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# Verkehr der Zukunft 2060: Synthesebericht

## Transports du futur 2060: Synthèse

## Transport of the future 2060: Synthesis Report

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# Summary


## Research package with a long-term horizon

The research package 'Transport of the future' considers a time horizon beyond that of typical forecasts. Its purpose is to identify and analyse possible disruptive effects. Four projects (technology, demography, spatial development, and climate) deal with future driving forces. Two projects (supply forms, urban transport) deal with concrete organizational aspects. One project focuses on demands on regulations and policy makers. To tie these together, future scenarios have been formulated. The impact structure 'driving forces - supply - potential - demands on the regulatory body' and the scenarios form the common thread for the entire research package. The variety of methods is deliberately broad and includes the analysis of new trends (so-called 'weak signals'), sketches of 'revolutionary images of the future', expert approaches, development of new quantitative models, case study analyses, and the involvement of pupils and students.

## Effects and potential of the driving forces

The most important driver of future transport demand growth continues to be **demographic development**. In addition to the general trend of population growth to over ten million residents in Switzerland by 2060, there is also a rapidly growing share of older people. Furthermore, increasing **urbanisation** and new ways of living and working can increase space efficiency and slow the demand for settlement space. Both driving forces place increased demands on the accessibility, functionality and efficiency of the future transport system. **Automation and networking** in particular (thanks to digitisation and artificial intelligence) can – if used correctly – make a significant contribution to meeting these demands. For example, new business models and a new understanding of mobility services can greatly help households without a car to meet their mobility demands. **Climate change**, on the other hand, places greater demand on the resilience and reliability of the transport system. For example, handling increasing peak traffic volumes due to heat waves and extreme weather conditions. The requirements for fossil-free mobility also increase the demands for increased traffic efficiency.

The development of **society and the economy** (e.g. individualisation, new values, or globalisation) characterises the analysed driving forces; a technological revolution can only take place in a global context. Climate change can trigger global migration flows. At the same time, however, new values towards people, technology and the environment can shape future attitudes. It is therefore important to “think in scenarios”.

## Disruption potential due to technology networked mobility business models

The future of mobility is automated, networked and fossil-free. The understanding of mobility can therefore change significantly in the future:

- **New hybrids** will develop between todays’ individual transport and public transport. They will gain in importance, especially due to automation. So-called 'on-demand' public transport is creating new business models that combine taxi services and sharing approaches with automated vehicles used individually or collectively.
- The **relationship towards the possession of mobility tools** and the value chain of transport is changing: 'I am part of a multimodal overall system, not bound to the possession of mobility tools and I am a producer and consumer of transport services at the same time'. Mobility services are thus becoming an explicit service unit (**mobility as a service**).
- **The automobile is becoming 'autonomous'**: As a previous symbol of (separate) individual transport, the car is developing into an intelligent, fossil-free means of transportation that can be embedded in the network and the multimodal transport chain.
- **New value chains and interfaces** will link the transport market with other markets (residential, work, shopping, infrastructure, logistics, electricity, tourism, and leisure)

even more strongly than today. The mobility market in the traditional sense is thus increasingly controlled by other markets and losing its independence.

- **Modes of transport** (road, rail, air transport) and **types of transport** (passenger and freight transport) are becoming intermingled, placing new demands on intermodality and the permeability of systems.
- **Data** is becoming an increasingly important trading unit in the transport market. The data market itself (with platform providers for mobility services) has the potential to completely change the market structure. This trend, which is already visible today, will increase massively in the future due to automation and networking.
- In addition to the real world of mobility and transport, the **virtual world** ('virtual and augmented reality') can become increasingly important and influence transport demand, both in the world of work (virtual forms of communication, 'digital office') and in the world of leisure ('virtual games').

