EXECUTIVE TRAINING

GOVERNING ENERGY TRANSITIONS

Mobility and the energy transition

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The topic of session 8 was formulated like this.

Mobility and the energy transition

- The link between environment, transport and the energy transition
- Planning infrastructure in the transition era
- Inter-federal cooperation for the energy transition

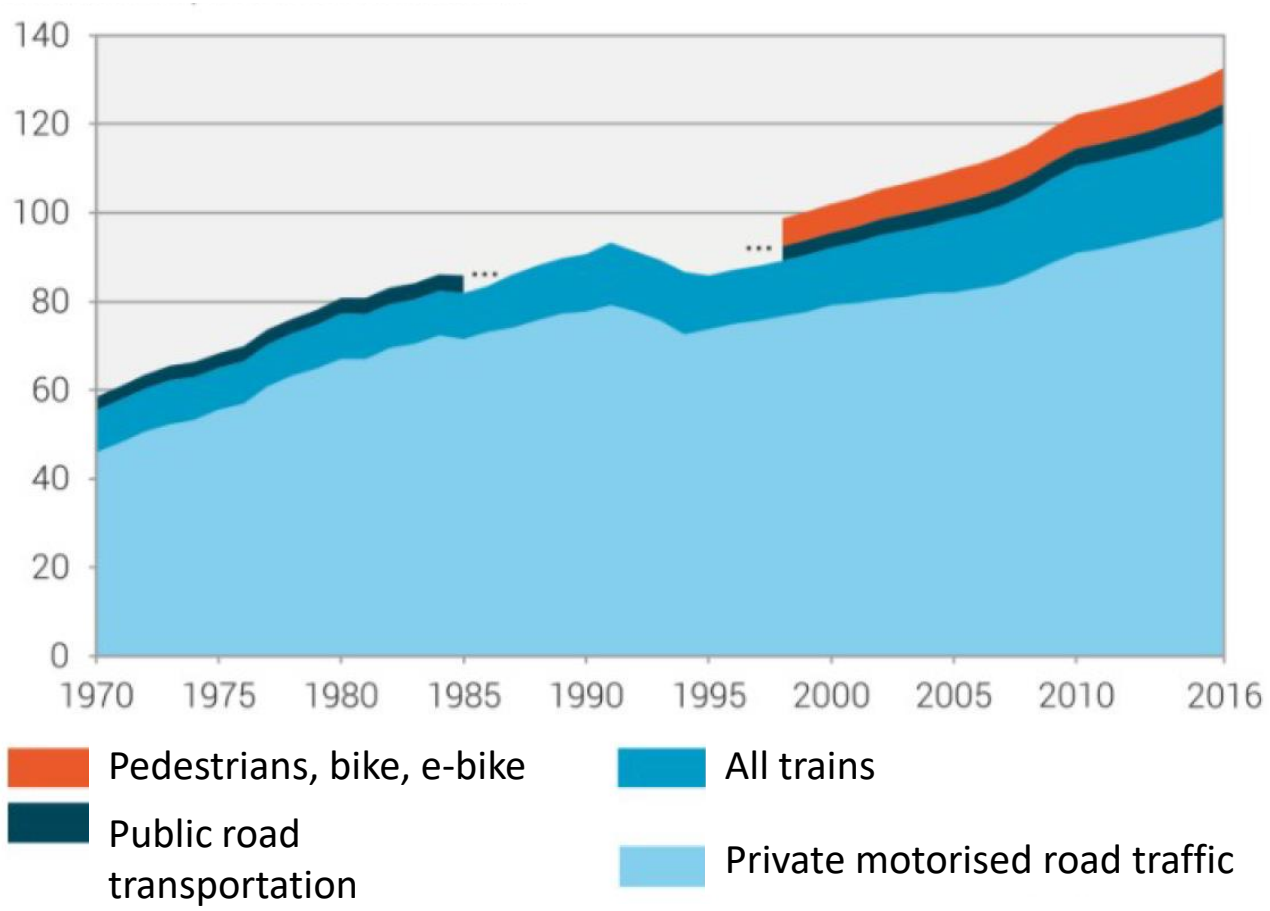
Table of contents

1. The structure and trends of swiss transportation sector
2. The impact of the swiss transportation system on climate and environment
3. The decisive advantages of electrification for the decarbonisation of transportation
4. Is electrification a problem in terms of power supply?
5. Behaviour and devices or infrastructure?
6. Decision-making at the federal level: inter-federal cooperation.

All graphics are from my recent report on electrical mobility.
Bibliographical sources: http://rogernordmann.ch/rapport-pour-une-electrification-rapide-de-la-mobilite-routiere/

1. The structure and trends of swiss transportation sector

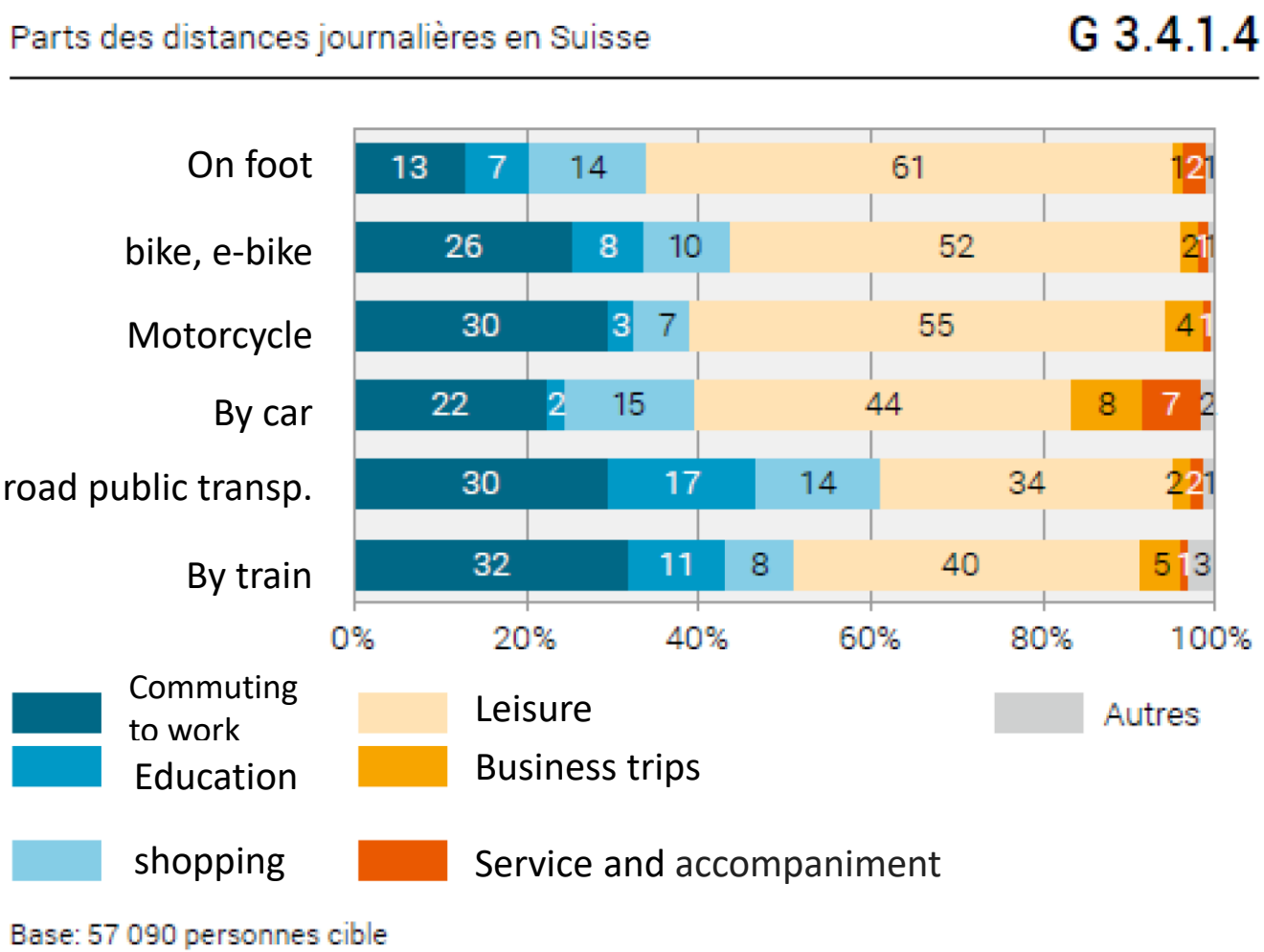
Quantitative evolution of kilometers travelled by swiss persons (1970 to 2016)



