for leisure-time activity, especially within residential areas. Nearby recreation areas can be reached more quickly and conveniently and, because they are safe and attractive, cycle lanes can also be used by less experienced cyclists. This promotes the use of bicycles by attracting new target groups.

To ensure that cycle lanes are designed appropriately, their planning and realisation have to be carried out in a coordinated manner by the involved municipalities. In view of this, it is desirable to integrate cycle lanes into regional transport plans and agglomeration programmes. Cycle lanes should not be regarded as a certain type of infrastructure, but rather as a level in the network hierarchy: cycle lanes – main routes – secondary routes.

Initiative calling for greater commitment on the part of the federal government

A people's initiative signed by around 120,000 citizens calling for the promotion of cycling, pedestrian and hiking routes was handed in on 1 March 2016.

The initiative is based on the existing article in the Federal Constitution (Article 88) regarding the promotion of pedestrian and hiking routes and wants to extend this to cycle lanes and routes for everyday and leisure-time use.

One of FEDRO's duties is to provide the most favourable conditions for the development and promotion of human-powered mobility. In view of this, its efforts aimed at supporting the cantons include:

- Contributions to infrastructure for human-powered mobility within the scope of the agglomeration programmes
- Publication of guidelines, enforcement aids, etc.
- Basic research and support for pilot projects
- Adaptation of existing legislation
- Evaluation and monitoring activities

Roads with low traffic frequencies the most suitable

Cycle lanes outside built-up areas are normally separated from the road, while in urban zones roads with low traffic frequencies are suitable for combined use by cyclists. On streets in residential areas the speed limit is normally 30 km/h. However, the principle of priority from the right that applies in these zones conflicts with the objective of providing uninterrupted travel for cyclists. In view of this, the option of providing specially designated cycle routes on these streets is currently being examined in Switzerland. This would make connections between residential areas more attractive for cyclists. Here the most important aspect is giving cyclists the right of way at junctions. Cycle routes of this nature already exist in Germany, Austria, Belgium and the Netherlands.

Pilot trials with cycle routes

Introducing cycle routes in Switzerland would require an amendment to the relevant legislation. As a decision-making basis, the effects in terms of road safety in particular are to be clarified in pilot trials, which will be initiated in spring 2016. The findings are expected to be available by the end of 2017. Five cities have agreed to take part in the trial, namely Basel, Bern, Lucerne, St Gallen and Zurich, and towns and cities in Western Switzerland are also being encouraged to join in.

FEDRO is coordinating the associated activities with the support of the Swiss Cycling Conference and the Swiss Council for Accident Prevention. The criteria relating to traffic signals and road signs and markings for the pilot trial are to be specified by FEDRO. The aim is to give priority to bicycle traffic on the stretches concerned and to make this clear through the use of appropriate markings on the road surface.

The involved towns and cities will be responsible for organising and financing the implementation and evaluation of the trials, while FEDRO will act as coordinator and prepare the final report.

On roads with designated cycle lanes, the lights will be green more frequently for cyclists.

1.8 billion Swiss francs for completion, maintenance and expansion

The federal government is to invest around 1.8 billion Swiss francs in the motorway/national roads network in 2016: 509 million for the construction of new stretches, 1.173 billion for expansion and maintenance of the existing network and 131 million for bottleneck elimination projects.

This year, work on new stretches is based on the 8th long-term construction programme that was adopted by the Federal Council on 22 February 2012. The continuation of projects already initiated is the main priority, including:
- The A9 in Upper Valais
- The Trans-Jura motorway (A16) in the cantons of Bern and Jura
- The eastern segment of the Biel bypass (A5)
- The Prättigau stretch (A28) in the canton of Grisons (Küblis tunnel)

In all, 509 million Swiss francs have been budgeted for new construction work to complete the network. The financing is to be provided by the Infrastructure Fund. The largest credit facilities were allocated to the following cantons: Valais, 238 million; Bern, 162 million; Jura, 43 million; Neuchatel, 14 million; Grisons,13 million. Roughly 70 percent of the credit facility for completion of the network is to flow into projects in Western Switzerland and Valais.
The completion of the planned network is to remain a shared responsibility between the federal government and the cantons, even after the entry into effect of the redistribution of financial responsibility and the accompanying division of duties: the cantons are responsible for construction work, while FEDRO is the supervisory authority.

Completion of the motorway/national roads network

This year the Federal Council approved the 9th long-term construction programme. During the next four years, an average of 460 million Swiss francs per annum is to be invested, mainly in the cantons of Bern, Valais, Schwyz and Uri. Approximately 96 percent of the network has been completed, while around 70 kilometres of national road stretches account for the remaining 4 percent. The most important work concerns the completion of the A5 and A16 in the canton of Bern, the A9 in Upper Valais and the A4 in the cantons of Uri and Schwyz.

Expansion and maintenance

Parliament has approved a budget of 1.173 billion Swiss francs for the expansion and maintenance of the existing network. The financing is to be provided by the Special Fund for the Financing of Road Transport.

Initiation of major maintenance projects in 2016:
- A1, canton of Geneva: Bernex to Ferney (tunnel safety)
- A2, canton of Ticino: Riviera
- A9, canton of Vaud: Vallorbe to Essert-Pittet
- A9, canton of Vaud: Flon viaduct
- A12, canton of Fribourg: La Joux des Ponts service station
- A13, canton of Grisons: Bärenburg tunnel safety shaft

Continuation of work on other stretches, including:
- A2, cantons of Solothurn and Basellandschaft: renovation of the Belchen tunnel
- A2, canton of Nidwalden: Acheregg to Beckenried
- A2, canton of Ticino: Airolo to Quinto
- A2, canton of Ticino: Svincolo di Mendrisio
- A4, canton of Schaffhausen: Galgenbuck tunnel
- A5, canton of Neuchatel: Colombier to Cornaux
- A6, canton of Bern: Rubigen to Thun
- A9, canton of Vaud: Montreux to Roche
- A13, canton of Grisons: Roveredo bypass

For more detailed information about all major construction projects on the motorway and national roads network, please go to www.autobahnschweiz.ch.

Bottleneck elimination programme

The total budget in 2016 for projects in the bottleneck elimination programme is 131 million Swiss francs. Most of this amount is to be invested in the widening of the Zurich northern bypass (A1) to six lanes, work on which has already commenced.

Five major projects on the motorway/national roads network

A1 – widening of the Zurich northern bypass

Measures to eliminate bottlenecks / widening of the stretch between Limmattal junction in the west and Zurich North junction in the east to six lanes / widening of stretch, including construction of a third Gubrist tunnel tube / construction of a new 600-metre long stretch of covered motorway and modification of Weiningen and Zurich-Affoltern junctions / simultaneous renovation of the Stelzen 400-metre long covered stretch / renovation of both existing tunnel tubes after completion of the third tube / all works to be carried out while keeping two lanes open in each direction / duration of project, 2016 to 2025 / total cost, approx. 1.55 billion Swiss francs.

A2 – comprehensive renovation of stretch between Airolo and Quinto

Widening of south-to-north tube of the Stalvedro tunnel, including construction of an emergency lane for rescue services / renovation of road surface and noise barriers, construction of infrastructure for treatment of run-off water / main objectives: to enhance road safety and significantly reduce road noise / to maintain traffic flow during the various construction stages / main work to be carried out in 2016 in the vicinity of Airolo, followed by work in the vicinity of Quinto / duration, 2015 to 2018 / total cost, around 250 million Swiss francs.

A2 – Belchen renovation tunnel

3.2-kilometre Belchen renovation tunnel as construction project with separate third tunnel tube, to the west of the two existing tubes at the border between the cantons of Basellandschaft and Solothurn / start-up ceremony and commencement of work on third tube on 9 February 2016 / excavation of around 470,000 cubic metres of material / use of largest tunnel boring machine in the country / duration, 2014 to 2022 / total cost, approx. 500 million Swiss francs (the two other tubes are to be renovated after the third one has been completed in 2022).

A6 – total renovation of stretch between Rubigen and Kiesen

Comprehensive renovation of the stretch between Rubigen and Kiesen / second stage, five-kilometre stretch from Niederwichtrach to Kiesen / total renovation to take place while maintaining full traffic flow / replacement of 45-year-old concrete surface with low-noise asphalt / new environmentally compatible drainage system / total cost, around 190 million Swiss francs (renovation of stretch between Kiesen and Spiez to commence in 2017).

A9 – renovation of Flon viaduct near Lausanne

The 40-year-old viaduct is in need of comprehensive renovation / renewal of expansion joints, edges and seals / adaptation of safety elements and signals to current standards / on both viaducts, six lanes to be kept open to traffic throughout the duration of the project / duration, April 2016 to the end of 2018 / total cost, around 30 million Swiss francs.

Six different asphalt types have been installed along the Kerzers viaduct. The objective of the long-term trial is to obtain findings relating to their acoustic and corrosion-protection properties.

FEDRO searching for the ideal asphalt surface

As part of its search for a road surface material that is both watertight and noise absorbing, FEDRO has initiated a ground-breaking trial in the canton of Fribourg. Six surface sections made of different asphalt compositions have been installed on the Kerzers viaduct (A1). Tests are now being carried out to determine which of these is best suited to meet the specified requirements.

When it comes to installing road surfaces on bridges or viaducts, civil engineers are faced with a conflict of goals: in order to protect the structure and its support system, the road surface needs to be as watertight as possible, so that no (salt)water can penetrate into the interior and cause corrosion. But there is also a disadvantage associated with watertight surfaces: they are unable to absorb noise. To date, no surface material exists that is both watertight and able to absorb noise.

