The Electric Power system

Switzerland

cigre

For power system expertise

Power system of Switzerland

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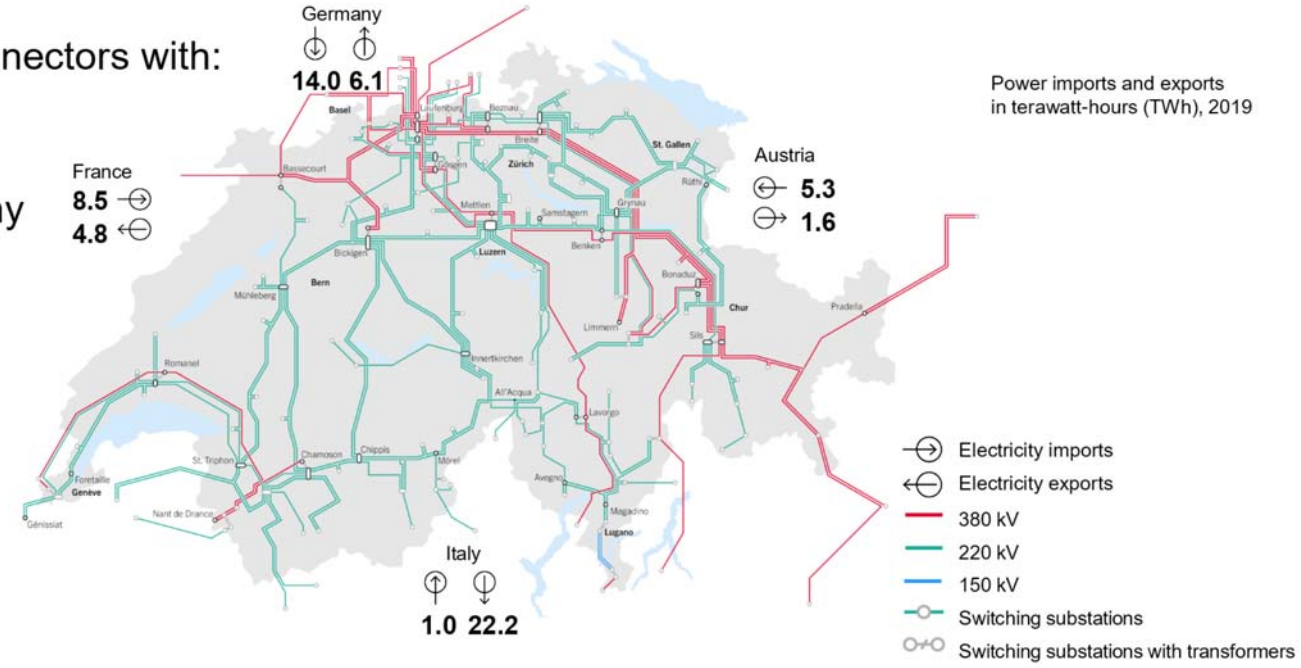
Basic facts

- Area: 41,285 km^2
- Population: 8,603,900 (2019)
- 1 TSO
- approx. 630 DSOs (2018)
- Peak load: max. 10.6 GW (max. of 2017 – 2019)
- Average interruption of electricity (2019): 19 min (source: ElCom; includes planned and unplanned interruptions)

Global map of the grid and of its interconnections

- 41 Interconnectors with:
  - Austria
  - France
  - Germany
  - Italy

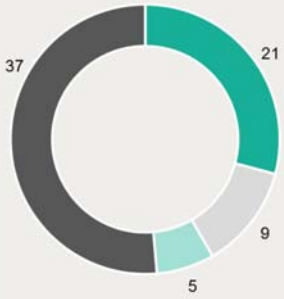


Power system of Switzerland

Source: Swissgrid

Overview of the Swiss electricity market

Production 2019
72 TWh

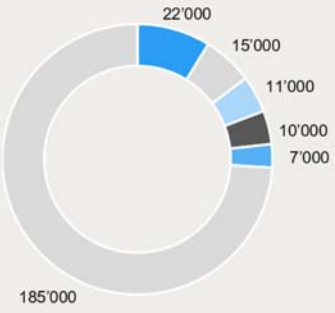


- Axpo
- Alpiq
- BKW
- Others

Transmission
6,700 km[1]

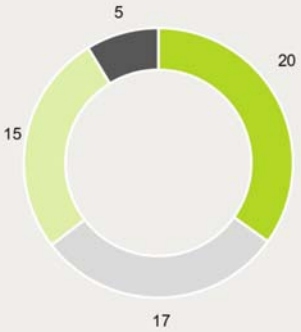
- Swissgrid

Distribution
250,000 km



- BKW FMB
- EKZ
- Groupe E
- Romande Energie
- CKW
- Others[2]

Consumption 2019
57 TWh

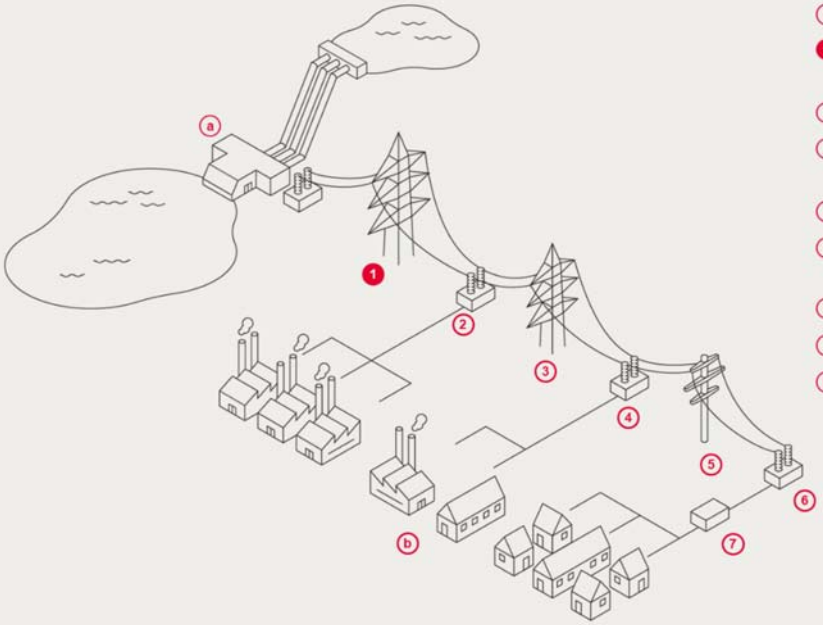


- Private households, agriculture
- Industry and manufacturing
- Service sector
- Transport sector