Two influencing factors are particularly relevant in making visions of the future more precise: The first is the extent of the diffusion of new technologies. The second is the extent of individual or collective behaviour. Three key scenarios can be derived from these two influencing factors:

*1. Evolution without disruption*

*2. Revolution of individual mobility services*

*3. Revolution of collective mobility services*

## Opportunities and risks

Increasing automation and professionalisation and maximum access to mobility services are not inevitably positive developments.

Transport will become **cheaper and more comfortable** thanks to relaxed driving conditions (especially regarding the traffic volume and parking), possible alternative activities in the vehicle, easier access due to needs-based on-demand services and networked door-to-door services. Because automated driving eliminates various cost elements (especially chauffeur costs), there is considerable potential for cost reduction.

Conversely, automation also requires considerable investments in vehicles and infrastructure. Infrastructure costs are also increasing as a result of climate change. Transport will therefore only become cheaper in the future if strong competition minimises the margins of new business models and if the improvements in productivity are passed on to customers.

These developments are also associated with increased traffic growth as well as increasing demand for environmentally, spatially and socially compatible design and fair competition among mobility service providers.

Great opportunities are also associated with the potential for **increased safety** due to future mobility. However, the reliability of automated control systems, ethical dilemmas, and vulnerabilities due to cybercrime can put these opportunities in question.

*In contrast to land-based passenger transport, freight and air transport have only been analysed selectively in the research project:*

*The **freight transport and logistics market** are already undergoing changes because new logistics requirements (e.g. online trading) and global competition are challenging the industry. Robotics, automation and the networking of transport services create new potential for cost savings. Prospectively, the cost reduction potential is greater in road freight transport than in rail freight transport. With increasing automation and new forms of propulsion (in the longer term, especially hydrogen), there is potential for long-distance trucking. Increased networking, automated transhipment and capacity increases will also lead to efficiency gains in rail freight transport.*

*The technical potential of new **air transport methods** (cargo drones, passenger taxis) is relevant to the market if the advantages in terms of reliability and price outweigh those of land-based transport. In view of the low capacities and probable considerable costs, these forms of transport are likely to remain limited to niche markets in the future, e.g. in city business traffic or in rural areas.*

## Mobility will continue to increase – with high potential for efficiency

The model analysis of the scenarios indicates that transport performance in all scenarios increases compared to today. This is particularly due to population growth and improved access to mobility services. Only strong collective usage (according to scenario 3), combined with strong urbanisation (growth in cities and agglomerations), can make it possible to reduce the number of kilometres travelled compared with today and at the same time maintain the share of rail transport.

*Development of passenger transport in the three future scenarios*

| | **S1 Evolution without disruption** | **S2 Revolution of individual mobility services** | **S3 Revolution of collective mobility services** |
|---|---|---|---|
| Passenger kilometres (change compared to 2015) | + 30% | + 35% | + 40% |
| % Collective transport (2015: 27%) | 29% | 25% | 49% |
| % Rail (2015: 22%) | 16% | 15% | 21% |
| Vehicle-kilometres car/taxi (change compared to 2010) | + 37% | + 95% | - 9% |
| Cost recovery ratio (2015: 86%) | 67% | 50% | 50% |

*Basis: Model calculations EBP and Ecoplan*

## Key actors of change: global and local players

On the **supply side,** the focus is on the diffusion of automation and networking with new mobility solutions. It is to be expected that technological development will be a global trend, with the major economic powers as drivers. This applies particularly to the vehicle and drivetrain market. In contrast, the rail and public transport market is more nationally oriented.

On the **demand side,** the population in cities and agglomerations will play a central role. Important factors are the availability and prices of private transport modes (e.g. car, bicycle) compared to integrated mobility services at the interface between today's public transport and 'on demand' services (individual and collective). These can be provided by both local and global actors. Another factor is the rapidly growing elderly population, which is increasingly taking advantage of both the comfort benefits and the improved accessibility of 'on demand' and automated mobility services.