World premiere

The poured asphalt that has been used for road construction to date is an extremely dense material. For this reason it was not technically feasible to produce it with hollow spaces in order to give it more favourable acoustic properties. In view of this, FEDRO initiated a research project on the Kerzers viaduct with the aim of developing a "low-noise" asphalt that is able to sustainably reduce tyre noise on the road surface and can be used on all engineering structures, especially bridges and viaducts.

This project, which is focusing on the composition of poured asphalt on the one hand, and on the properties and texture of the road surface on the other, is a world premiere. The main aspects on which the researchers are focusing are the cladding of the bedding material with suitable bonding agents and the properties of the grit.

From laboratory to viaduct

The research work was initiated in the laboratory in 2010. Here, fifteen trial sections were produced using a variety of compositions and both natural and artificial grits. These sections were then subjected to both material property and acoustic tests. Producing these sections was a major challenge for the researchers because they were required to emulate the standard production processes as closely as possible. A special device had to be developed that enabled the grit to be distributed evenly and in the correct quantity onto the asphalt layer. The material and acoustic properties of the various sections formed the basis for the choice of the most promising compositions.

In order to test the laboratory findings in daily traffic, FEDRO selected the Kerzers viaduct as a suitable location on the motorway network since the road surface and seals were in poor condition, and in any case the viaduct would need to be completely renovated. With a length of 750 metres, this viaduct is ideally suited because it was possible to install six different trial asphalt sections along it. This ensures that each section is subjected to equal loads and the results of the tests can be directly compared with one another.

The test has been ongoing since September 2015. In the extension of the test segments, a low-noise rolled asphalt was installed in order to make a direct noise-level comparison with the trialled poured asphalt.

Measurements to be carried out for three years

Before the renovation work on the Kerzers viaduct was initiated, the acoustic properties of the existing surface were measured. The resulting readings form the baseline for the ongoing tests. The noise measurements are to be continued as of spring 2016 and will be carried out for the next three years. The goal here is to find a durable, low-noise and inexpensive surface for bridges and viaducts that is fully watertight and is able to comply with the noise abatement measures defined by FEDRO. The costs of this research project are around 500,000 Swiss francs.

Installation of a trial asphalt surface on the Kerzers viaduct.

Tunnel lighting: balancing act between energy consumption and road safety

Tunnels are critical stretches of the motorway and national roads network. Abrupt changes in lighting can give rise to accidents. In the Lungern tunnel (canton of Obwalden), FEDRO is currently examining ways to improve the lighting and simultaneously reduce energy consumption. Initial findings indicate that light-coloured surfaces and walls have a positive influence on energy consumption in tunnels.

Entering a poorly-lit road tunnel can be a disturbing experience. Fortunately there are only very few such tunnels in Switzerland According to the applicable standard (SIA 197/2), all road tunnels with a length of over 300 metres must be properly lit, but in Switzerland lighting is installed even in shorter tunnels. Nonetheless, accidents occur more frequently at tunnel entrances and exits than on other stretches of road, and they are often listed as black spots in the road accident statistics. To reduce the risk of accidents, tunnels need to be equipped with suitable lighting, and this in turn requires energy. FEDRO is currently conducting tests in the Lungern tunnel at the foot of the Brünig Pass with the aim of gaining a better understanding of the correlation between energy consumption and the brightness of the road surface, walls and ceiling.

Structure of the lighting system

Tunnel lighting systems are structured as follows:

- Adaptable lighting at the entrance and exit
- Main lighting along the interior of the tunnel
- Auxiliary guiding and emergency lights throughout the entire tunnel

With the exception of emergency lighting, all light sources are permanently in operation, though the intensity is higher during the day than at night. The interaction of the lighting with the black road surface and in many cases dark tunnel walls still causes reduced driving comfort in many tunnels.

Until a few years ago, orange-glowing sodium vapour lighting was used at tunnel entrances and exits, while fluorescent tubes were used for the interior. The introduction of LED lighting systems that were designed specifically for use in tunnels prompted FEDRO to conduct tests in order to determine the correlation between brightness and energy consumption.

Measurements before and after cleaning

The Lungern tunnel is an ideal candidate for such a comprehensive study, which was initiated in December 2012 when the tunnel was opened and is to be carried out over a period of five years. This tunnel was chosen because at the time at which the criteria for the test were defined in 2011, its structure had been completed but it was still possible to adapt the colour of the ceiling and surface, as well as the type of lighting. Its length of 3.6 kilometres is also ideal for it to be divided into several sections for measurement purposes. The walls are white throughout the tunnel. For the purpose of the study, the tunnel was divided into the following sections:

Section 1
Length, 835 metres – light surface – raw concrete ceiling

Section 2
Length, 530 metres – light surface – light ceiling

Section 3
Length, 730 metres – dark surface – light ceiling

Section 4
Length, 1,484 metres – dark surface – raw concrete ceiling

The following measurements are being carried out: light density, properties of the wall and road surfaces, output of the interior lighting, ageing of the wall coating and lighting temperature. The measurements are carried out each spring and autumn before and after the tunnel is cleaned. A distinction is also made between day-time and night-time lighting.

The Lungern tunnel was divided into four sections in which different colouring was used for the walls and road surfaces. The aim of the study was to determine the effect of brightness on electricity consumption in the tunnel.

Initial findings

After a measurement period of three years, the initial findings may be summarised as follows:

1. A light surface has a significant influence on brightness in the tunnel. In the sections with a light surface the interior lighting can be dimmed to 20 percent during the day and to 10 percent at night. With a dark surface, however, the lighting can only be reduced to 60 percent during the day, while at night it is still possible to reduce it to 20 percent. With a light surface, energy savings of around 60 percent can be achieved with LED lighting in the interior compared with a dark surface.

2. White walls unequivocally have a positive influence on the level of brightness.

3. White markings on a light surface darken continuously. The contrast with the surface decreases, which means the markings are more difficult to perceive. Tests are being carried out to determine how this phenomenon can be counteracted: for example, by using double-sided black contrast marking or increasing the thickness of the marking (currently 60 percent).

4. From the findings to date it may be deduced that the distance of eight metres between LED lamps could be significantly increased, especially when a light road surface is installed. However, the exact additional distance has not yet been determined.

5. A light-coloured tunnel ceiling does not offer any advantages with respect to light density in the tunnel

The consolidated findings are to be initially published in FEDRO's manuals and subsequently flow into the corresponding FEDRO guidelines. This means they will be at the disposal of engineers for planning and construction purposes.

The impacts of the Volkswagen manipulation scandal in Switzerland

In 2015, the reports on the manipulation of engine software by Volkswagen came as a shock for the entire automobile industry. The Volkswagen group faked its VW, Audi, Seat and Skoda models' compliance with the nitrogen oxide (NOx) limit levels by manipulating the software. FEDRO responded by imposing a ban on the registration of the models in question. In the meantime, a recall action has been implemented and the necessary adjustments are now being made.

In order for a vehicle to be approved for use on the road, it has to comply with the applicable technical requirements. If this is the case, the vehicle is granted a type approval. FEDRO is the authority responsible for issuing type approvals for motor vehicles and thus for deciding which models may be registered in Switzerland. On the basis of the bilateral agreements with the EU, Switzerland recognises the type approvals issued by EU member states. This means that those vehicles do not have to be tested separately in Switzerland. FEDRO had to take action in the case of Volkswagen, however, because the German Motor Vehicle Transport Authority (KBA) reported that this manufacturer had fraudulently obtained type approval for several of its models by manipulating the software in the engine control unit in order to fake compliance with the nitrogen oxide limit levels.

170,000 manipulated vehicles in Switzerland

The exhaust manipulations by VW were initially publicised in the USA and then towards the end of September 2015 in Europe. Around ten million vehicles manufactured by the VW group (VW, Audi, Seat and Skoda models) were involved, including 170,000 in Switzerland. On 25 September 2015, the KBA notified the authorities of the countries concerned about the manipulations carried out by VW on some of its models. In response, on 2 October 2015, FEDRO issued a directive to the cantonal registration authorities to no longer register those models that had been affected by the software manipulation. This directive only applied to vehicles that were to be registered in Switzerland for the first time, i.e. it did not apply to vehicles that had already been registered here. The purpose of this differentiated registration ban was to prevent a further increase in the number of unlawful vehicles in the Swiss vehicle fleet, while at the same time protecting owners of such vehicles who had bought them in good faith. On 14 October 2015, the KBA provided the type approval authorities with more detailed information, as a result of which FEDRO was able to modify its directive and to give the go-ahead on 20 October 2015 for the registration of utility vehicles.

Recall action until autumn 2017

On 7 January 2016, the KBA approved the recall concept for all the affected models and announced that it would be approving the necessary repair measures on a step-by-step basis (per model) in the next few months. The Swiss general importer for the VW group (AMAG) then took steps to initiate the recall action for vehicles registered in Switzerland immediately after the KBA had given the go-ahead for each model. This was the basis for FEDRO to issue a new directive on 29 January 2016 easing the registration ban for vehicles that had been imported into Switzerland prior to 5 October 2015 and at the same time specifying the criteria for the re-registration of those vehicles that had been repaired as part of the recall. The recall is being supervised by FEDRO and is expected to be concluded in autumn 2017.