Total still growing.

- Public transportation growing faster (16% → 20% from 2000 onwards)
- private motorized traffic per capita: stable (75%).

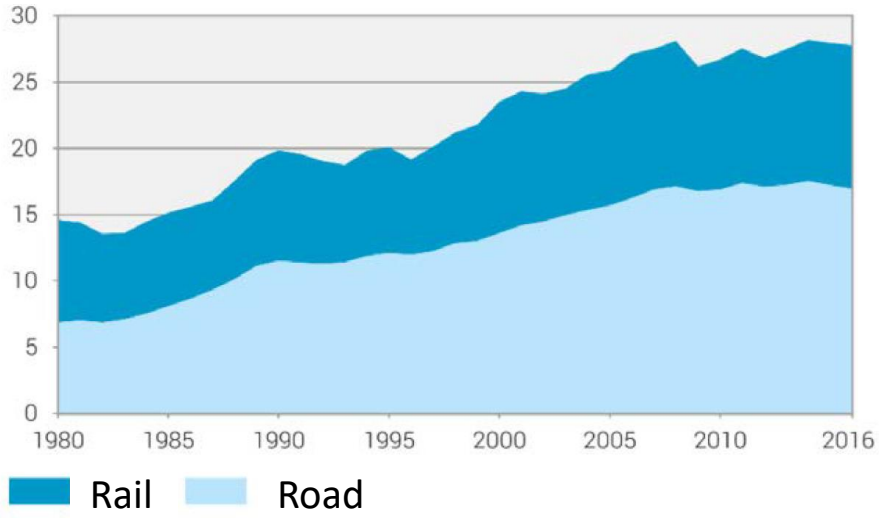
Reason for travelling, differentiated per means of transport



Car usage:
Commuting to work = 50% of leisure

Freight in and through Switzerland

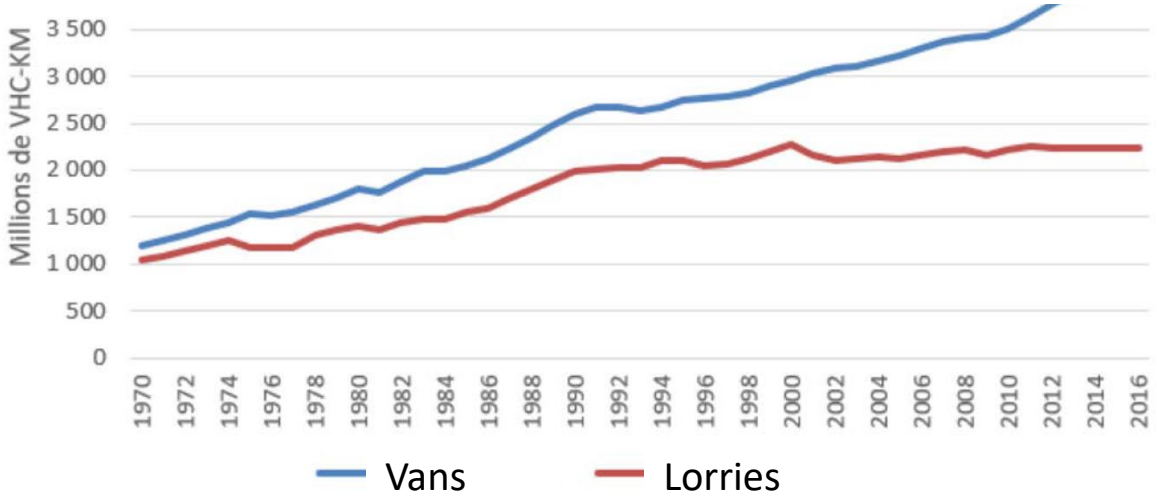
Modal split between road and rail (billions tons-KM)



Données de base route: véhicules lourds indigènes et étrangers de transport de marchandises; véhicules légers indigènes de transport de marchandises

Rail: valeurs en tonnes-kilomètres nettes (sans le poids des conteneurs et des véhicules routiers de transport de marchandises en transport combiné)

Evolution of road freight



Quantitative stabilisation

- Rail 39% of tonnage (low 2010 at 36%)
- Rail very strong for transalpine freight
- Road very dominant for internal freight

- Lorries-KM: stable because of «LSVA» (ton-KM tax) and increase of maximal load
- Strong expansion of vans