## Critical points: Key issues for politics and society

Particularly regarding new forms of automated mobility, various questions beyond regulatory approval and transport growth need to be clarified:

- **Road vs. rail**: Thanks to automation, road has the greater theoretical potential for efficiency gains, cost reductions and new forms of service than rail. It is therefore a question of promoting collective transport and also using this as an opportunity to further develop the strengths of public transport:
  ► What role should future rail transport play as the backbone of the collective transport system and how can it be ensured that new mobility services offer collective transport in order to avoid an increase in performance?
- **Individual vs. service oriented**: The decisive factor for new mobility services is that the possession of individual mobility tools decreases without unnecessarily inducing traffic.

► How can car-free households and the sharing concepts as approaches to a collective transport system be supported towards a breakthrough?

How can vehicle capacity factors in road transport be increased while at the same time satisfying potential demand? To what extent are ride pooling and the use of 'robovans' really accepted?

- **Self-determination vs. heteronomy**: Automation and robotization using algorithms and artificial intelligence have an ethical dimension. This field of tension covers all areas of life and the economy. Therefore, an ethical discourse is needed that goes beyond the transport sector.
  ► How can artificial intelligence be gradually and meaningfully introduced? How can a consensus be reached on the associated ethical issues (e.g. controlling vehicles in critical situations)?
- **Safety vs. capacity**: Automation first increases traffic safety. If speeds (at medium level) can be harmonised and distances between vehicles or trains reduced, capacity will also increase. However, reducing distances could be contrary to safety considerations.
  ► How can the principle of 'safety first' be put into practice while at the same time increasing the reliability of the transport system?
- **Economies of scale vs. market dominance**: Innovations need room for economies of scale in order to create market potential. However, there is a risk that specific (global) players will gain a high degree of market power and dominance. In this regard different competition models (American-Anglo-Saxon and European) oppose each other.
  ► How can fair competition conditions and creative spaces be created to gradually open attractive new markets?
  How can it be ensured that necessary information and data are made publicly available by implementing an 'open source approach' without jeopardising private incentives?
- **High-tech vs. low-tech:** Although cycling and walking could be integrated into the future mobility chain, they do not benefit directly from automation. It is however undisputed that they should continue to play an increasingly important role with respect to the last mile and for coping with short distances as urbanisation progresses.
  ► How can it be ensured that new mobility services in local transport do not compete with cycling and walking, but specifically complement them?
- **Emotions vs. rationality**: Mobility – this applies to all means of transport – is associated with emotions. In the transport system of the future this accounts for robotic vehicles, individualised mobility services, aircraft or virtual systems. At the same time, there are increasing demands for a rational and highly efficient collective transport.
  ► How can the desire for ownership in the mobility sector be influenced? How can the desire for new things and innovations be generated without losing sight of the goal of increasing efficiency?

***It can also happen differently: Corona as an example***
*The corona crisis in 2020 demonstrates that exogenous, unpredictable events can also influence mobility behaviour. For example, it could accelerate digitisation regarding home office and thus contribute to breaking traffic peaks. However, the corona crisis could also call into question the positive value attitude towards collective transport services in the long term and thus reduce transport efficiency.*

## Postulates for dealing with distributional issues

The future developments outlined above also have an impact on important distributional issues:

- **Urban – rural**: All areas benefit in different ways from new automated mobility services. While the city will be the nucleus for the development of new forms of collective mobility, in rural areas improved accessibility is likely to play a major role. The model calculations in this research package have shown that the driving forces analysed here have little influence on spatial development (e.g. spatial distribution of living and working). On the other hand, it is likely that the volume of traffic that crosses spatial boundaries can increase, especially thanks to improved accessibility and reliability.
  ► A balanced relationship between living and working and places of short distances must continue to be an important objective of spatial and transport planning. A decisive change will take place in **agglomerations.** Only if agglomerations apply an urban approach to spatial and transport planning will it be possible to achieve inner development that provides high quality of public space, orientation towards households with rare usage of cars, and a focus on collective means of transport, cycling and walking.
  Also, in **rural areas**, must automated services be designed to be efficient and collective.
- **Old – young**: The share of the older population is increasing. Older people can benefit from new automated services disproportionately. Young people, in contrast, can play a pioneering role in the development of new digital and networked services in urban areas.
  ► The aim must be to ensure that collective means of transport are used by all age categories with a high capacity factor.
- **Rich – poor**: Individual automated mobility services are a luxury goods. Standardised and collective mobility services, on the other hand, are for the masses. The increasingly tailor-made services can therefore also lead to greater segregation. This places new demands on a fair and generally accessible transport system.
  ► Mobility services and new forms of services should be highly diverse, freely selectable and accessible to all, but without exploding the volume of traffic.
- **Big and small business Switzerland-Europe-World**: In terms of the transport of the future both local and global players are innovators.
  ► The aim is to ensure that the value-added potential of new mobility services generates a high regional benefit.

## Organic, proactive and steering approach

Managing laissez faire or proactively: The regulator is faced with the challenge of influencing future development in a balanced way so that it is possible to make use of opportunities and to avoid risks. It is therefore necessary to develop an organic approach that builds on the previous strengths of Swiss transport policy by using the following concepts: anticipation, monitoring, limited approval, testing and coordination on an international level. This path has already been initiated in recent years.

This gives rise to the following points of reference for transport policy:

- **Enabling competition and making profits:** Without competition, there is a risk that new and innovative technologies and products will get stuck in pioneer and start-up status. Controlled competition must be developed with a clear framework, considering social and economic policy objectives.
- **Laboratories and experimental space**: New transport solutions and forms of behaviour not only require the engagement of actors from politics and business, but also from society in particular. New forms of mobility go hand in hand with new ways of life (living, working, leisure). In particular, the organisation of sharing approaches requires enabling and experimentation in real life, for example in cooperation with neighbourhoods or selected test persons.
- **Considering decision and investment cycles**: New infrastructure has a long lead time and a lifetime of at least 50 years, whereas new means of transport can be introduced or removed from the market quickly. This is shown, for example, by current offers in the

field of urban micro-mobility. When making any decision, it is therefore important to consider how long this will inhibit or encourage future developments.

- **Managing capacity utilisation**: Collective use of transport is central. Accordingly, it is necessary to develop instruments that influence the capacity utilisation. Switzerland has had positive experience in this respect in the freight transport sector: With the distance-related Heavy Vehicle Fee (LSVA) and the simultaneous introduction of the 40-tonne limit, a set of instruments has been created which increases capacity utilisation and absorbs part of the productivity effects.
- **Internalisation of external costs**: This economic postulate of transport policy continues to be of great importance in connection with the authorisation and pricing of automated services, new forms of propulsion to decarbonise transport, and new mobility services. It helps to ensure that the polluter pays principle is followed and helps to avoid negative effects.
- **Scarcity as an opportunity**: 'Necessity is the mother of invention'. The theory of innovation claims that great inventions are above all the result of necessity. Scarcity arises especially in urban areas or on motorways. The question therefore arises how bottlenecks can be used to test or introduce new innovative approaches (e.g. parking policy and automated parking, multifunctional spaces instead of traffic areas, automated harmonised driving to eliminate congestion).
- **International coordination and ethical dialogue**: In particular, the discussion on the handling of data as well as the approval of artificial intelligence concerns extends beyond the transport sector and requires a continuous discussion between society, economy and politics.

## State as regulator and enabler – new challenges as coordinator, infrastructure manager, and owner

This places significant new demands on the regulator. Central to this is the approval of fully automated vehicles and the question of when the first road sections may be used exclusively by vehicles of level automation IV/V. This results in new requirements for infrastructure development and traffic control to increase capacity and safety. Also, ensuring fair competition for new mobility services, the handling of data, the future handling of constructing and financing public transport and the inclusion of new mixed forms is of importance. The expected decline in the cost recovery ratio (in road transport mainly caused by the loss of mineral oil tax revenues) requires new transport financing.