Nitrogen oxide – an irritant gas

The exhaust gas for which the VW diesel engines are unable to meet the specified limit levels is nitrogen oxide (NOx). This is an irritant gas that attacks the mucous membranes of the respiratory organs and respiratory tract. Nitrogen oxides are also responsible for the build-up of ozone in summer smog during periods of high UV radiation. A high proportion of NOx emissions is attributable to the operation of diesel engines in road transport. NOx emissions from motor cars therefore represent a risk to people's health as well as to the environment. The purpose of the specification of limit levels, which have to be tested during the type approval procedure, is to ensure that motor vehicles do not emit higher levels of this exhaust gas than is permissible by law. If the limit level is exceeded, the vehicle is not granted type approval.

Electrical recharging facilities at motorway service stations

The proportion of electric vehicles on Swiss roads is increasing, and this means that demand for public infrastructure for recharging facilities is also on the rise. FEDRO is responsible for creating the prerequisites for the installation of recharging facilities at motorway service stations.

The number of electric vehicles on Switzerland's roads is not yet very high – 7,531 as of the beginning of 2016. In 2015, they accounted for just 1.2 percent of new vehicle registrations. But the proportion is rapidly increasing. In the past few years, the number of electric vehicles has risen by around 50 percent per annum. This is, of course, good news with respect to the reduction of CO_2 emissions and over the long term will also reduce the dependency on fossil fuels for motorised transport.
However, electric vehicles require their own recharging infrastructure. They can be charged at home overnight so that they can be used for daily purposes without having to be recharged, but in order to travel longer distances their batteries need to be recharged en route as quickly as possible.

Facilities at eleven service stations

Service stations along the motorways are the ideal solution for long-distance travel, because recharging takes longer than refuelling with petrol or diesel. Depending on the facility, the vehicle and battery size, recharging for a distance of 100 kilometres takes 20 to 40 minutes. Service stations are the ideal location for this, because drivers can use the other facilities while the batteries are being recharged. As of March 2016, fast-charging facilities had been installed at eleven of the almost 60 service stations on the Swiss motorway network.

Fuel pump at a service station equipped with a plug for recharging electric vehicles.

Available at all service stations in the medium term

It is FEDRO's duty to examine the prerequisites for the development of a network of fast-charging stations for electric vehicles on the motorway/national roads network. As owner of the network and representative of the federal government, FEDRO is working together with the cantons and owners of the service stations to create favourable conditions for private investors.

In the medium term, the goal is for every service station to be equipped with a fast-charging facility with the three most widely used types of plug so that as many types of electric vehicle as possible can be accommodated. The federal government is ensuring that sufficient attention is paid to user-friendliness and expansion options and that the recharging facilities are suitable for use over the long term. For the time being, it is not pursuing the option of developing dedicated service stations for electric vehicles because this would call for comprehensive legislative amendments.

New standard for ensuring safety at motorway roadwork sites

Personnel at roadwork sites on the motorway/national roads network are exposed to danger every day. Increasing traffic volumes and inattentive drivers represent a potential threat for workers and operational personnel. A new standard that entered into effect on 1 January 2016 is intended to enhance the safety of motorway construction.

In September 2015, an articulated HGV collided with a bus at a roadwork site on the A2 motorway near Sursee (canton of Lucerne), injuring 41 people. A semitrailer crashed at high speed into a roadwork site on the A13 motorway in the Rhine Valley (canton of St Gallen) on 14 November 2012, killing one of the workers. On 20 May 2013, at a one-day roadwork site on the A1 motorway near Würenlos (canton of Aargau), an articulated HGV struck a roadworks sign, dragging it 30 metres along the road and (fortunately) only slightly injuring one of the workers.

These three incidents show how dangerous it can be working on a motorway construction site and how important it is to set up safe roadwork sites. To prevent accidents, it is essential to display roadwork signs repeatedly and well in advance, reduce the speed limit, mark temporary lanes and ensure they are wide enough, and protect roadwork sites against impacts.

The new standard that entered into effect on 1 January 2016 describes how a roadwork site should be set up. It replaces the standard dating from 1999, which no longer met the applicable requirements and did not correspond to the current status of technology. In the past twenty years, the traffic volume in Switzerland has doubled and the roads have become increasingly congested. This has greatly increased the hazard potential on the country's motorways.

Safety and traffic flow

The aim of the new standard is to ensure the highest possible degree of safety for road users and for personnel at roadwork sites. Its main focus is on the visibility of road signs and signals, the safe management of traffic and the protection of construction sites. The rules have been tightened for almost all aspects of the display of temporary road signs, including the quality of the utilised materials and the design of road signs, the use of temporary road markings, the use of lighting at roadwork sites and the use of mobile traffic lights and illuminated signs. The new standard also has facilitated the smooth and safe flow of traffic so that the stretch concerned can continue to be used during construction or maintenance operations. Construction work and traffic management always have to be coordinated and carefully aligned with one another.

Short-term roadwork sites

The new standard describes the signalisation and installation of roadwork sites in great detail, and distinguishes between short-term and long-term sites.

Short-term roadwork sites have to be dismantled within 72 hours. They may be movable (e.g. for the maintenance of embankments). They are used for minor repairs, greenery maintenance and cleaning operations. From the point of view of safety, they represent a particular challenge for the personnel on site because it goes without saying that, for short-term sites, the safety measures cannot be as comprehensive as those for long-term sites. It is, therefore, all the more important to display suitable, clear and uniform warning signs throughout the entire motorway/national roads network.

Traffic on the left, roadwork site on the right: for the renovation of this bridge on the A9 motorway in Valais, the site is separated and secured from traffic with the aid of mobile metal barriers.

The new standard calls for the following measures to draw the attention of road users to a roadwork site:
- Use of speed bumps
- Use of mobile impact attenuators
- Use of overhead signals
- Imposition of speed limits for work to be carried out in the emergency lane.

Long-term roadwork sites

These sites are set up at a given location for a lengthy period of time, and the requirements in terms of site protection are thus significantly higher. Long-term sites normally interfere with traffic flow to a major extent and for a lengthy period. They are set up for the purpose of carrying out maintenance work that requires major structural measures. With respect to the protection of long-term sites, the new standard calls for the use of physical barriers or restraint systems (cf. page 30). These take the form of barriers installed between the road and the construction site. The new standard precisely defines the requirements on temporary and mobile restraint systems. For example, the connections between the elements must be difficult to separate, and the material must not be brittle or breakable. In addition, the new standard also calls for a greater minimum width of the traffic lanes. More space for traffic means greater safety for the adjacent roadwork site. It is safer for road users to drive in wider lanes, and the risk of lateral collisions can be reduced.

Transitional periods

The new standard governing the safety of roadwork sites on the motorways and national roads (SN 640 885) was published on 30 June 2015 by the Swiss Association of Road and Traffic Professionals (VSS).

In order to ensure planning and legal certainty, however, certain transitional periods were defined. The new requirements call for investments in barrier systems and their materials, as well as in the training of maintenance personnel who have to erect and dismantle these objects. For **long-term roadwork sites,** the new standard became applicable for all projects initiated after 1 January 2016. For projects that were initiated before this date the old standard may still be applied as long as the project's measures concept was submitted before 2016. The new standard has to be applied insofar as this is feasible at reasonable additional cost and without infringing against regulations. **For short-term roadwork sites,** SN 640 885 (2015-16 version) must be applied as of publication date as long as this is feasible at reasonable additional cost. It must be implemented in full by not later than 1 January 2018.

Vehicle restraint systems between roadwork sites and the roadway

The barriers between the roadway and roadwork site are an essential element in the new standard, which precisely defines the requirements on these components.

Unlike its predecessor, the new roadwork standard (cf. pages 28 ff) stipulates that temporary barriers must be placed between the roadway and the roadwork site. It also specifies the corresponding requirements in detail, which are based on the degree of retention, which in turn indicates the extent to which the barrier is permitted to be deformed in the event of an impact. The higher the degree of retention, the less the barrier can be deformed.

Thanks to the option of defining the degree of retention based on the risk potential, such systems afford roadwork site personnel a higher degree of protection. A distinction is therefore made between minimum requirements and recommendations. "Soft" systems that are more easily deformed may still be used in the future, though no longer in danger zones such as roadwork sites that are adjacent to the roadway and which are occupied by workers and also contain trenches and construction equipment. In these zones, the use of more rigid systems that do not deform so easily is recommended.

Increased safety for road users

The more stringent requirements on temporary vehicle retention systems also result in significantly greater safety for road users. Furthermore, they reduce the severity of accidents and thus the duration of road closures, and this has a positive influence on the availability of the stretch of road concerned. The use of crash cushions, which absorb impact energy, also increases road safety. Although these were not envisaged in the previous standard, they have been in use for a number of years already, and the resulting experiences were incorporated into the new standard. As a rule, every mobile warning sign now has to be equipped with an impact absorber. In the view of FEDRO there was a strong need for action with regard to the use of speed bumps that are placed in front of mobile warning signs. Research has shown that these can greatly reduce rear impact collisions. In accordance with the new standard, speed bumps have to be used at short-term roadwork sites when a temporary reduction in the number of lanes is required.