Huge increase of air traffic

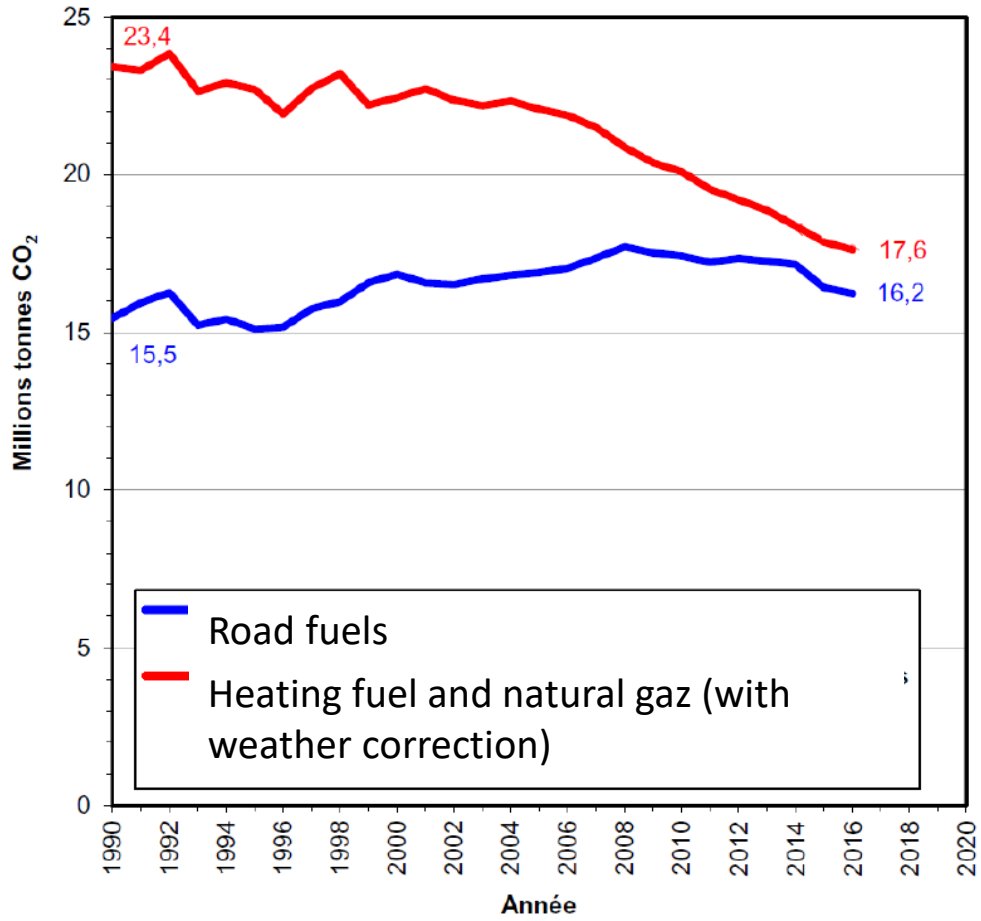
Average flying distance per capita	
2000	2633 KM
2015	8986 KM

Important cost reduction and productivity improvement.

Currently: 5 million tons CO2 = 10% of national emissions (growing strongly).

2 The Impact of the Swiss Transportation System on Environment and Climate

CO_2 emissions from road and heating fossil fuels in million tons/year
(Without energy conversion, garbage and fuel of international aviation)



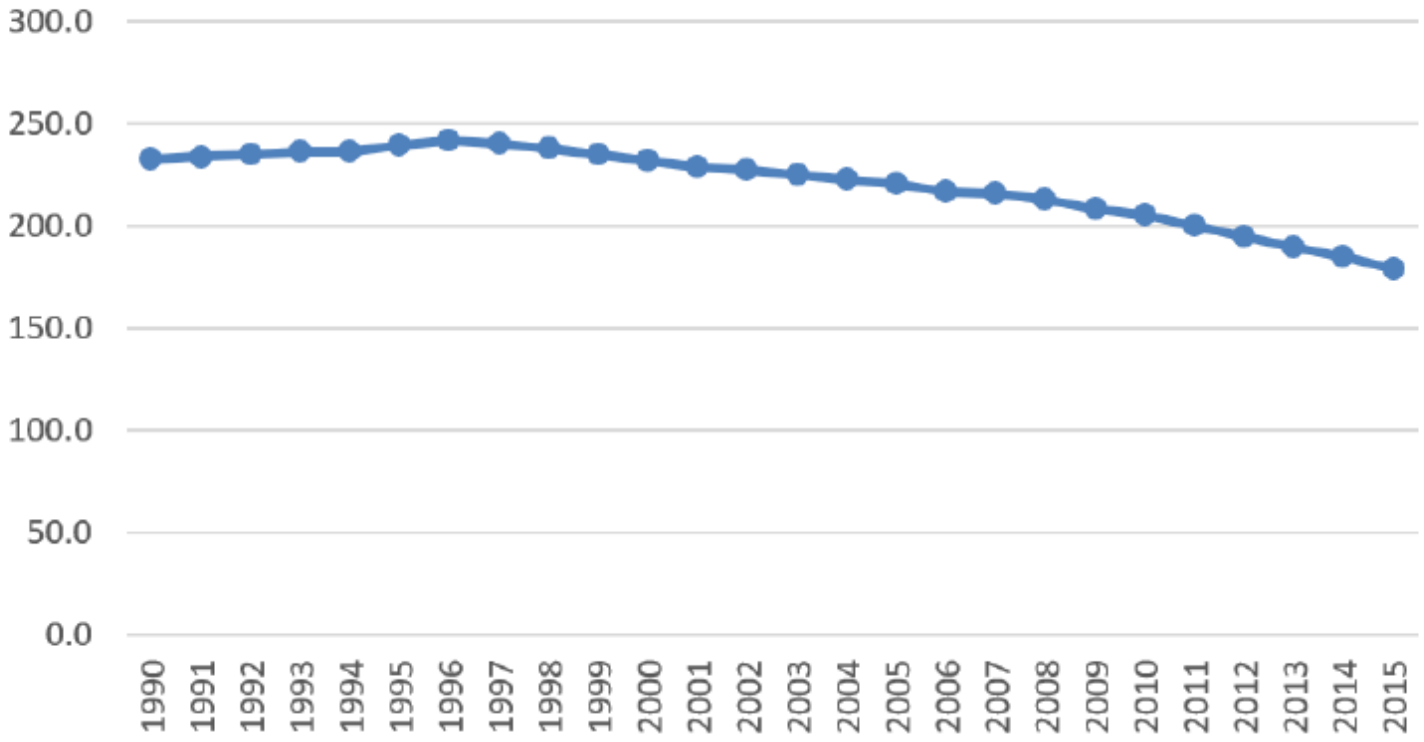
Emissions by the different categories of Vehicles

	CO_2-Emissions 2015 (millions of tons)
Cars	10.29
Vans	0.83
Lorries	1.75
Buses	0.36
Motorcycles	0.24

Overall Greenhouse gases emitted in Switzerland (CO_2 and others, without international aviation) = 48 Millions of tons)

Slow improvement of real emissions

Real CO_2 emissions from cars
In gramm per Car-Km



Far away from the EU & Swiss regulation for news cars (95 gr/CO2).