[1] 380 kV: 1,780 km and 220 kV: 4,920 km
[2] A total of ~650 distribution grid operators in Switzerland

All numbers are rounded,
Sources: Websites and annual reports of CKW, EKZ, BKW, Alpiq, Axpo, Groupe E, Romande Energie, SFOE, Swiss electricity statistics 2019

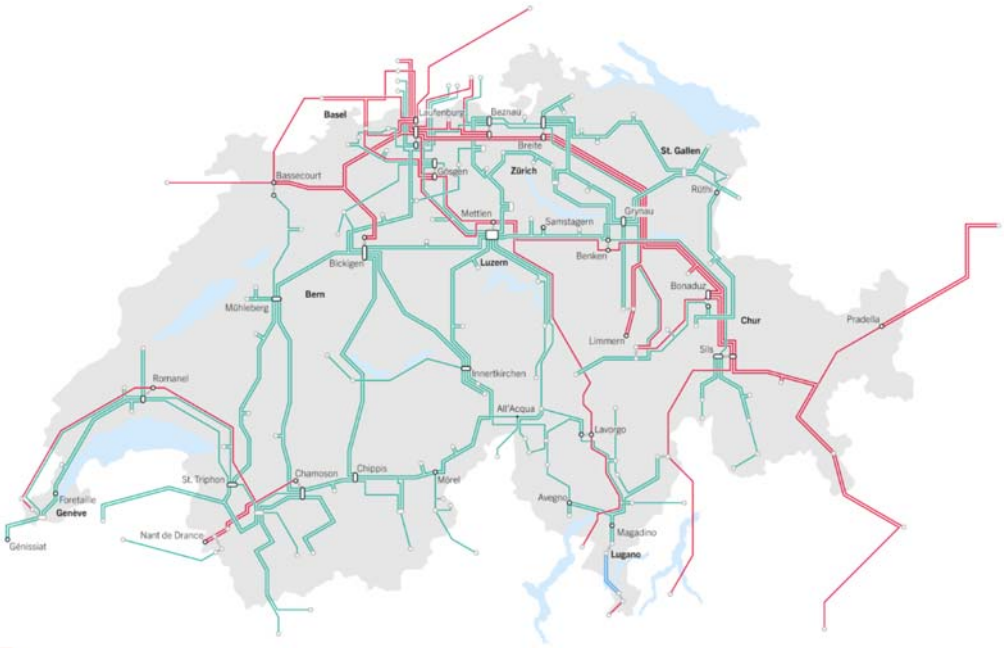
Structure of electrical power system



- (a) Generator
- (1) Grid level 1: Extra-high voltage in the 220/380 kV transmission grid
- (2) Grid level 2: Transformer
- (3) Grid level 3: High voltage in the 50 to 150 kV national distribution system
- (4) Grid level 4: Transformer
- (5) Grid level 5: Medium voltage in the 10 to 35 kV regional distribution system
- (6) Grid level 6: Transformer
- (7) Grid level 7: Low voltage in the 400/230 V regional grid
- (b) Consumers

Source: Swissgrid

Map of the extra-high voltage grid



- Switzerland's transmission grid extends across 6,700 kilometres of lines, 12,000 pylons and 125 substations with 146 switching substations, as well as 41 connections abroad
- It is comprised of both 380 kV and 220 kV lines

380 kV
220 kV
150 kV
Switching substations
Switching substations with transformers