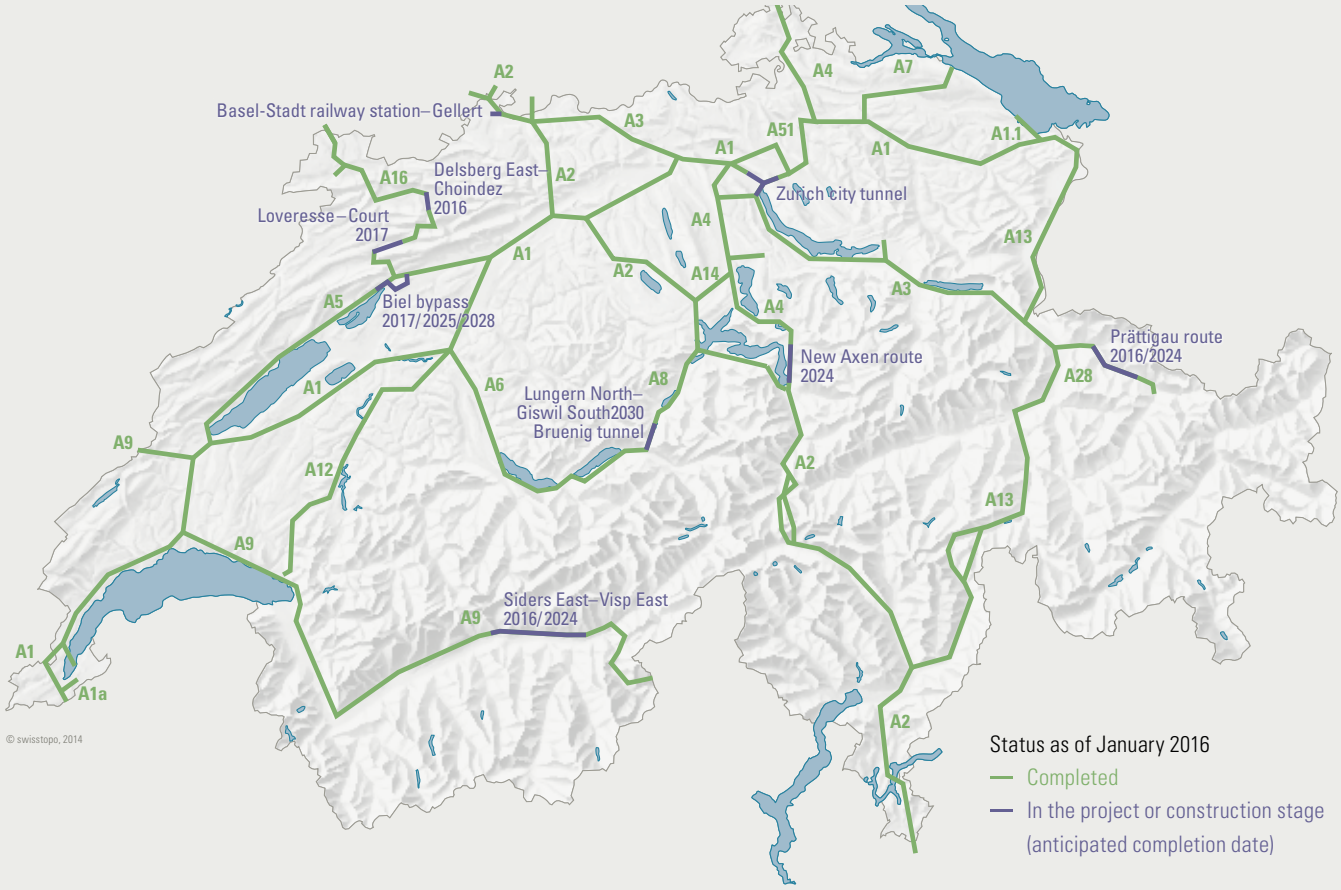
Speed bumps are a simple and efficient means of warning about lane closures. They can prevent collisions with traffic signs and thus significantly reduce the severity of accidents in zones where drivers have to change lanes.

This warning vehicle is equipped with an impact attenuator (yellow).

Facts, figures, statistics

Three new stretches to be opened in 2016

In 2015, no new stretches were opened on the Swiss motorway/national roads network. As of the end of the year, the total length of the network was 1,823.3 kilometres. Three new stretches with a total length of 14.16 kilometres are to be opened in 2016 in the cantons of Grisons, Jura and Valais. The longest of these (6.2 kilometres) is in Valais between Leuk/Susten East and Gampel/Steg West. As of the end of 2016, the total length of the network will increase to 1,837.5 kilometres.



Opening of three stretches in 2016

Motorway	Canton	Stretch	2 lanes	4 lanes
A9	VS	Leuk/Susten East to Gampel/Steg West		6.2 km
A16	JU	Delsberg-Ost to Choindez	3.6 km	1.3 km
A28	GR	Dalvazza to Trun	3.06 km	

The Swiss motorway/ national roads network

Total length by road category (km)

	8-lane	7-lane	6-lane	5-lane	4-lane	3-lane	2-lane	Mixed-traffic roads	Total
	in use	in use	in use	in use	in use	in use	in use	in use	in use
Zurich	1.2		31.3		116.6	1.9			151.0
Bern			13.2	3.1	126.2		46.9	19.4	208.8
Lucerne			2.6	2.7	53.2				58.5
Uri					37.1		16.3	16.1	69.5
Schwyz				2.7	40.5		2.2	4.3	49.7
Obwalden					1.8		22.3	13.3	37.4
Nidwalden					22.9		2.9		25.8
Glarus					16.6				16.6
Zug			6.0		11.7				17.7
Fribourg					84.2				84.2
Solothurn			6.5	5.4	31.9				43.8
Basel-Stadt			3.5		6.0				9.5
Basel-Landschaft			9.5	3.3	17.4				30.2
Schaffhausen							17.2		17.2
St Gallen				4.3	135.5				139.8
Grisons					43.6		94.6	27.9	166.1
Aargau		1.2	14.0	1.7	82.4				99.3
Thurgau					42.8				42.8
Ticino			7.3	18.0	83.7		27.8		136.8
Vaud	0.6		2.8	5.7	183.4		12.8		205.3
Valais					60.1		15.6	28.6	104.3
Neuchâtel					34.6		3.0	1.9	39.5
Geneva					27.2				27.2
Jura					34.1		8.2		42.3
Total	**1.8**	**1.2**	**96.7**	**46.9**	**1,293.5**	**1.9**	**269.8**	**111.5**	**1,823.3**

The Swiss motorway and national roads network comprises roads with two to seven lanes, though the majority are four-lane stretches (1,340.4 kilometres). The longest stretches are in the cantons of Bern (208.8 kilometres), Vaud (205.3 kilometres) and Grisons (166.1 kilometres). The 1960 federal resolution on the motorway network called for a total of 1,892.5 kilometres of motorway/ national roads, of which 1,823.3 kilometres had been completed as of the end of 2015. This means that a further 69.2 kilometres have yet to be opened in order to complete the planned network.

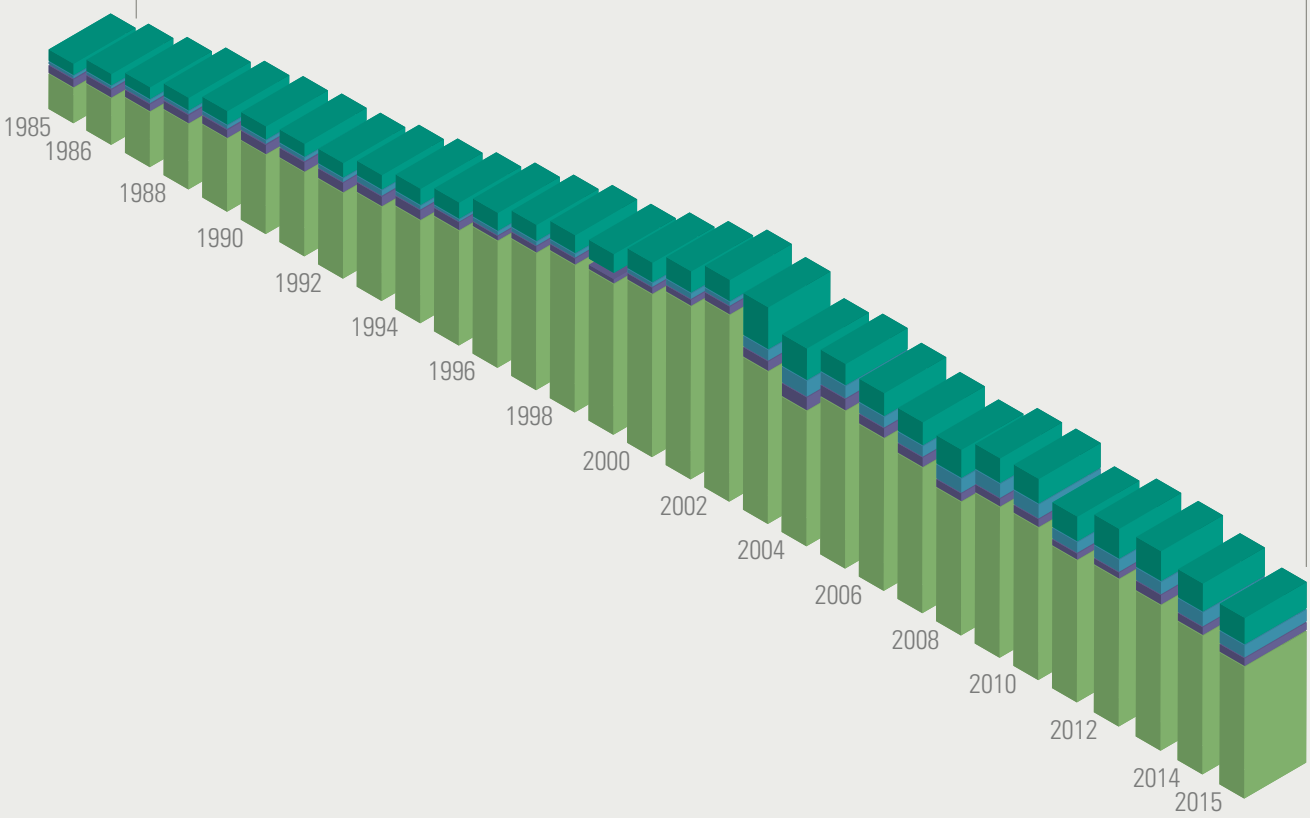
Three new tunnels to be opened in 2016 (bringing the total to 242)

Motorway/ national road	Canton	Stretch	No. of tubes	Length	Height	Approx. cost (Swiss francs)
A9	VS	Turtmann (covered stretch)	2	1.1 km	5.2 m	270 million
A16	JU	Delsberg-Ost to Choindez (Choindez tunnel)	1	3.6 km	5.2 m	240 million
A28	GR	Dalvazza to Trun (Küblis tunnel)	1	2.25 km	5.2 m	210 million

Volume of transalpine goods transported by road down again slightly

In 2015, a total of 1,110,397 heavy goods vehicles crossed the Alps on Switzerland's roads (a decrease by 13,106 vehicles, or 1.2 percent, versus 2014). Thus, the downward trend persisted (a decrease by 1.7 percent had already been recorded in the previous year). The figure of 1.11 million HGVs is slightly below the average for the past ten years (1.25 million). The biggest decreases were recorded at the Gotthard and Grand St. Bernard (9 percent at the latter).