Two reasons

- Time lag due to slow replacement rate for cars
- Growing average between formal test bank and reality (now around 40%)

Noise, air and space and energy

In addition to the climate problems, road transportation also presents the following problems

1) Noise

2) Local air pollution (including latest diesel scandal)

   Both of them harm quality of life, cause early death and health damage and reduce the legal possibilities of building houses (Because noise and air pollution levels are already above the norms).

3) Space

   Road infrastructures use 2% of swiss ground (the same as housing). Notice that some (few) roads are also used by trolleybuses and tramways, and some other by buses.
   By comparison: Train infrastructures cover
   0.2% of swiss ground.

4) Energy

   Transportation represents about 1/3 of overall net energy consumption in Switzerland (overwhelmingly imported and fossil).
   The climate and the energy are exactly the two sides of the same coin.

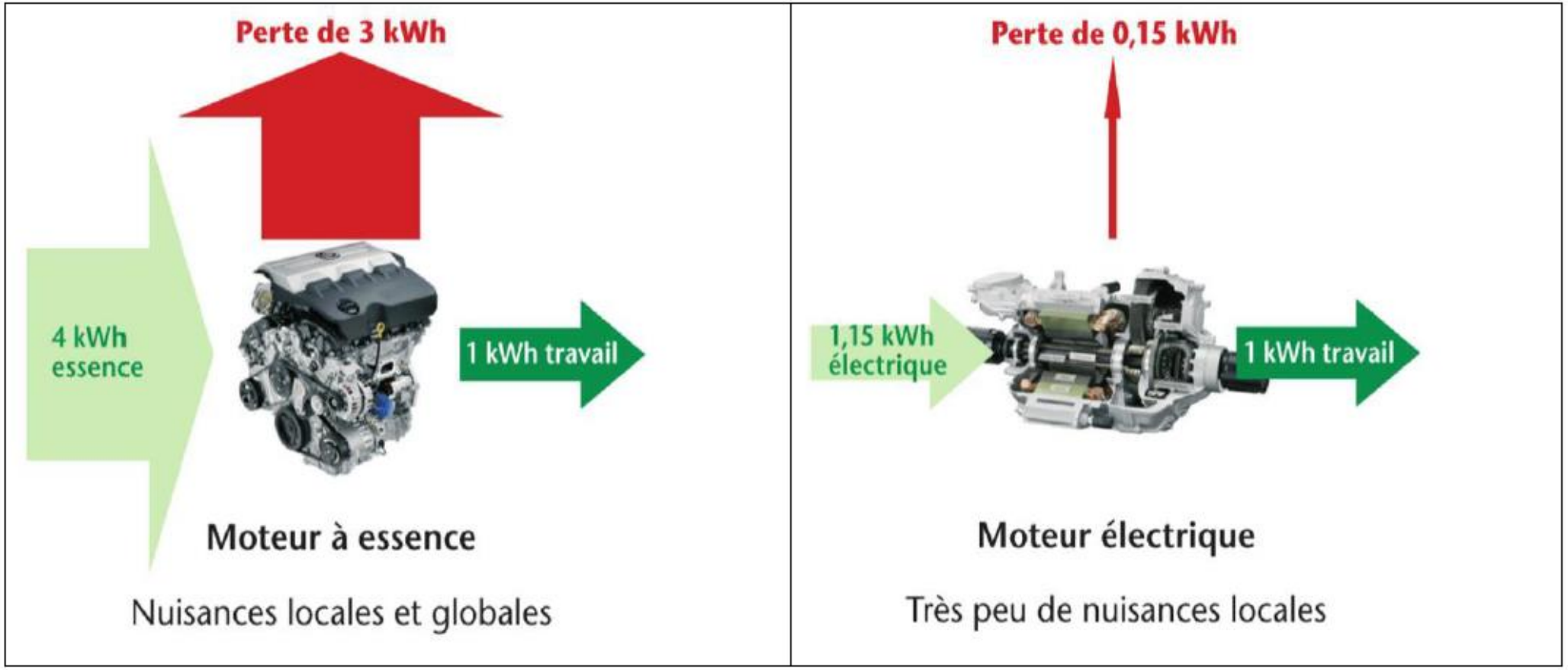
   Electricity for public transportation is around 1% of net energy consumption.

Preliminary conclusions

- We have a very serious climate, environment and energy supply problem in the transportation sector.
- Despite strong and successful long term policies to develop public transportation, only weak shift in proportion towards public transportation
- Road Mobility is still growing, albeit slower. It has still huge environmental problems
- Aviation has long left its marginal elitist segment to become a popular transportation medium. Its growth makes it very problematic.
- Weclearly have a demande-side problem. We need strong policies for spatial planning. We need economic and organisational incentives to moderate mobility consumption.
- It is also a matter of values: Personally, I doubt whether every additional trip increases our well-being!
- It not only an environmental problem, but also a cost problem regarding infrastructures (construction and maintenance cost).
- **But: we clearly can't solve the CO2 problem of transportation by hoping for a drastic reduction in individual motorised mobility. Already a stabilization would be a substantial breaktrough.**

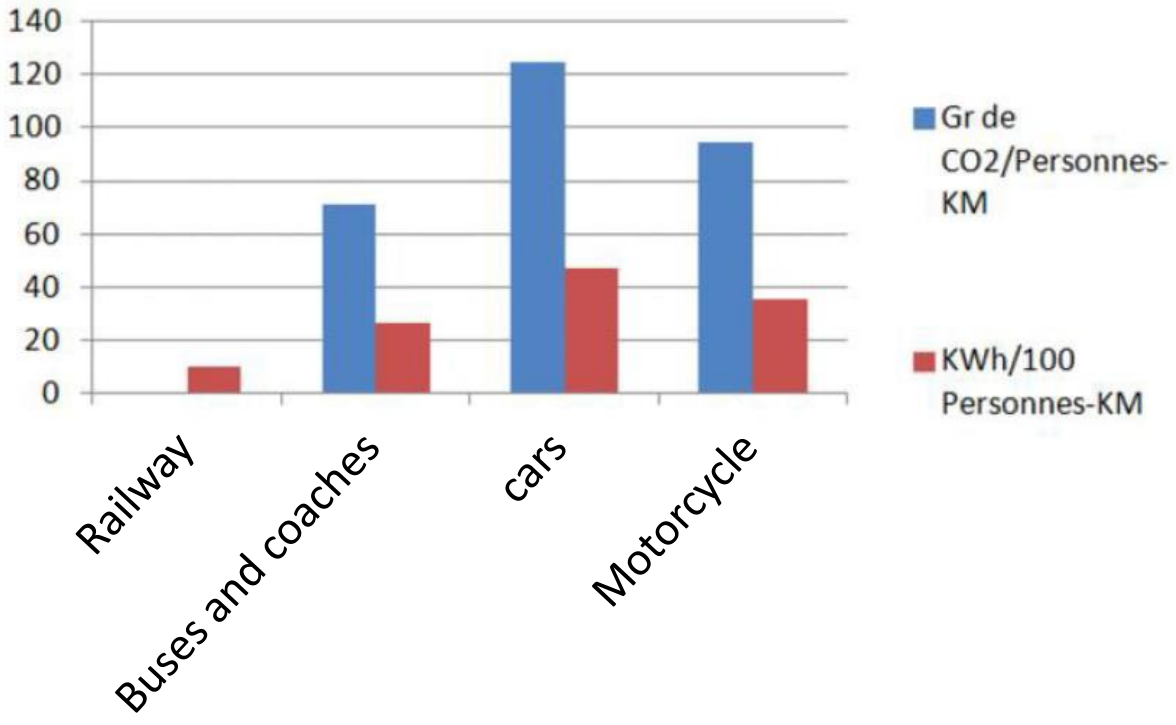
3. The decisive advantages of electrification for the decarbonisation of transportation