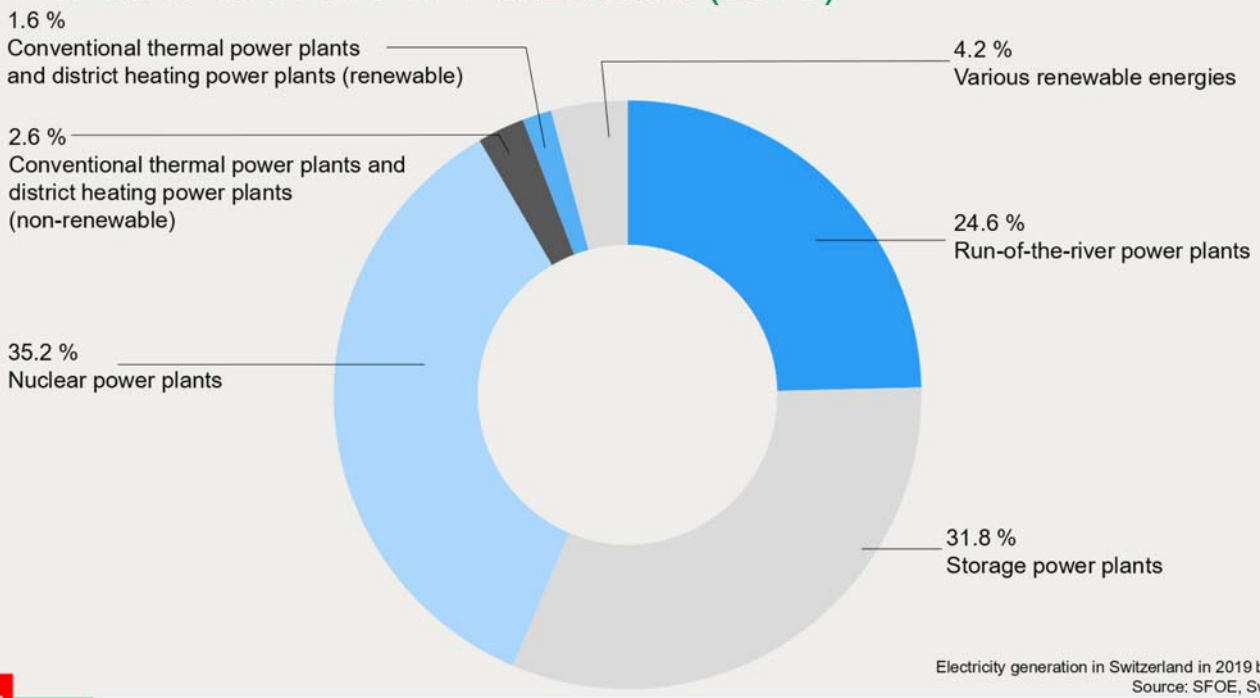
Power system of Switzerland

Source: Swissgrid

Information on TSO

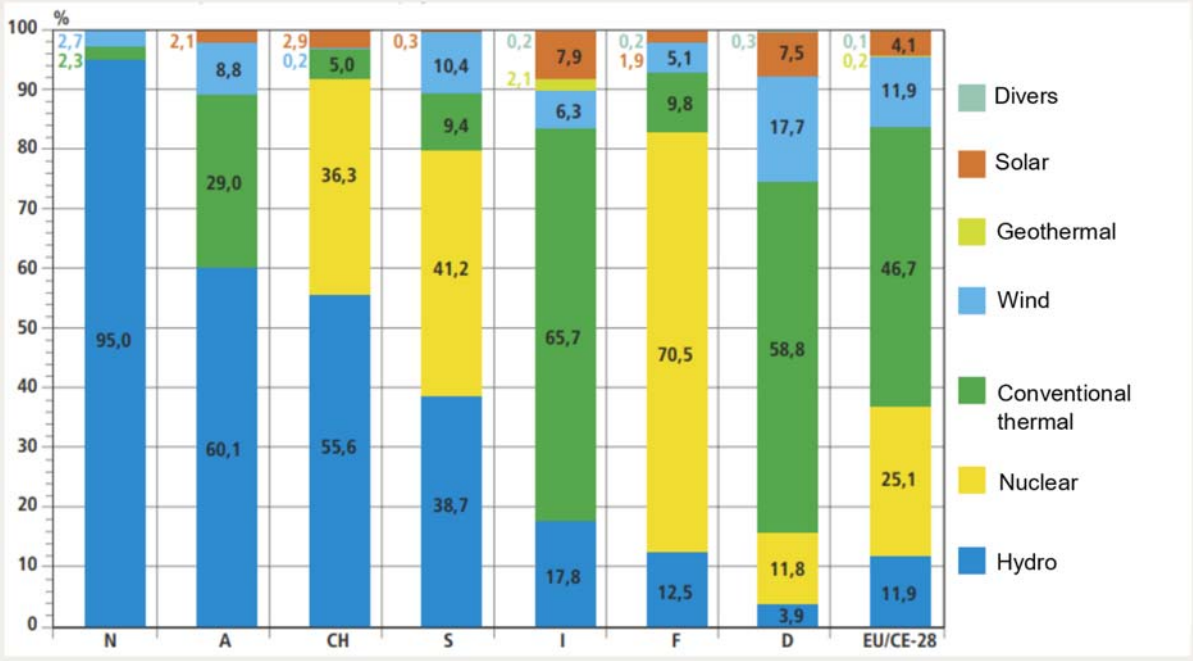
- Name: Swissgrid
- 6,700 km
- 21 transformers
- 12,000 pylons
- 146 switching substations
- 41 connections to other countries
- 530 employees (2020)
- www.swissgrid.ch

Power structure of Switzerland (2019)



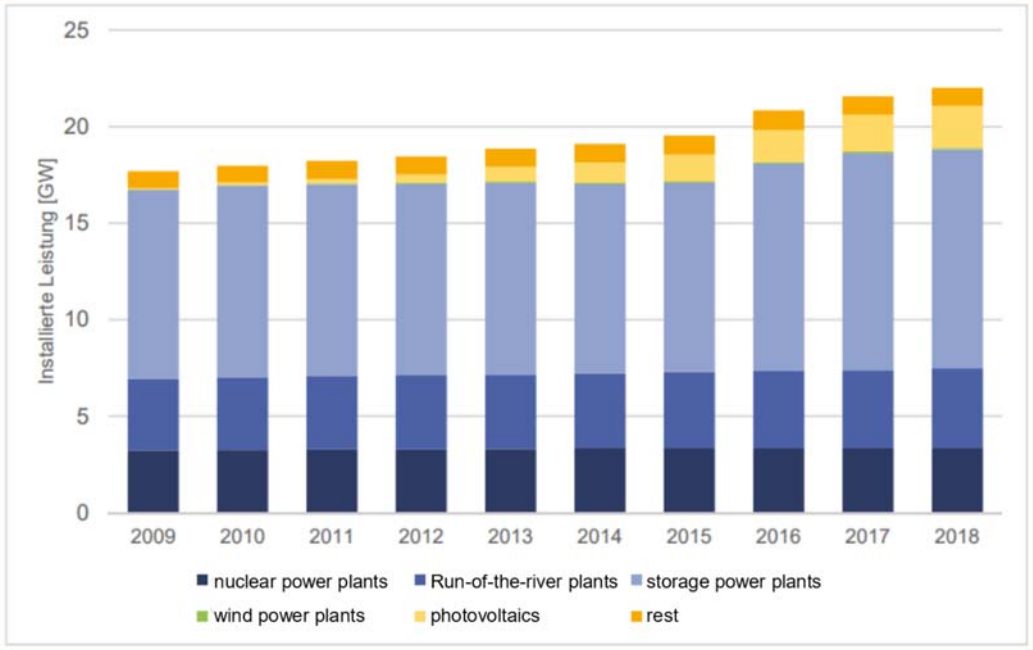
Electricity generation in Switzerland in 2019 by power plant category, in %
Source: SFOE, Swiss electricity statistics 2019