1985		2011	2012	2013	2014	2015	Change 2014/2015
75,000	San Bernardino	193,639	182,318	177,133	172,263	183,822	6.7%
19,000	Simplon	79,640	85,000	80,740	80,160	85,519	6.7%
43,000	Grand St Bernard	57,883	55,194	48,880	47,383	43,010	-9.2%
353,000	Gotthard	927,332	886,088	836,655	823,697	798,046	-3.1%
490,000	Total	1,258,494	1,208,600	1,143,408	1,123,503	1,110,397	-1.2%



Source: Federal Roads Office FEDRO

Further increase in vehicle kilometres

In 2015, vehicles covered a total distance of 26,485 billion kilometres on the Swiss motorway/national roads network (an increase by 4.2 percent versus 2014).

For 2015, the number of vehicle kilometres was calculated with the aid of a detailed traffic model, which produces more accurate results than the previous method. In the past, the traffic volume over a length of several hundred metres in each of the approximately 440 access roads and junctions was slightly overestimated. The new model takes account of the fact that a low proportion of vehicles leave the motorway at exit roads and that the true figure for the traffic volume is only attained at the end of the following entrance road. While the deviation of the results versus the previous method is relatively minor, it is nonetheless apparent in the total figure. In order to permit a comparison of the figures for 2015 with those of the two previous years, the number of vehicle kilometres for 2013 and 2014 was calculated retroactively using the new model.

Kilometres travelled on the motorway/national roads network

Year	Billion km	Change in %
2013	25.170	–
2014	25.415	+1,0
2015	26.485	+4,2

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

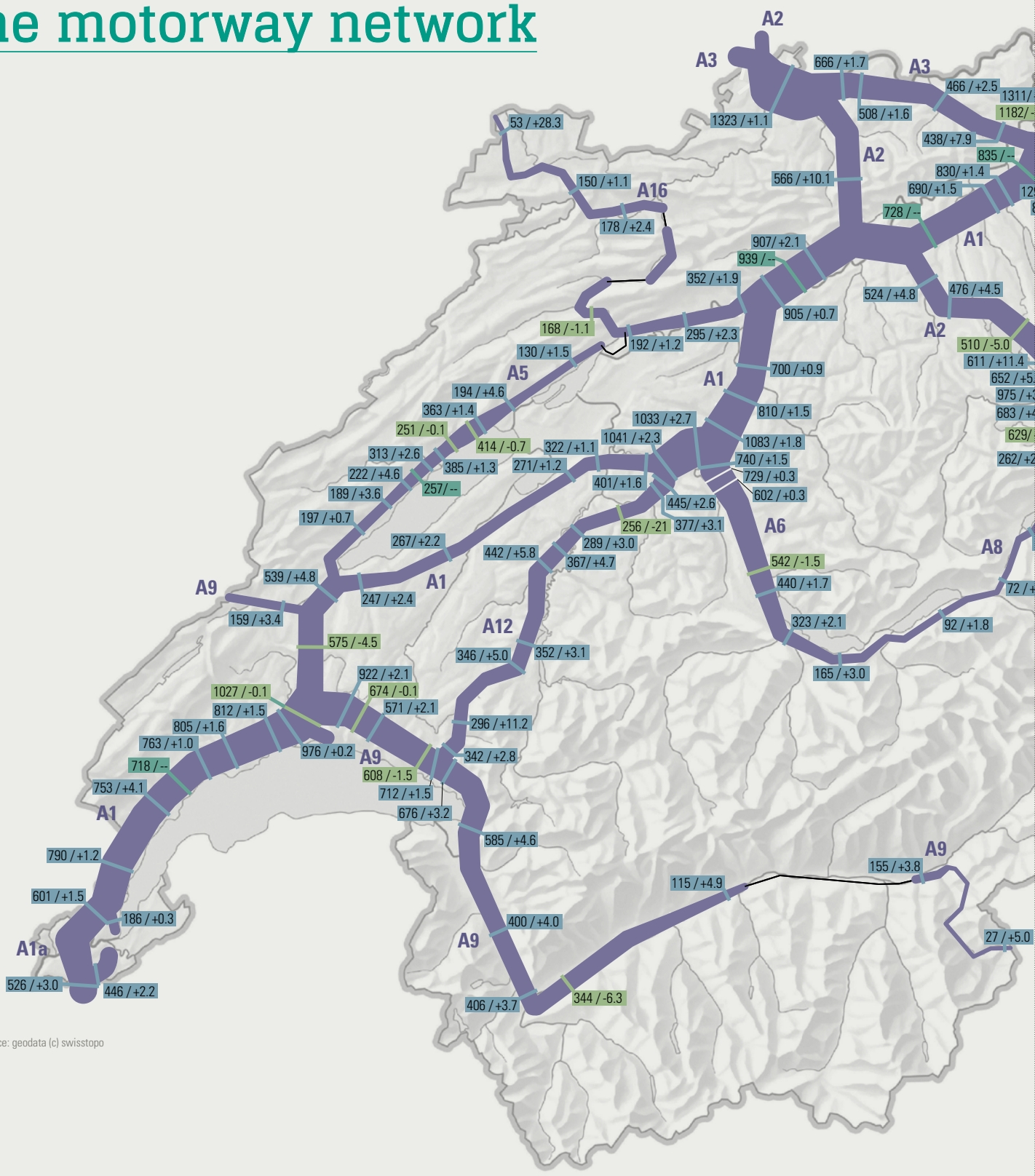
Causes	2013	2014	2015	Change in %
Congestion	17,144	18,395	19,968	+7 / +9
Accidents	2,345	2,322	2,263	-1 / -3
Roadworks	991	674	516	-32 / -23
Other	116	150	91	+29 / -39
Total	20,596	21,541	22,838	+5 / +6

Daily traffic volume

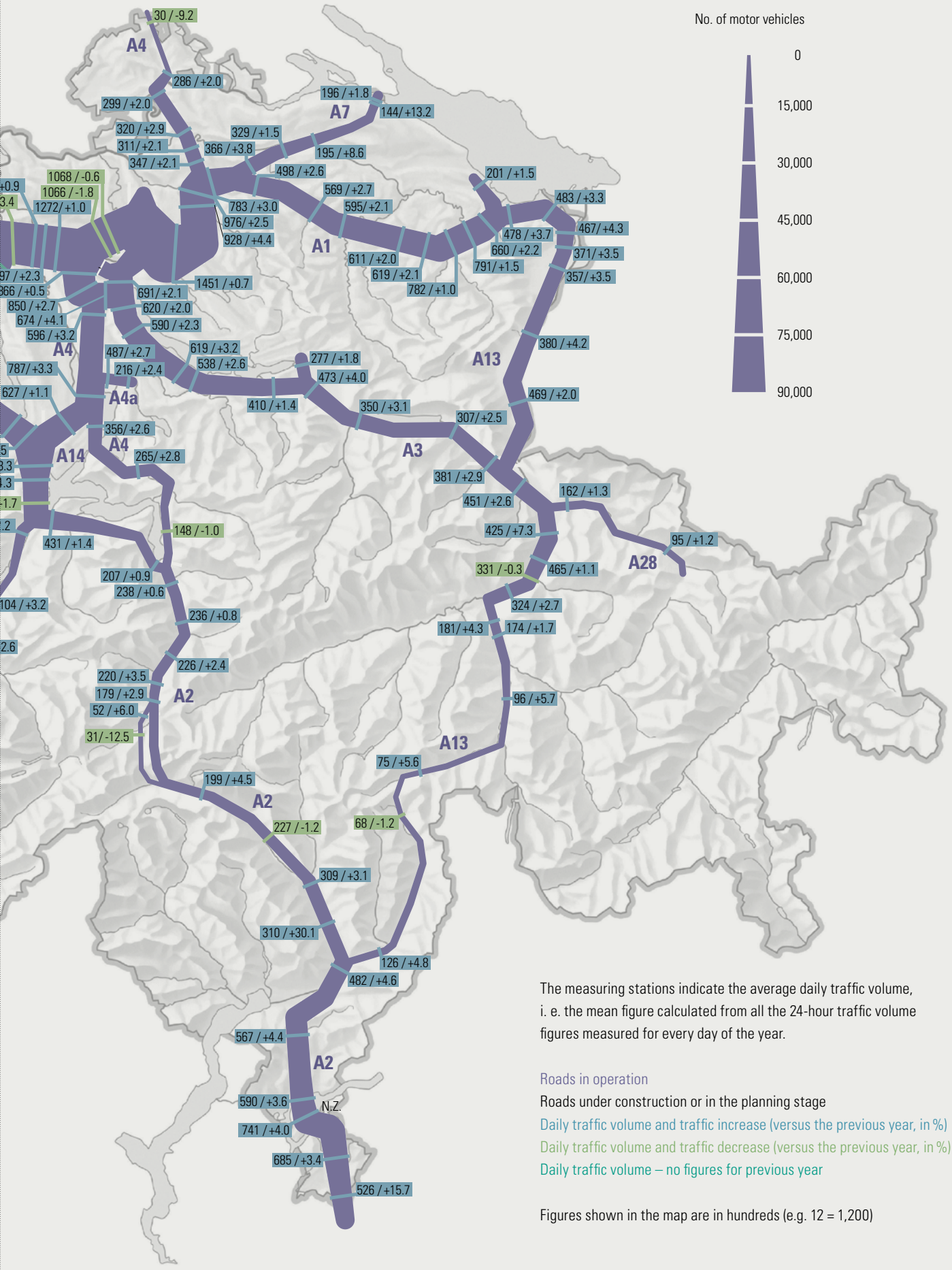
A1		2014	2015	Change in %
ZH	Wallisellen	144,134	145,119	+0,7
AG	Neuenhof	129,932	–	–
AG	Baden, Bareggtunnel	126,781	129,655	+2,3
ZH	Zurich northern bypass, Seebach	110,182	109,772	-0,4
ZH	Zurich northern bypass, Affoltern	107,408	–	–
AG	Würenlos	126,027	127,035	+0,8
ZH	Weiningen, Gubrist	108,610	–	–
A2		**2014**	**2015**	**Change in %**
BL	Muttenz, Hard	130,882	132,313	+1,1
Bs	Basel, Gellert Nord	–	–	–
A6		**2014**	**2015**	**Change in %**
BE	Schönbühl, Grauholz	106,337	108,301	+1,8