Difference between fuel and electrical engine

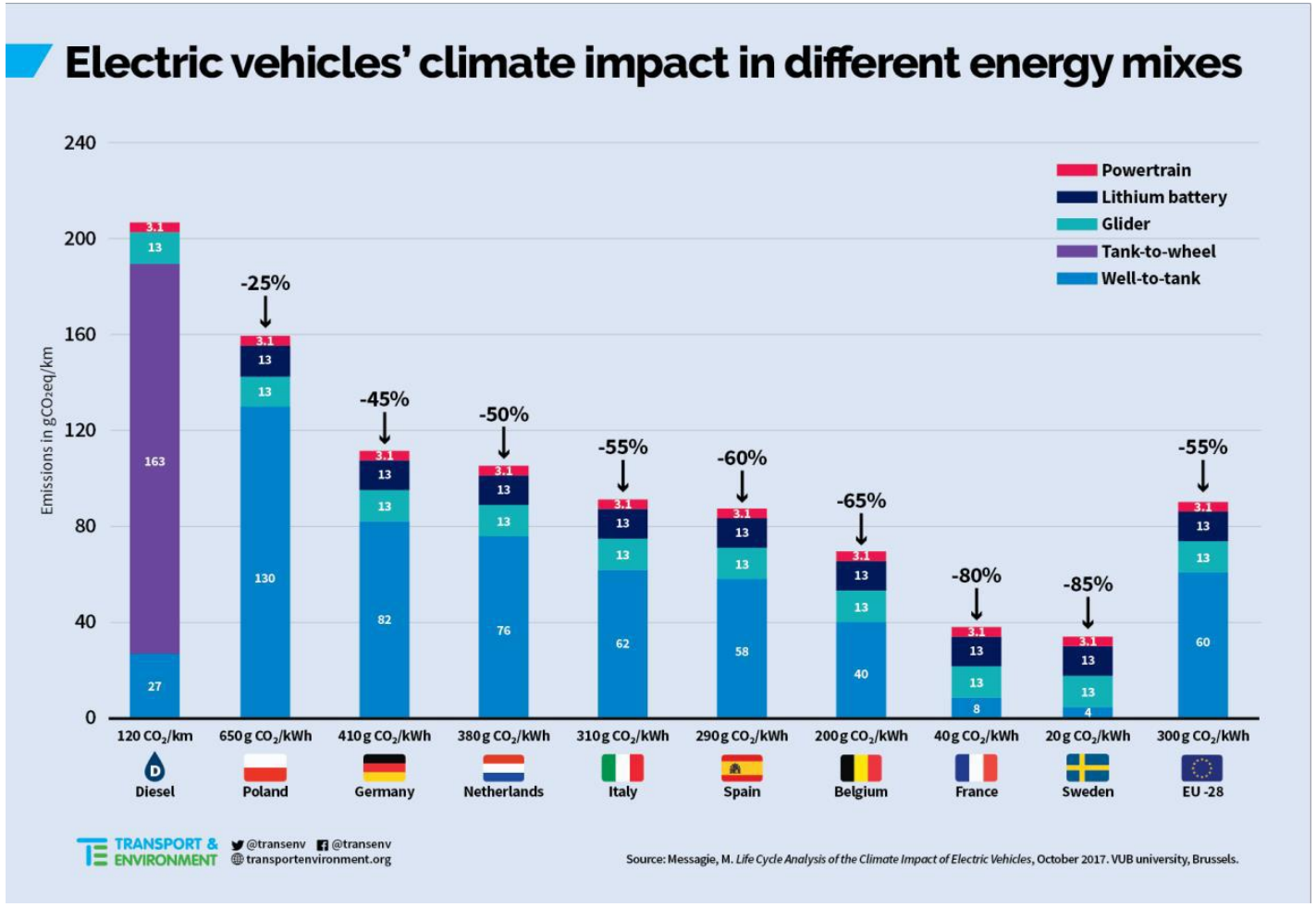


Swiss trains, Tramways and trolleybuses are already electric

Comparison of CO2 emissions and energy-use between different transportation means (transport of a person on a given distance)



Carbon content of electricity is the killer criterion



Construction, energy transformation and use in real conditions (only climate)

Carbon intensity of energy is decisive (well-to-wheel).

Battery is not mainly a climate problem, but rather a material one.

But oil production is increasingly becoming an ecological problem in itself (deep-see, oil sand, shale gas…)

(more in my report)

Cars, vans, lorries, motorcycles, buses, even possibly planes

Images: Galeuchet, Independent.co.uk, Siemens

Electrification of road mobility can lead to a great environmental improvement (climate, noise, local air pollution). Under two conditions:

- if we succeed in stopping quantitative expansion of transportation sector
- Electricity should be renewable