Power structure CH vs. Europe



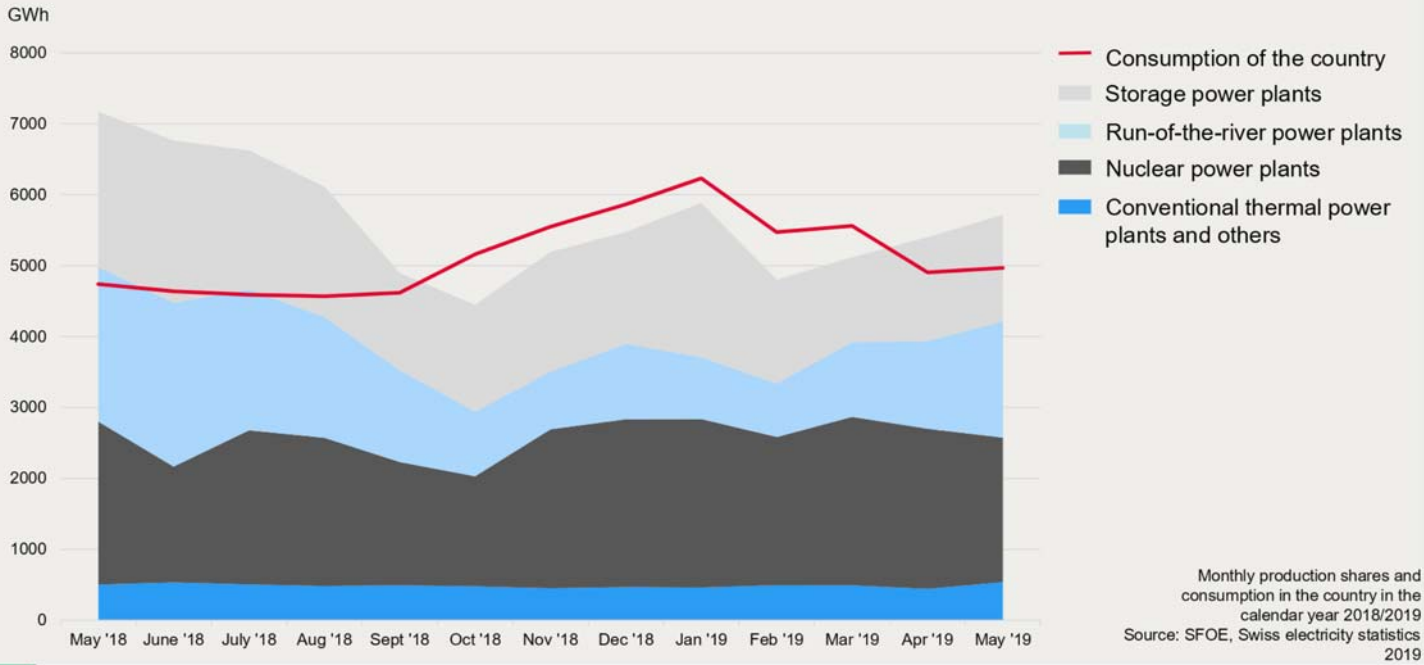
Electricity generation in 2018 by power plant category, in %
Source: SFOE, Swiss electricity statistics 2019

Installed capacity 2009 – 2018



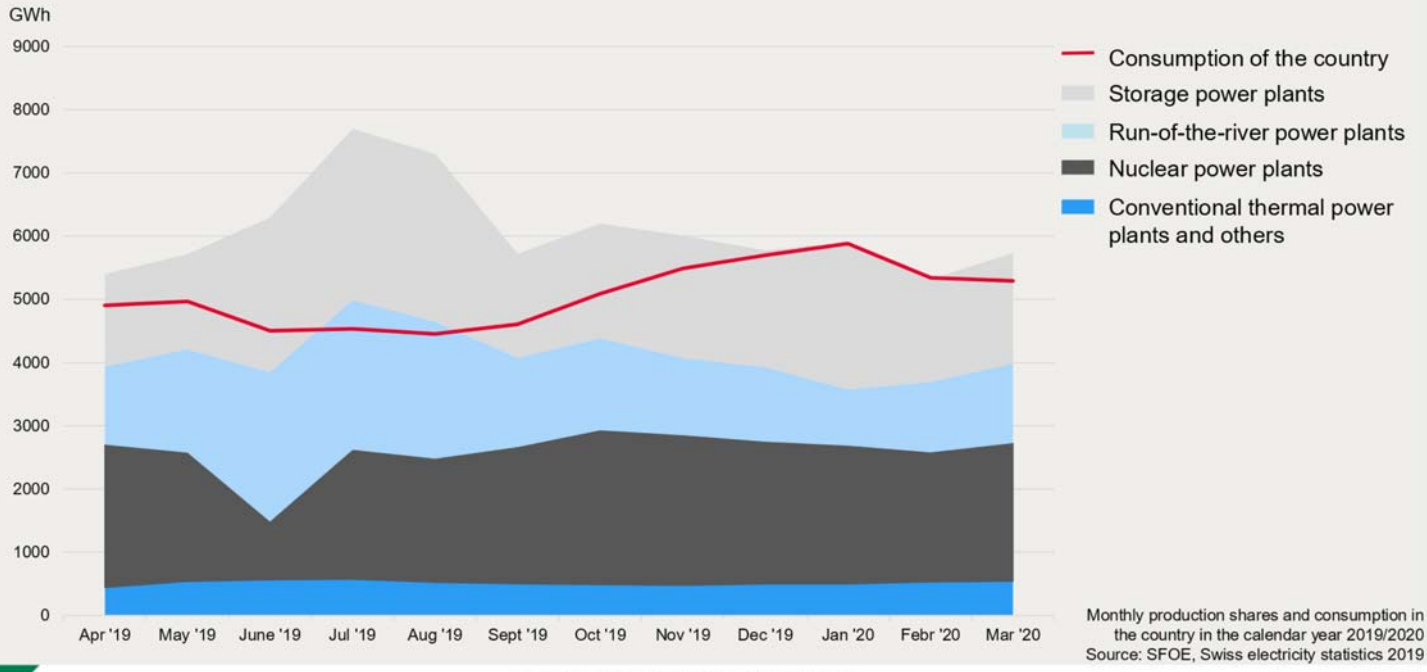
Source: ElCom, security of electricity supply of Switzerland 2020