No figures or percentages due to roadwork sites or technical maintenance of equipment

Map of traffic volume on the motorway network



Source: geodata (c) swisstopo



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

Figures shown in the map are in hundreds (e.g. 12 = 1,200)

Fatalities up by four percent in 2015

In 2015, a total of 253 people died in road accidents in Switzerland (ten more than in 2014). The number of fatalities due to accidents involving cars fell again, but by contrast, the number of fatally injured pedestrians and users of bicycles and motorbikes was higher.

Although the number of people who died on Switzerland's roads rose by four percent in 2015 versus the previous year, the increase does not in fact contradict the general downward trend, as the number of fatalities in 2015 was down by 16 percent versus the average figure for the previous four years. A total of 3,830 people were also seriously injured in road accidents in 2015.

Negative balance with respect to cyclists and motorcyclists

The number of fatally injured cyclists and motorcyclists fell by 14 percent versus 2014, while by contrast the number of e-bike users who lost their lives rose to 14 (compared with 5 in 2014). More than two-thirds of the victims were 65 or older.

Last year, 66 motorcyclists died in road accidents – a 25 percent increase versus 2014. Here the unusually warm weather in the summer was probably a contributing factor. Almost two-thirds of fatal motorbike accidents occurred in the period from June to September – more than double the number recorded in summer 2014.

Efforts to increase the safety of two-wheeled vehicles are being constantly pursued. For example, an enforcement aid was introduced in order to eliminate the existing deficits in the infrastructure for motorcyclists. In addition, in 2015 a brochure was published that analyses accidents involving cyclists and motorcyclists, and a variety of road safety campaigns and courses were launched by entities dedicated to accident prevention (e.g. the Road Safety Fund).

Increase in the number of fatally injured pedestrians

In 2015, 58 pedestrians lost their lives in road accidents – around a third more than in 2014. Almost two-thirds of them were 65 or older, and around one-third were killed on pedestrian crossings. However, the general trend is downward.

Slight increase on the motorways

Last year, the number of fatalities on the motorways rose slightly (plus 4) versus 2014. This increase is attributable to the occurrence of three particularly serious accidents resulting in several fatalities. With the exception of 2012 (coach crash near Siders), the trend in the number of fatalities on the motorways and national roads is generally downward.

The annual road accident statistics are based on the register of road accidents kept by FEDRO, in which accidents on public roads and sites are recorded that involve at least one motorised or non-motorised vehicle, or a pedestrian or equipment similar to a vehicle.

In 2015, the definition of "serious injury" was changed and two new categories were specified ("life-threatening injury" and "severe injury"). This means it is now possible to classify seriously injured road users more clearly and unequivocally. The changed definition is the reason for the decrease in the number of seriously injured people and the increase in the number of people with minor injuries.

Fatalities

	2014	2015	%
By form of transport			
Cars	97	75	–23
Passenger transport vehicles	3	2	–33
Goods transport vehicles	5	4	–20
Motorcycles	53	66	+25
Motor scooters	1	3	+200
Electric bikes	5	14	+180
Bicycles	29	25	–14
Pedestrians	43	58	+35
on pedestrian crossings	*14*	*18*	*+29*
elsewhere	*29*	*40*	*+38*
Others	7	6	–14
Total	**243**	**253**	**+4**
By assumed main cause			
Influence of alcohol	24	30	+25
Speeding	37	29	–22
Inattention / distraction	18	19	+6
By type of road			
Motorways and expressways	26	30	+15

Serious injuries

	2014	2015	%
By form of transport			
Cars	959	882	–8
Passenger transport vehicles	32	27	–16
Goods transport vehicles	49	71	+45
Motorcycles	1 199	1 099	–8
Motor scooters	84	82	–2
Electric bikes	145	163	+12
Bicycles	890	838	–6
Pedestrians	627	600	–4
on pedestrian crossings	*256*	*255*	*0*
elsewhere	*371*	*345*	*–7*
Others	58	68	+17
Total	**4,043**	**3,830**	**–5**
By assumed main cause			
Influence of alcohol	367	320	–13
Speeding	542	460	–15
Inattention / distraction	469	450	–4
By type of road			
Motorways and expressways	242	258	+7

Accidents resulting in fatalities / injuries

	2014	2015	%
Fatalities	229	238	+4
Serious injuries	3,818	3,612	–5
life-threatening injuries		*174*	
severe injuries		*3,438*	
Minor injuries	13,756	13,886	+1
Total	**17,803**	**17,736**	**0**

101,000 more vehicles on Switzerland's roads

2015 inventory of motor vehicles in Switzerland

	Motor vehicles (total)	Cars	Passenger transport vehicles	Goods vehicles	Agricultural vehicles	Industrial vehicles	Motor-cycles	Mopeds incl. fast electric bikes
Total	**5,885,642**	**4,458,069**	**65,720**	**393,598**	**191,132**	**67,101**	**710,022**	**159,915**
Lake Geneva region	**1,086,563**	**834,331**	**11,179**	**68,090**	**23,151**	**10,380**	**139,432**	**13,722**
Vaud	512,471	403,749	5,386	30,694	13,743	4,051	54,848	7,323
Valais	274,284	209,439	3,207	19,127	7,851	4,618	30,042	2,498
Geneva	299,808	221,143	2,586	18,269	1,557	1,711	54,542	3,901
Central plateau	**1,326,932**	**986,977**	**17,394**	**89,566**	**60,550**	**16,354**	**156,091**	**50,993**
Bern	724,953	519,826	10,743	52,159	38,657	10,216	93,352	33,042
Fribourg	227,585	176,522	2,509	13,960	9,844	2,231	22,519	6,791
Solothurn	198,328	152,385	2,069	13,233	5,469	2,035	23,137	7,915
Neuchâtel	120,941	96,255	1,539	6,810	2,963	1,183	12,191	2,033
Jura	55,125	41,989	534	3,404	3,617	689	4,892	1,212
Northwest Switzerland	**762,913**	**588,822**	**7,967**	**53,681**	**17,860**	**6,433**	**88,150**	**26,935**
Basel-Stadt	85,191	65,741	797	8,163	172	662	9,656	2,724
Basel-Landschaft	187,537	145,003	1,882	13,053	3,849	1,567	22,183	7,342
Aargau	490,185	378,078	5,288	32,465	13,839	4,204	56,311	16,869
Zurich	**925,409**	**723,697**	**9,357**	**58,939**	**15,988**	**10,245**	**107,183**	**20,047**
Eastern Switzerland	**882,831**	**652,436**	**10,393**	**61,854**	**43,184**	**14,042**	**100,922**	**24,349**
Glarus	30,719	23,013	319	2,202	1,366	601	3,218	810
Schaffhausen	60,317	44,296	845	4,043	2,879	765	7,489	1,813
Appenzell A. Rh.	41,947	30,874	509	2,343	2,365	566	5,290	1,338
Appenzell I. Rh.	13,379	9,246	102	838	1,258	254	1,681	486
St Gallen	362,744	272,067	3,996	24,915	15,179	5,054	41,533	10,545
Grisons	152,688	109,262	2,100	12,326	9,346	3,943	15,711	2,805
Thurgau	221,037	163,678	2,522	15,187	10,791	2,859	26,000	6,552
Central Switzerland	**599,367**	**449,563**	**7,018**	**39,581**	**26,360**	**6,576**	**70,269**	**20,077**
Lucerne	284,459	209,062	3,377	19,345	14,387	2,815	35,473	10,854
Uri	26,497	19,346	370	1,575	1,311	484	3,411	838
Schwyz	126,689	96,378	1,391	7,814	5,340	1,639	14,127	3,736
Obwalden	30,612	21,771	429	2,096	2,013	480	3,823	1,499
Nidwalden	34,476	26,049	426	1,867	1,330	338	4,466	1,254
Zug	96,634	76,957	1,025	6,884	1,979	820	8,969	1,896
Ticino	**301,627**	**222,243**	**2,412**	**21,887**	**4,039**	**3,071**	**47,975**	**3,792**
Federal administration	0	0	0	0	0	0	0	0

Source: Swiss Federal Statistical Office

In 2015, the total number of motorised road vehicles registered in Switzerland was 5,885,642 (an increase by 101,558 or 1.8 percent versus 2014). Viewed over the past 25 years (i.e. since 1990), the vehicle fleet has increased by more than half (55.8 percent). Cars account for three-quarters of all motor vehicles.