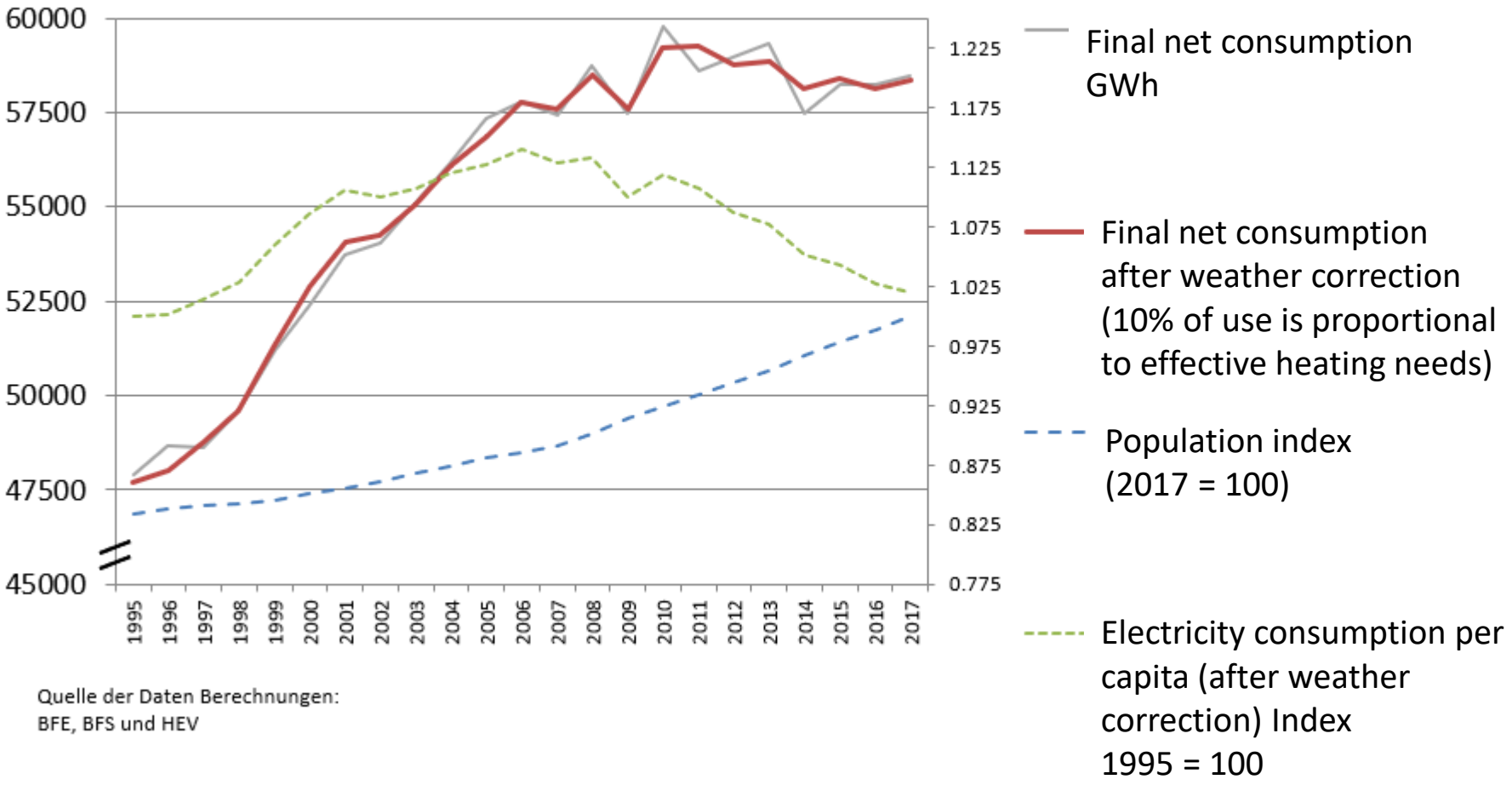
Doubts about other alternatives :

Agrofuels: mostly a catastrophic ecological impact and as inefficient as fossil fuel for internal combustion engine

Synthetic gas (produced with surpluses of renewable electricity): low conversion efficiency if internal combustion. Stationary reconversion in electricity after storage and use in electrical cars is more efficient.

4. Is electrification a problem in terms of power supply?

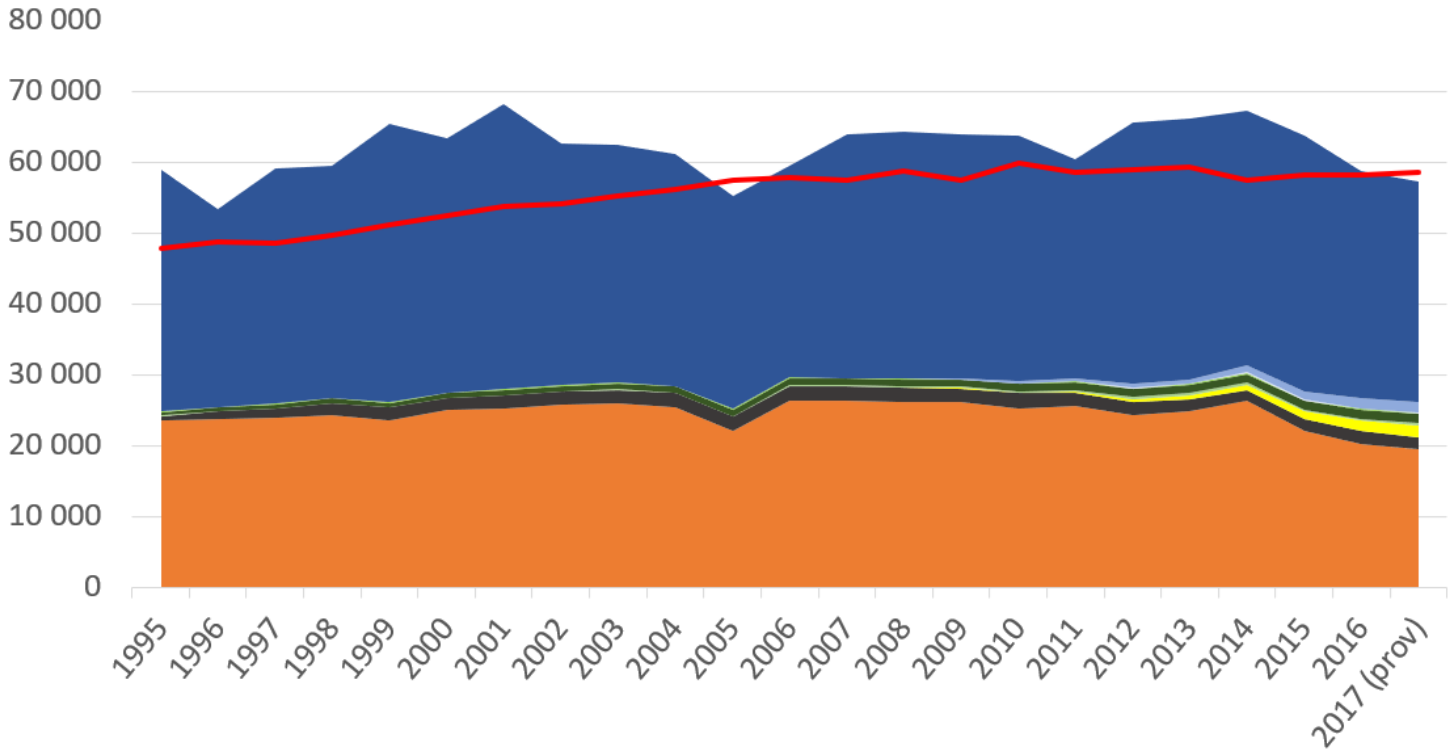
Final net consumption of electricity in Switzerland (1995 – 2017, GWh)