## Need for regulatory action – Agenda

In light of these developments, a rough 'transport policy agenda' for dealing with the transport of the future can be derived. On the one hand, it is a question of continuing the direction of current transport policies. On the other hand, individual approaches must be questioned in the long term and new questions must be clarified.

While some issues can be implemented organically by regulating future developments in stages (e.g. regulation of automation up to level IV), fundamental decisions are also needed. These must be made early on (taking risk considerations into account) in order to allow (or not) new developments on a large scale. It is also a question of approaching the future without an ideological way of thinking. New forms of mobility services at the interface of current public and private transport can also be seen as an opportunity to overcome differences in political opinion.

*Need for regulatory action (focus on national level)*

| Policy and action areas | New topics and questions |
|---|---|
| **Spatial planning policy/ agglomeration programmes**<br>*Support for urbanisation* | • Spatial embedding of hubs (centres, sub-centres, along motorways)<br>• Admission of sharing offers in public space<br>• Automated parking<br>• Incentives for car-less households |
| **Road infrastructure policy**<br>*Safety and capacity with automation; investment in software instead of hardware; network hierarchies* | • Clarification of capacity benefits due to automation,<br>• Enabling testing environments<br>• Approval for the different degrees of automation: design of motorways and lane management<br>• Digitisation programme for motorways<br>• Climate-friendly infrastructure<br>• New organisational forms of road operation with performance mandates and control concepts |
| **Road traffic law**<br>*Registration of vehicles, insurance* | • Vehicle approval and type testing<br>• Driver behaviour with automation<br>• Clarification of liability issues for fully automated driving |
| **Rail infrastructure policy**<br>*Digitalisation, new systems* | • Implementation of Smart Rail (digitalisation of infrastructure) and clarification of capacity utilisation<br>• Further development of urban railways (2G)<br>• Introduction of new systems and operator models (infrastructure concession law) |
| **Public transport policy**<br>*Basic services, new mobility services, ordering and financing* | • Redefinition of the minimum requirements for public transport<br>• Approval of new mixed transport systems and actors (concession law, taxi legislation)<br>• Combined mobility, regulation of platform offers<br>• Incentives for shared mobility and MaaS |
| **Financing and steering**<br>*Sustainable financing Infrastructure, market-based incentives to increase efficiency* | • Mobility pricing: mileage-based levy to compensate for falling mineral oil tax revenues<br>• Differentiation according to capacity utilisation, vehicle and time of day<br>• Specifications for the utilisation of automated vehicles |
| **Freight transport**<br>*Modal shift and the importance of carrier* | • Approval of automated trucks and handling of platooning<br>• Promotion and automation of combined transport: focusing support policy on innovation<br>• Development of new logistics systems (e.g. cargo sous terrain) |
| **Pedestrian and cycle traffic**<br>*Bicycle infrastructure, new transport services* | • Infrastructure development and network hierarchy (especially fast cycle routes)<br>• Approval and conditions for new micro-mobility services<br>• Further development of road traffic law for mixed traffic at low speeds |
| **Air transport policy**<br>*Approval, safety* | • Approval of drones<br>• Approval of air taxis, dealing with pilot operations |
| **Digitisation/ Data**<br>*Data management, data security* | • Data access and handling: requirements for open source<br>• Conditions for data producers<br>• Database of the federal government and security infrastructure |

In addition to these content-related topics, there are also organisational issues concerning:

- **overall organisation**: coordination of overall mobility and transport, institutionalised caretaker role for future mobility at national level (DETEC), clarification of interfaces with other sectors (energy, real estate, telecommunications, etc.).
- **vertical division of responsibilities:** the national level of regulation is expected to become more important. At the same time, however, the cities and agglomerations are key actors.
- **organisation of the infrastructure**: role of the public authorities as owners, processes for the long-term expansion programmes and operation.
- **positioning in public transport** and the (different) ownership roles of the federal government, cantons and municipalities.