Monthly production and consumption, 2018/2019



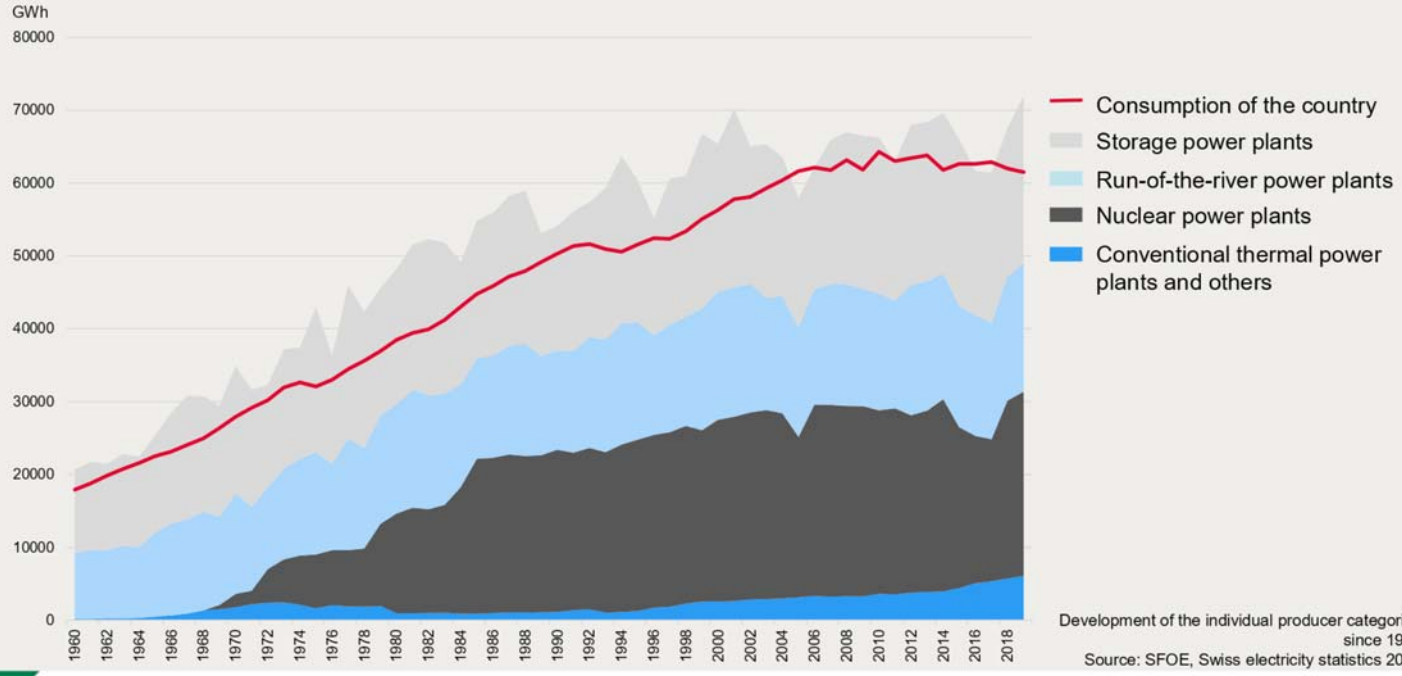
Monthly production shares and consumption in the country in the calendar year 2018/2019
Source: SFOE, Swiss electricity statistics 2019