327,143 new cars put into circulation

New registration of motor cars

	2005	2011	2012	2013	2014	2015
Type						
Limousine	192,290	206,969	196,221	174,544	163,298	166,465
Station wagon	57,750	111,628	128,957	127,985	134,195	154,122
Convertible	10,642	9,358	8,867	7,625	6,590	6,556
Engine capacity (cc)						
Below 1,000	5,047	9,653	13,548	18,907	18,942	27,397
1,000–1,399	44,933	97,643	89,272	80,098	77,576	75,995
1,400–1,799	60,494	85,228	78,913	75,025	68,020	69,118
1,800–1,999	81,026	81,249	94,510	84,036	86,115	95,673
2,000–2,499	30,053	21,875	23,217	21,540	20,847	23,076
2,500–2,999	21,282	21,121	21,434	19,429	20,816	22,472
3,000 and over	17,834	10,734	12,227	9,727	9,819	9,530
Electric motor	13	452	924	1,392	1,948	3,882
Gear mechanism						
Automatic	74,872	66,935	74,151	69,916	73,709	84,352
Manual	185,081	243,846	238,988	221,389	211,701	224,729
Hydrostatic	46	18	17	13	7	7
Others	683	17,156	20,889	18,836	18,666	18,055
Fuel						
Petrol	185,120	211,540	200,576	185,070	180,875	185,469
Petrol and battery		5,444	5,721	6,193	6,165	7,676
Diesel	74,114	109,324	124,911	115,656	113,304	127,899
Others	1,448	1,646	2,837	3,235	3,739	6,099
Drive						
4×4	56,934	94,709	112,469	111,502	117,039	131,917
Rear-wheel drive	21,719	19,553	19,416	14,924	15,511	17,466
Front-wheel drive	181,967	213,637	202,075	183,698	171,513	177,723
Others	62	56	85	30	20	37
Total	**260,682**	**327,955**	**334,045**	**310,154**	**304,083**	**327,143**

Source: Swiss Federal Statistical Office

Higher proportion of cars with low pollutant emissions

Depending on their pollutant emissions, cars are classified into emission categories or Euro categories 1 to 6, with category 6 specifying the most stringent limit levels. Between 2005 and 2015, the proportion of vehicles with relatively high emission levels (categories 1 to 3) to the overall motor car fleet fell from 80.3 to 24.4 percent, while the number of cars with low emission levels has correspondingly increased. The proportion of vehicles that already meet the latest and most stringent emission limit levels (category 6) was 5.7 percent in 2015.

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

	2005	2015
Cars	260,682	327,143
Passenger transport vehicles	2,785	4,995
Goods vehicles	23,535	35,290
Agricultural vehicles	3,371	3,740
Industrial vehicles	3,012	4,213
Motorcycles	45,230	51,787
Trailers	18,073	22,309
Total vehicles	**356,688**	**449,477**
Total motor vehicles	**338,615**	**427,168**

Source: Swiss Federal Statistical Office

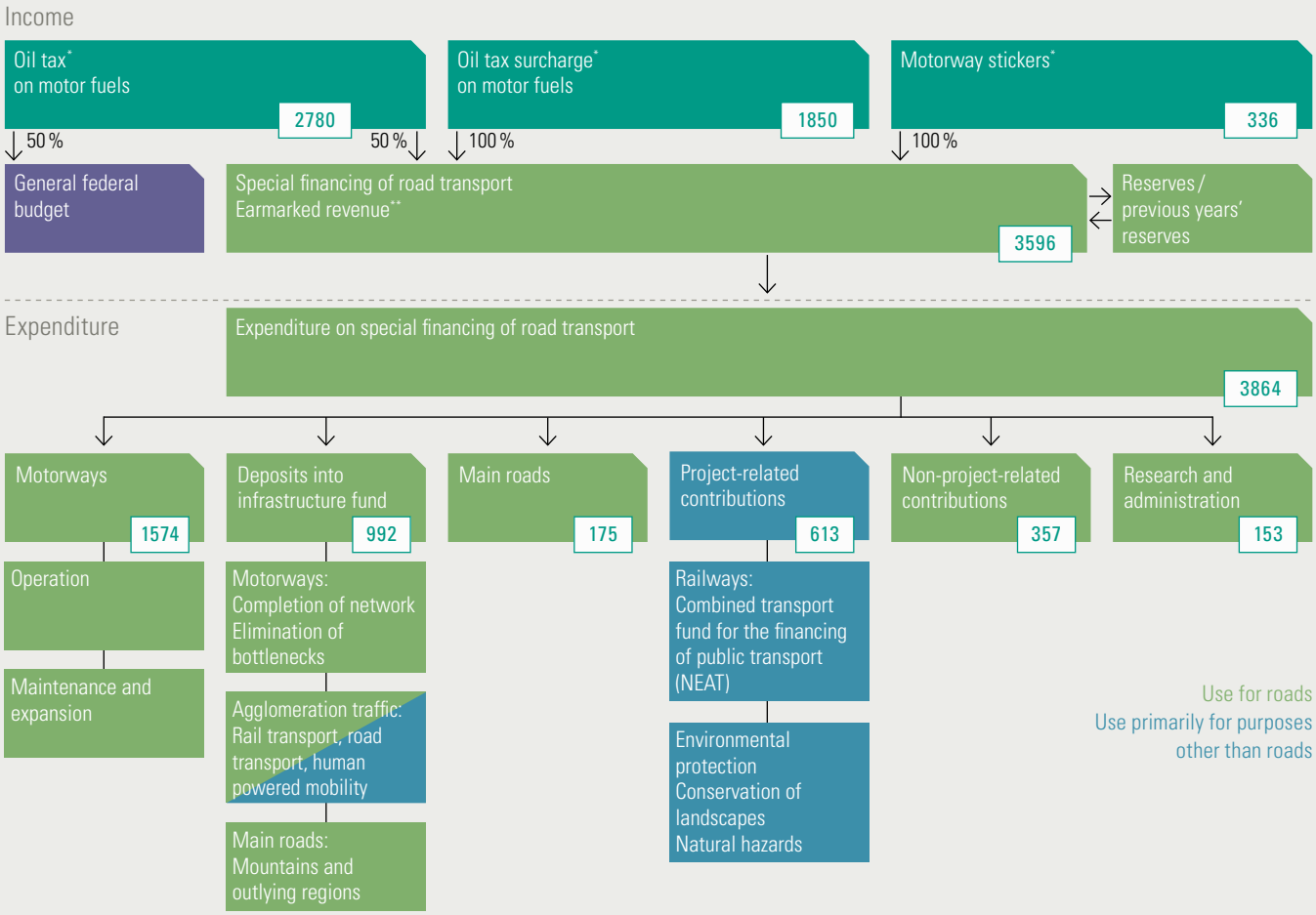
A total of 427,168 motorised road vehicles were put into circulation in 2015. This represents an increase by 7.7 percent versus the previous year and is close to the all-time record (430,973 vehicles in 2012). The number of new registrations of motorbikes was 51,787 (a new record). In the most important category (cars), a total of 327,143 vehicles were registered, or 7.6 percent more than in 2014. The total number of registered cars rose by 1.7 percent in 2015 to 458,069. This means there are now 541 cars per 1,000 inhabitants in Switzerland. The trend in the proportion of electric vehicles has been impressive over the past few years: following increases by 52.6 percent in 2013 and 65.4 percent in 2014, the number grew by 69.7 percent in the year under review. However, the 7,531 electric vehicles that were registered in 2015 only represent a proportion of 0.2 percent of the overall vehicle fleet.

Special financing of road transport

At the federal level, the tasks and expenditure relating to road transport are financed via the Special Fund for the Financing of Road Transport. In this fund, the earmarked revenue is used for financing the associated expenditure. The fund's sources are revenue from the oil tax (50 percent) and the oil tax surcharge (100 percent) on fuels (aviation fuels are excluded in both cases), and the net income from the sale of motorway stickers (vignettes). The tax rates and levies specified by law are as follows: oil tax for petrol, 43.12 cents, and for diesel, 45.87 cents per litre (unchanged since 1993), oil tax surcharge, 30 cents per litre (unchanged since 1974). The motorway sticker costs 40 Swiss francs per annum (unchanged since 1995). A variety of road traffic related tasks are financed via the fund: in addition to the financing of federal road infrastructure, i.e. the motorways and national roads, contributions towards cantonal road infrastructure and other federal activities relating to road transport (cf. diagram: project-related contributions) are provided by the fund.