Quelle der Daten Berechnungen:
BFE, BFS und HEV

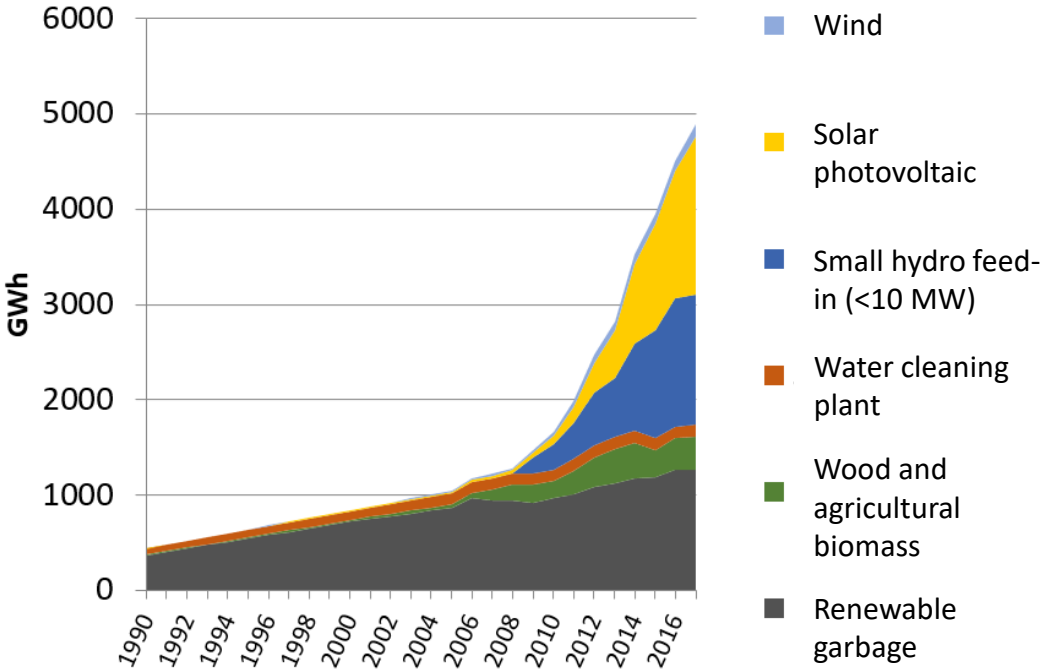
- Recently: substantial enhancement of efficiency in use of electricity
- Stabilisation after 1 century of growth
- Decrease of 10% per capita during the last 10 years

Production and net consumption of electricity in Switzerland GWh



- Nuclear
- Solar photovoltaic
- Renewable garbage
- Wind
- Net big Hydro (without pump energy and Feed-in small hydro)
- Fossil (mostly garbage)
- Wood and agricultural biomass
- Water cleaning plant
- Small hydro feed-in (<10 MW)
- Net consumption

Production of new renewable electricity included feed-in small hydro



1990 bis 2000 und 2000 bis 2005: linear interpoliert.

Long run:

- Full electrification of cars = 12'000 GWh
- Full electrification including buses, lorries, vans, motorcycles, off-road = 20'000 GWh

Electricity for transportation is a part of the overall generation problem

Relplacement of Nuclear Power by stable consumption: 19 TWh (1/3)

Very long run: same quantity for electrifying all road mobility (80 TWh fossil –> 20 TWh electricity)

But medium run: electrifying 1/3 of cars = 4 TWh

Recent NRE and small-hydro increase = 4 TWh in ten Years.

Potential is here: 30 TWh PV alone on optimal buildings (now: 1.7 TWh).

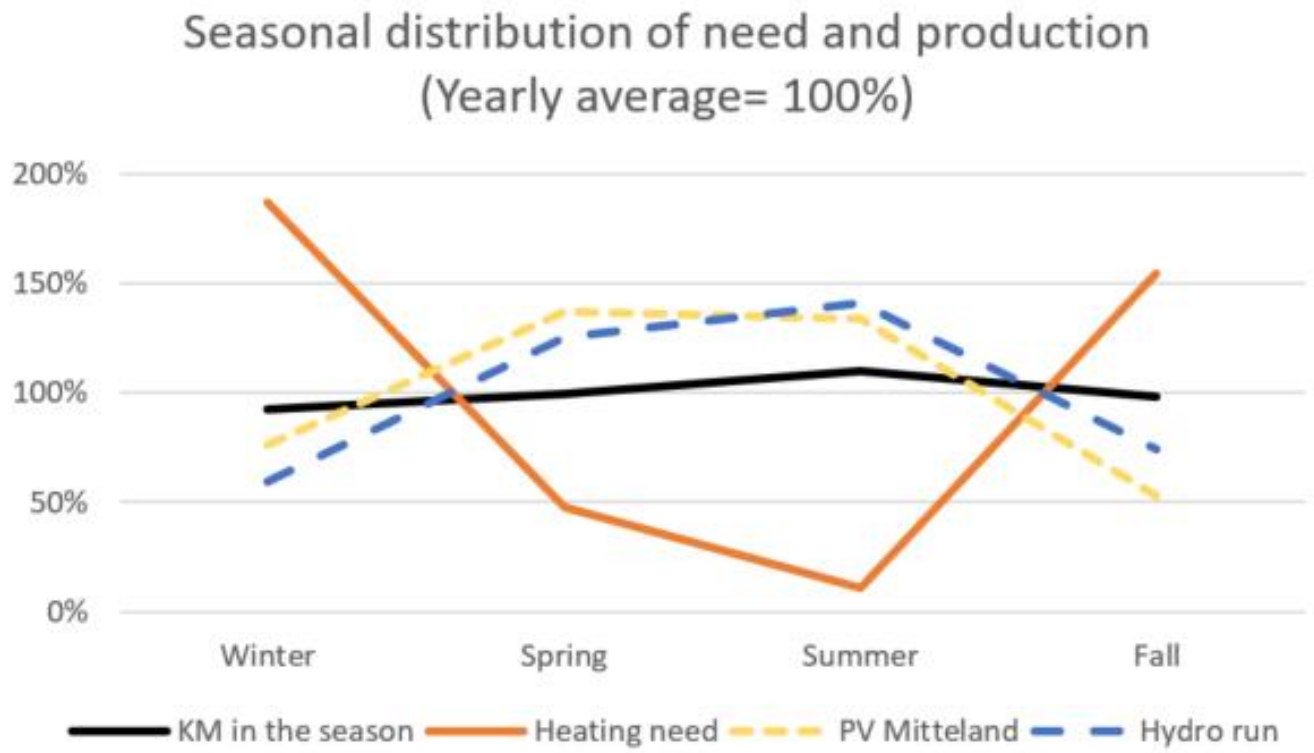
Other surfaces also possible: f. i. Infrastructures. And other technologies.