Monthly production and consumption, 2019/2020



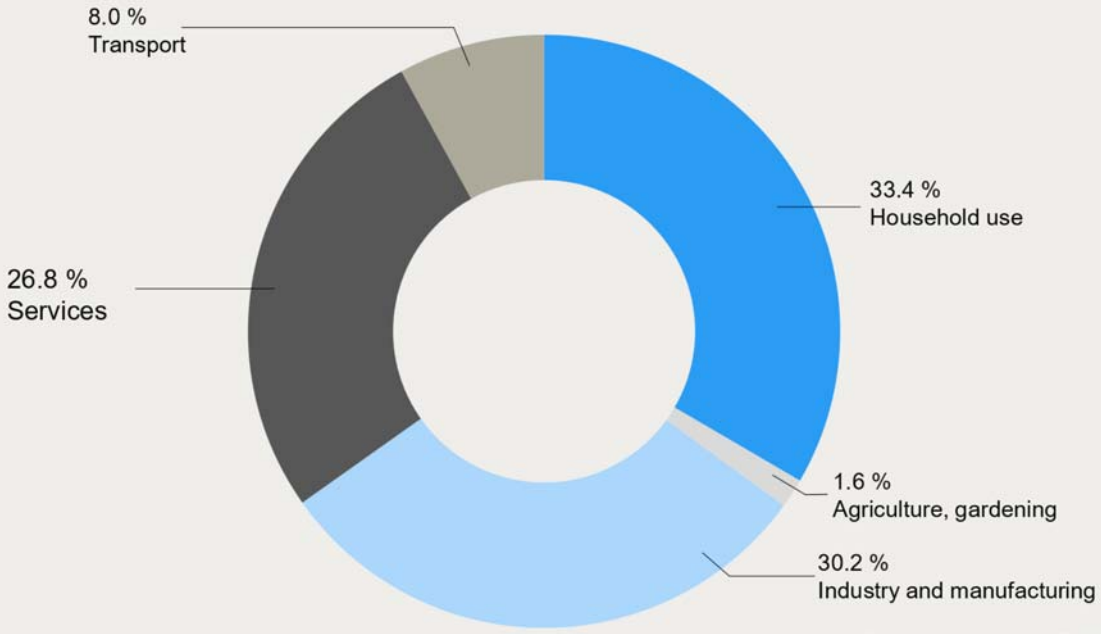
Monthly production shares and consumption in the country in the calendar year 2019/2020
Source: SFOE, Swiss electricity statistics 2019

Development of the Swiss generation mix



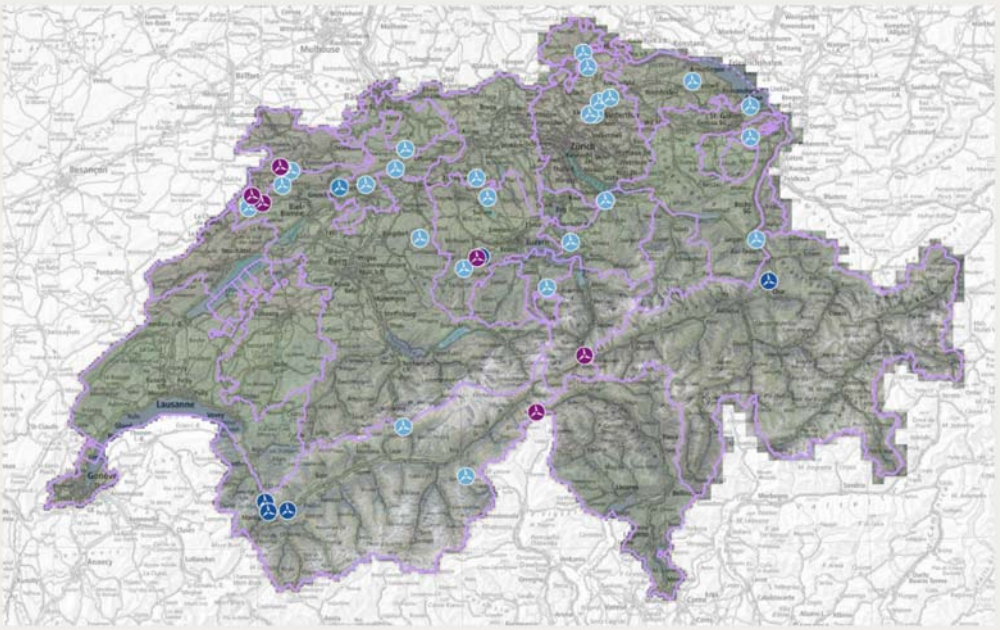
Development of the individual producer categories since 1960
Source: SFOE, Swiss electricity statistics 2019

Swiss consumption in 2019 by customer category



Electricity consumption in Switzerland in 2019 by customer category, in %
Source: SFOE, Swiss electricity statistics 2019

Location of installed wind turbines in Switzerland



Wind energy plants
(Sacle: ∞ to 1:100 000)

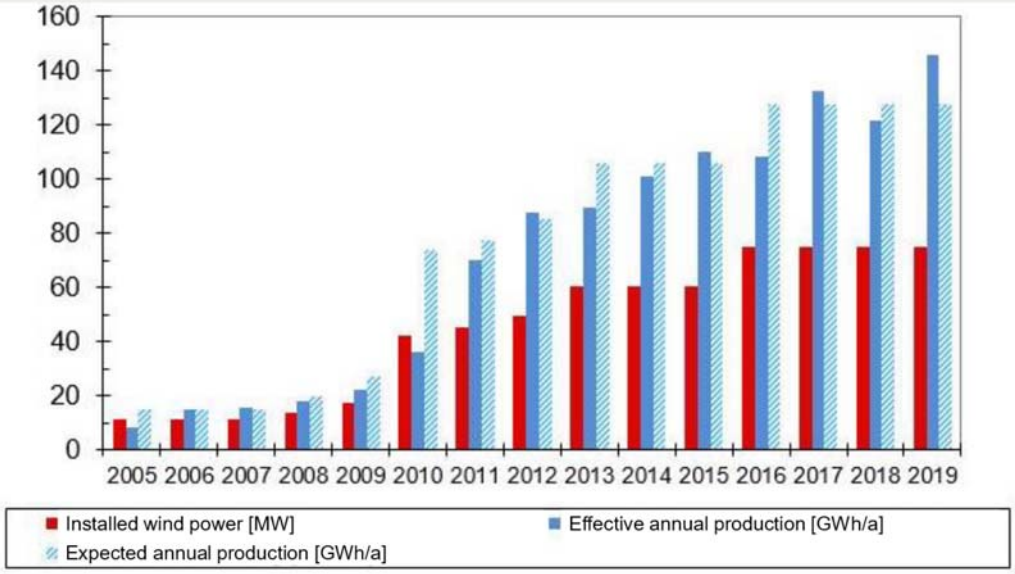
- Small single plant
- Medium single plant
- Big single plant
- Wind park