Parliament is responsible for deciding on the annual expenditure for the various areas of activity within the framework of the resolution on the federal budget. The annual difference between income and expenditure increases or reduces the reserves carried forward from the previous years. As of 2018/19 an annual financing gap of around 1.3 billion Swiss francs has to be anticipated. In addition to

Flows of funds in 2015 (in million Swiss francs)



* Net income
** Including miscellaneous income (20 million Swiss francs)

Figures based on the national financial accounts.
Minor differences may arise in some totals due to the rounding up or down of individual figures.

the above fund, the Infrastructure Fund has been in operation since 2008. Its revenue comes from the Special Fund for the Financing of Road Transport (in the form of fund deposits) and is used for the financing of the motorways and national roads (completion, elimination of bottlenecks), transport infrastructure in cities and agglomerations (private motorised transport, public transport, human-powered mobility) and main roads in mountainous and outlying regions. With the establishment of the Infrastructure Fund, the financing of motorways and national roads was divided among two funds. The duration of the Infrastructure Fund is limited to 20 years. Parliament approved a total credit of 20.8 billion Swiss francs (as of 2005, excluding inflation and value-added tax) for the financing of the various tasks and activities. Throughout the fund's duration, Parliament has to approve the annual financial statement together with the budget and the withdrawals from the fund for the various tasks. When approving the federal budget, it also specifies the amount of the annual deposits to be made into the fund. The Infrastructure Fund has a liquidity reserve, the level of which increases or decreases according to the annual difference between the deposits and withdrawals.

Fund for the financing of motorway and agglomeration traffic

On 18 February 2015, the Federal Council submitted its dispatch to Parliament concerning the creation of a fund for the financing of motorway and agglomeration traffic, the closure of the financing gap and the programme for the strategic development of the motorways and national roads. It is proposing to adapt the existing structure to the Special Fund and the Infrastructure Fund (cf. www.astra.admin.ch > Themen > Strassenfinanzierung > NAF).

Special Fund for the Financing of Road Transport: expenditure, 2013–2015* (in million Swiss francs)

		2013	2014	2015
Motorways / national roads	Operation	353	346	347
	Maintenance / expansion	1,108	1,304	1,227
Infrastructure Fund	Annual deposit	1,026	1,029	992
Main roads	Contributions to cantons	172	174	175
Project-related contributions	Remuneration, combined transport; contributions for private railway sidings, terminals, etc.	199	205	188
	Fund for major railway projects (NEAT quarter)	277	266	287
	Environmental protection	108	98	91
	Protection of cultural heritage and landscapes	15	15	15
	Disaster prevention: protection against flooding	41	32	32
Non-project-related contributions to roads	General contributions to cantons	367	365	350
	Contributions to cantons without motorways	7	7	7
Research / administration		148	154	153
Total expenditure*		3,821	3,996	3,864

Infrastructure Fund: revenue, 2013–2015** (in million Swiss francs)

	2013	2014	2015
Completion of the motorway network	627	547	493
Elimination of bottlenecks on the motorways	95	67	54
Contributions to transport infrastructure in towns and urban centres	399	291	212
Contributions for main roads in the mountains and outlying regions	45	46	46
Total withdrawals / expenditure	1,166	951	806

* Figures based on the national financial accounts.
** Based on the liquidity statement.

Minor differences may arise in some totals due to the rounding up or down of individual figures.

Number of confiscated licences up again

In 2015, a total of 80,176 drivers had to surrender their licence (an increase by 3.1 percent versus 2014). As in the past, speeding and driving under the influence of alcohol were the main offences, as can be seen from FEDRO's register of administrative measures (ADMAS).

The number of confiscated licences in 2015 was 80,176 – an increase by 2,417 (or 3.1 percent) versus the previous year. Around 60 percent of the licence withdrawals were for one to three months, while 26.9 percent (+12.7 percent) had to be confiscated for an indefinite period. Generally speaking, the main offences were speeding and driving under the influence of alcohol. The number of withdrawals due to speeding rose by 2.2 percent to 30,622. By way of comparison, the record figure recorded in 2010 was 35,427. With regard to cases of driving under the influence of alcohol, the number of sanctions administered was more or less the same as in 2014. While the number of confiscated licences (blood alcohol level 0.08 percent or higher) declined slightly by 0.6 percent to 15,686, the number of warnings issued (blood alcohol level between 0.05 and 0.079 percent) rose by 1.3 percent to 6,369. The number of licences confiscated due to driving under the influence of drugs rose by 13.3 percent versus 2014 to 4,554. Withdrawals due to inattentiveness and distraction (e.g. illegal use of mobile phones and navigation devices) rose by 1.4 percent to 10,735 versus the previous year. The number of warnings in this category increased sharply in the year under review by 20.7 percent to 6,594.

Administrative measures

	2014	2015	%*
Measures imposed against drivers			
Warnings to holders of a learner's licence	305	332	8.9
Warnings to holders of a driver's licence	50,586	52,991	4.8
Withdrawal of learner's licence	3,261	3,577	9.7
Withdrawal of driver's licence	77,759	80,176	3.1
Of which withdrawal of provisional licence	6,923	6,684	–3.5
Cancellation of provisional driver's licence	1,652	1,505	–8.9
Refusal of learner's or driver's licence	3,649	3,420	–6.3
Refusal to accept a foreign driver's licence	19,872	20,437	2.8
Instruction in road use	2,158	2,058	–4.6
New driving test	2,763	2,827	2.3
Examination by specialised psychologists	4,515	4,376	–3.1
Special requirements	5,998	5,331	22.2

* Change in percent

Administrative measures

	2015	%*
Reasons for withdrawal		
Speeding offences	30,622	2.2
Drink driving (> = 0.08%)	15,686	–0.6
Inattention	9,157	–2.0
Failure to give way	4,505	5.9
Failure to observe traffic signals	1,483	–5.1
Unlawful overtaking	2,170	9.7
Other driving errors	5,302	–1.1
Alcohol addiction	2,075	6.0
Influence of medicaments or drugs	4,554	13.3
Drug addiction	3,496	10.2
Sickness or infirmity	5,149	7.4
Other reasons	22,002	3.8
Duration of withdrawal		
1 month	33,977	7.1
2 month	2,056	–5.6
3 month	16,363	–1.4
4 to 6 months	7,850	–9.2
7 to 12 months	2,571	–7.9
More than 12 months	1,060	–14.9
Indefinite period	23,530	12.7
Permanent withdrawal	47	–20.3

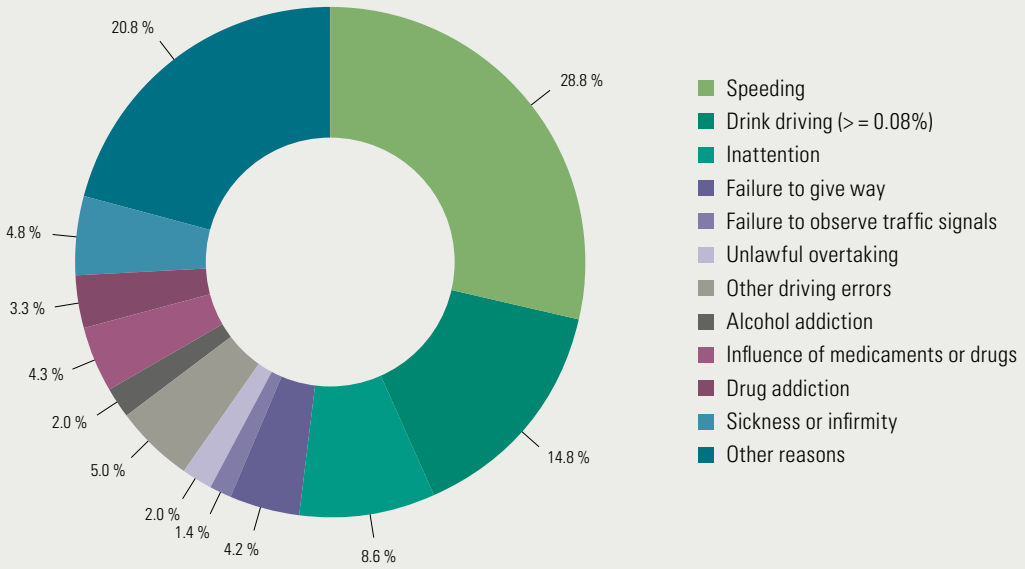
* Change in percent

	2015	%*
Age of persons affected		
Under 20	4,439	–2.1
20 to 24	12,304	0.8
25 to 29	11,252	1.6
30 to 34	9,943	6.1
35 to 39	8,303	2.3
40 to 49	16,310	1.9
50 to 59	12,924	12.1
60 to 69	5,894	5.4
70 and over	6,085	6.7
Reasons for withdrawal or refusal of learner's/driver's licence		
Learner driving unaccompanied	389	–4.2
Driving error	2,270	4.8
Drink driving	742	–7.9
Driving without a licence	2,807	–2.9
Failure to pass driving test	181	–3.2
Driving despite withdrawal of licence	190	2.7
Theft	444	–5.5
Sickness or infirmity	118	–2.5
Other reasons	2,441	3.8
Reasons for warnings		
Speeding	44,406	3.9
Drink driving (> = 0.050 to 0.079%)	6,369	1.3
Inattention	3,914	1.9
Failure to give way	2,316	10.7
Driving an unroadworthy vehicle	2,208	14.5
Failure to observe traffic signals	824	3.5
Unlawful overtaking	280	15.7
Other reasons	8,494	17.9

* Change in percent versus 2014

Reasons for withdrawal

in percent



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Valid from 1 June 2016

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