Also partial import of renewable.

Efficiency gains on existing use: around 15 TWh?

Key issue: efficiency of electrical cars (Electrifying SUV is a nonsense).

Seasonal issue: electrifing moblity easier than electrifing heating



Data: microcensus, Meteotest, Heizgradtagen HEV, BFE

Both sectors building and mobility:

- actually use +- same quantity of fossil → +- same emissions.
- electrification divide by 4 commercial energy need

<u>But big difference in seasonal distribution of demand:</u>

- Energy need for mobility +- evenly distributed over year (light correlation with hydro and sun generation).
- While heating shows exactly the opposite profile of hydro and sun generation.

→ Electrifying mobility is much less complicated to integrate in the grid than using electrical heat pump in order to decarbonize houses (even if insulation can compress the electricity demand for Heating purpose)

Failure of the electricity market to induce investment

Switzerland has excellent predisposition for electrifying mobility because of huge storage capacity and good grid.

Seasonal storage can even be reinforced with power to gaz.

Cost isn't the issue

Currently, the driver pays around 35 Ct the fossil fuel he need for travelling 5 KM (custom taxe and surtaxe on fuels not included).

For the same distance with an electrical car, the cost are lower: he needs 1 KWh, which costs maximum 25 ct:

Grid cost (10 ct) and full cost new renewable (15ct)

Paying 25 Ct/KWh electricity is not at all a problem for drivers

But the main problem is elsewhere:

Huge internal market failure: electricity it sold at marginal cost. Therefore full generation costs are not covered. Nobody can invest massevly in such circumstances.

The actual market setting can't deliver it! (Remember that the unregulated and original status of electicity is a monpol, not a market!)

We need strong correction of the actual market setting and incentives by the state in order to stimulate investments.

(also consider the second market failure: environmental costs are only slightly integrated in the price)

5. Behaviour and devices or infrastructure?

Roads (and airport): To many, critical to maintain, space intensive. Congestion is a the only constraint to demand growth. Expansion would be clearly negative for energy transition and stimulate rebound effect after electrification.

Train, tramway, subway: Punctual expansion where capacity problem and to improve connexion to European High-speed train network. Mostly optimisation (electronics instead of concrete). Only positive if modal shift from road (or sky) to rail. Critical problem of maintenance cost.

Electrical grid (transmission and distribution): currently high quality, therefore only modest reinforcement is needed. Optimisation needed for energy transition, and mobility is part of it.

Loading infrastructure for e-cars: investment required. If it is well coordinated with generation and grid, the cost is modest.

Freight: “Cargo-souterrain” (underground freight system)? High energy and climate efficiency. But risk of rebound ?

Power Generation: huge investment required, but can be paid by users instead of taxpayers. Pre-condition: correction of market failure.

-> Energy transition in transportation sectors isn’t mainly a matter of investing in transport infrastructure. Only power generation needs strong investments.

Energy transition in transportation sector needs behavioural changes and a technological shift rather than new infrastructures

1) Stop quantitative expansion of mobility and try to reduce it

- Pricing more parking and flying (feasibility of congestion taxes and mobility pricing in Switzerland is questionable)
- Optimisation of spacial planning and organisation in order to reduce forced mobility
- Cultural shift: one isn't happier by flying 10 times a year.

2) Real modal shift towards clean transport modes

Efficient public transportation, bikes, e-bikes and travel on foot

Supply optimisation of public transportation focused where potential for modal shift.

But also access, speed and park restrictions (downtown/city center)

3) Electrification of the (remaining) fossil road mobility

Need for clarification and exemplarity

- Communication: clear political statement in favour or electrical mobility
- Personal engagement
- Public sector: Electrification of the bus sector, vans and other public vehicles

Need for incentives and duties

- Incentive or quota for electrical car
- Regulation against energetical inefficiency to avoid E-SUV expansion
- Fleet substitution (for example mail delivery)
- Special regulation in cities, such as restricted access for vehicles with fossil fuel engine
- Reinforcement of car sharing as punctual substitute of electrical car.
- Investment in load-infrastrcture and inter-operation rule
- Compulsory partial equipment for public and company parkings with load infrastructures
- Research in electricity storage to improve weight, efficiency and ecological impact.

And: intelligent regulation of the electricity field instead of naive belief in free market. Security for investment instead of nebulous propaganda a “the market will fix it”.

6. Decision-making at the federal level: inter-federal cooperation

Why does Switzerland have a suboptimal transportation policy in terms of climate?

Is it due to a suboptimal cooperation between different authorities at the federal level?

<u>On the way to a GHG-reduction in the transportation sector, we have to solve several goal conflicts</u>

- Classical economic growth and freedom of choice vs resources constraint.
- Competition between cantons for infrastructures
- Short term interest to pollute, with strong lobbies vs general interest
- Societal contradiction: higher consumption vs climate.
- Revenues of fuels tax vs reduction of CO2 emission

Until now, the direct conflict between mobility and climate has not been adressed.

Only secondary measures (technical emission standards, spacial planing and development of public transportation)

There isn't in the swiss society a will to reduce the amount of kilometers and to ban fossil fuels.

<u>Next realistic steps:</u>

Electrify road mobility?

And rise awareness of the climate issue related to flying in order to implement first measures?

Institutional setting matters, it's not enough to solve goal conflicts

- CH: one broad Ministry including energy, infrastructure and climate.
  - Makes governmental coherence possible (but doesn't ensure it).
  - Allows good cooperation inside of the Minstery

  But
  - Doesn't allow to solve at the governmental level the conflicts between the diverse professional logics of offices (Astra want more roads, Bazl more flights, Bafu less environmental damage, Elcom lower electricity cost, BAV more public transportation, and so on
  - Even in a given office: BFE/re more renewable, BFE/atomic longer nuclear use…).
  - Lack of exclusive ministerial advocacy and high sensibility to cross-sectorial lobby / capture….

- The swiss federalist system allows decentralised innovation in policy making and pragmatic flexible implementation, but also to skirt national policy. Conflicts of prerogative between national and cantonal level often lead to inaction.
- Democratic procedures (parliament and direct democracy) have limited capacity to cope with extremely broad and complex topics (Energy strategy 2050 touched the limit).
- Democratic decisionmakers are a mirror of the society and its unsolved goal conflicts. They only partially succeed in overcoming those contradictions in decision making.
- Democratic decisionmakers can try to make the public opinion aware of the conflicts, hoping for a positive retroaction.

Thank you for your attention

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