Turbine
(Scale: 1:99 999 to 1:25 000)

- Power < 100 kW
- Power ≥ 100 kW and < 1000 kW
- Power ≥ 1000 kW

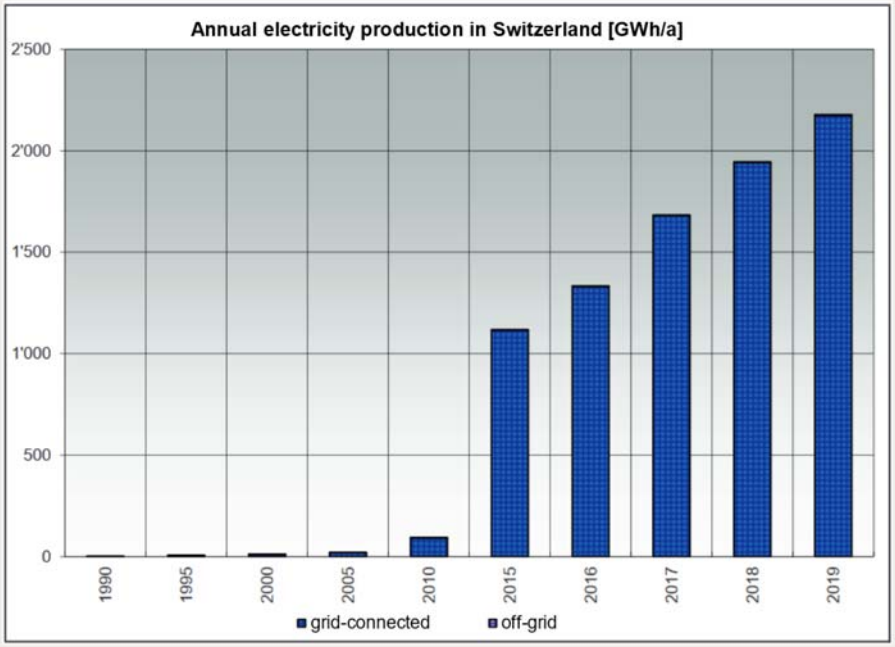
Source: wind-data.ch, date: 17.08.2020

Development of wind power in Switzerland (≥ 150 kW)



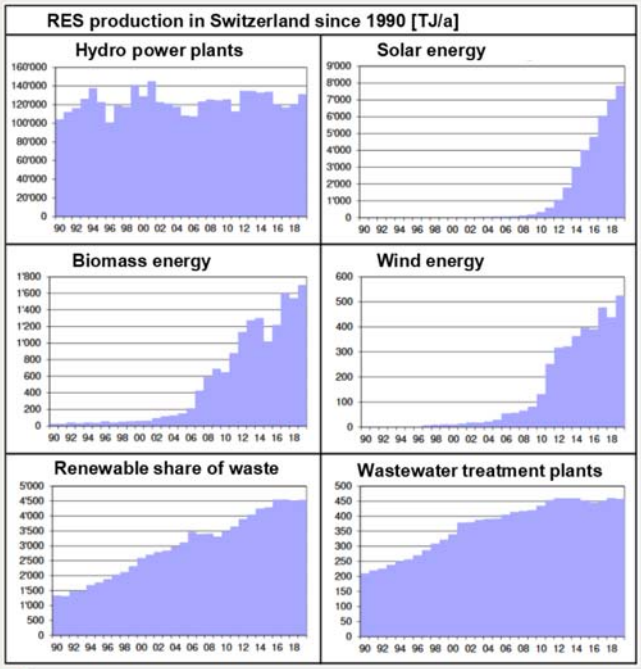
Source: www.suisse-eole.ch, date: 17.08.2020

Development of photovoltaic power



Source: Swissolar / SFOE,
Markterhebung Sonnenenergie 2019, July 2020

RES production per annum [TJ/a]



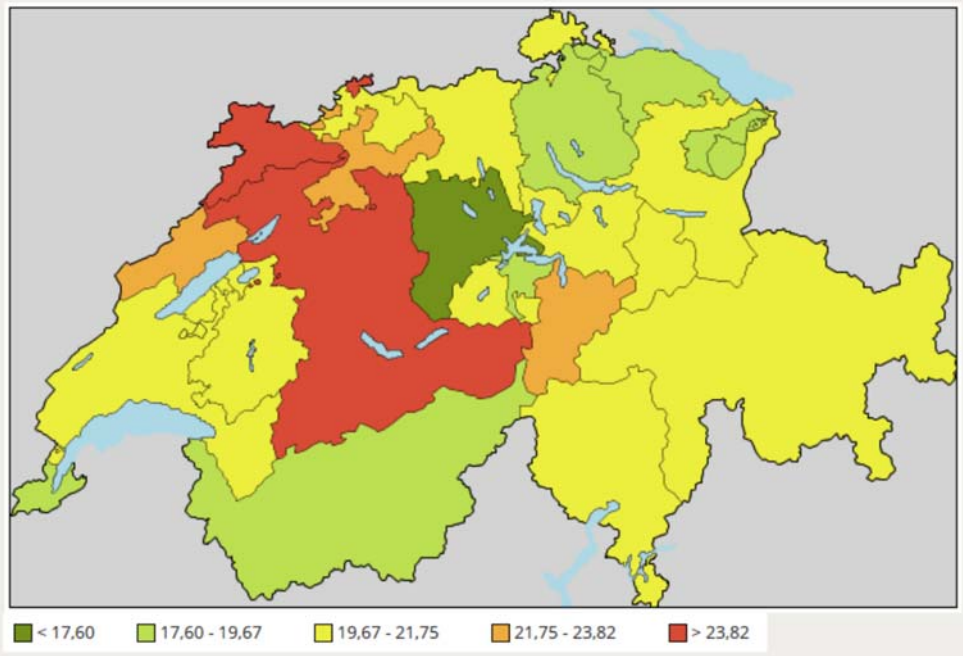
Source: SFOE,
Swiss renewable energy statistics 2019, June 2020

RES objectives

- Objective of Energy Strategy 2050: Increase in annual generation of renewable energy (excl. hydropower):
  - By 2020: 4,400 GWh
  - By 2035: 11,400 GWh
- The increase in generation of renewable energy results in volatile loop flows due to the highly variable production patterns
- There are not enough ways to store excess energy
- This grids no longer satisfy current transportation needs

Source: SFOE: Swiss renewable energy statistics 2018, Energy Strategy 2050 document following the referendum on 21 May 2017

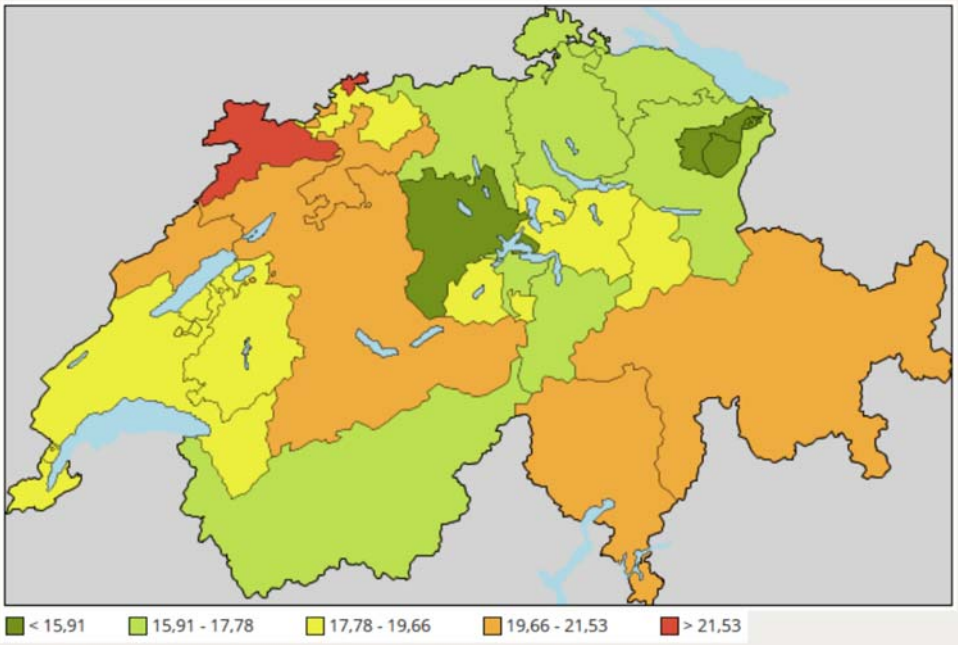
Regional price differences for households



Electricity price for 2020 in CHF/MWh, category H4: flat with 5 rooms, 4,500 kWh/a, Standard product

Source: ElCom, www.strompreis.elcom.admin.ch

Regional price differences for industry consumers

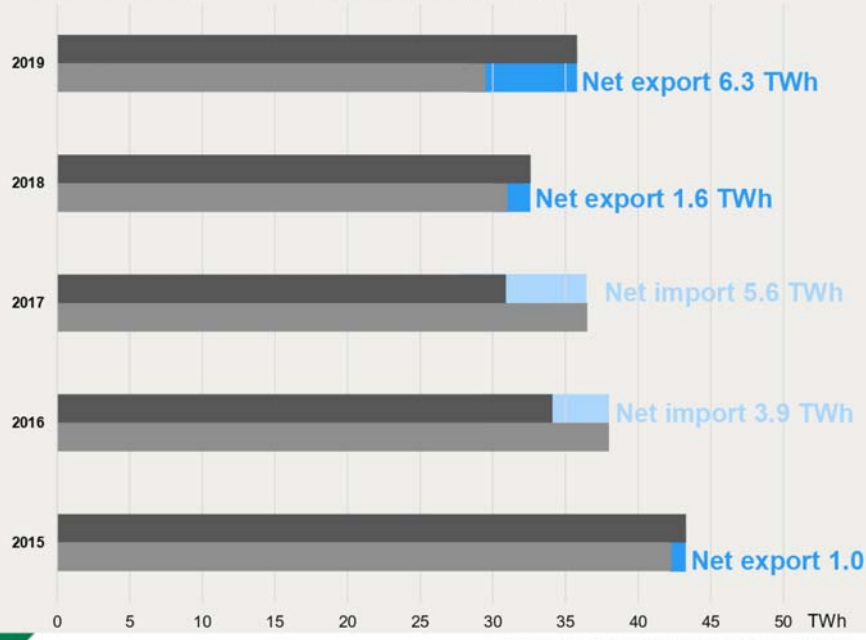


Electricity price for 2020 in CHF/MWh, category C3: mid-size company with 150,000 kWh/a, max. 50 kW

Source: ElCom, www.strompreis.elcom.admin.ch

Power balance: import and export

Import and export of energy in TWh per year



Ratio of the cross-border energy flows 2019

Source: SFOE, Swiss electricity statistics 2019, 2018, 2017, 2016
Cross-border energy flows, Swissgrid

Challenge: no bilateral electricity agreement with the EU

- Increasing transit through Switzerland carries the danger of overloading.
- Unplanned load flows have increased considerably.
- Increasing interventions in real-time operations are necessary – emergency measures are becoming a normal incidents.
- With the introduction of market coupling in Europe: ten-fold increase in n-1 violations.

→ High costs with no benefits for Switzerland

→ Impairment of grid stability

→ Impairment of import capability

→ Negative implications for the security of supply