ENERGY STRATEGY 2050
MONITORING REPORT
2018 ABRIDGED VERSION

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

CONTENTS

CONTENTS

INTRODUCTION

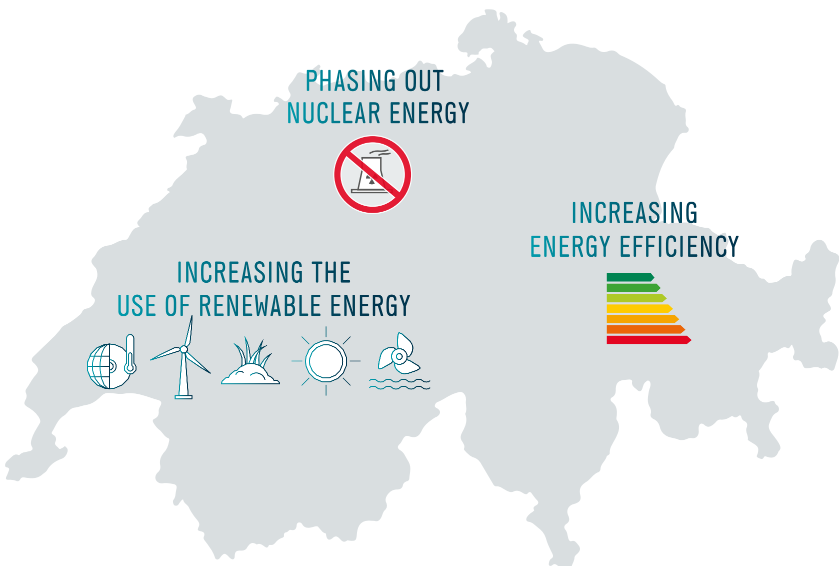
Switzerland has reorganised its national energy policy as a result of the adoption of Energy Strategy 2050. The energy strategy should facilitate the gradual phasing out of nuclear energy and the successive reorganisation of the Swiss energy system by 2050. The entire process will take place while maintaining the high degree of security of supply and Switzerland's reasonable prices for energy. The intention is to significantly increase energy efficiency and the share of renewable energy used in the energy mix as well as reduce CO_2 emissions from energy sources. In addition, no further general licences for the construction of nuclear power plants may be issued (Federal Council, 2013).

Continued ▸ ▸ ▸

In the referendum of 21 May 2017 Swiss voters accepted the new energy legislation, which entered into force at the beginning of 2018. The new Energy Act (EnG) defines the guidelines for energy and electricity consumption, production from new renewable sources, and hydropower. It also provides for financial measures to expand the use of renewable energies and to support existing hydropower plants. Parliament defined the time limits for these measures in the Act. In the dispatch on the Climate and Energy Incentive System (KELS) the Federal Council proposed a change from a promotion to a steering system (Federal Council, 2015) for the period after the funding measures expire (Federal Council 2015). However, Parliament did not approve the bill. In the climate sector and with reference to the reduction of use of fossil energy the focus is now on the next stage of the Swiss climate policy which is currently being dealt with by Parliament (Federal Council, 2017a). In the consultation procedure on the amendment of the Federal Electricity Supply Act, the Federal Council has also proposed that the electricity market be adapted with the aim of guaranteeing long-term security of supply, increasing economic efficiency and accelerating market integration of renewable energies (Federal Council, 2018c).

The reorganisation of the Swiss energy system needed for Energy Strategy 2050 is a long-term project. Because of the long time period involved, the Swiss Federal Office of Energy (SFOE) has established a monitoring system in cooperation with the State Secretariat for Economic Affairs (SECO) and other federal offices that will facilitate observation of significant developments and progress, measurement of the degree to which targets are attained, examination of the economic cost and

Source: SFOE/heyday



↗ www.energystrategy2050.ch

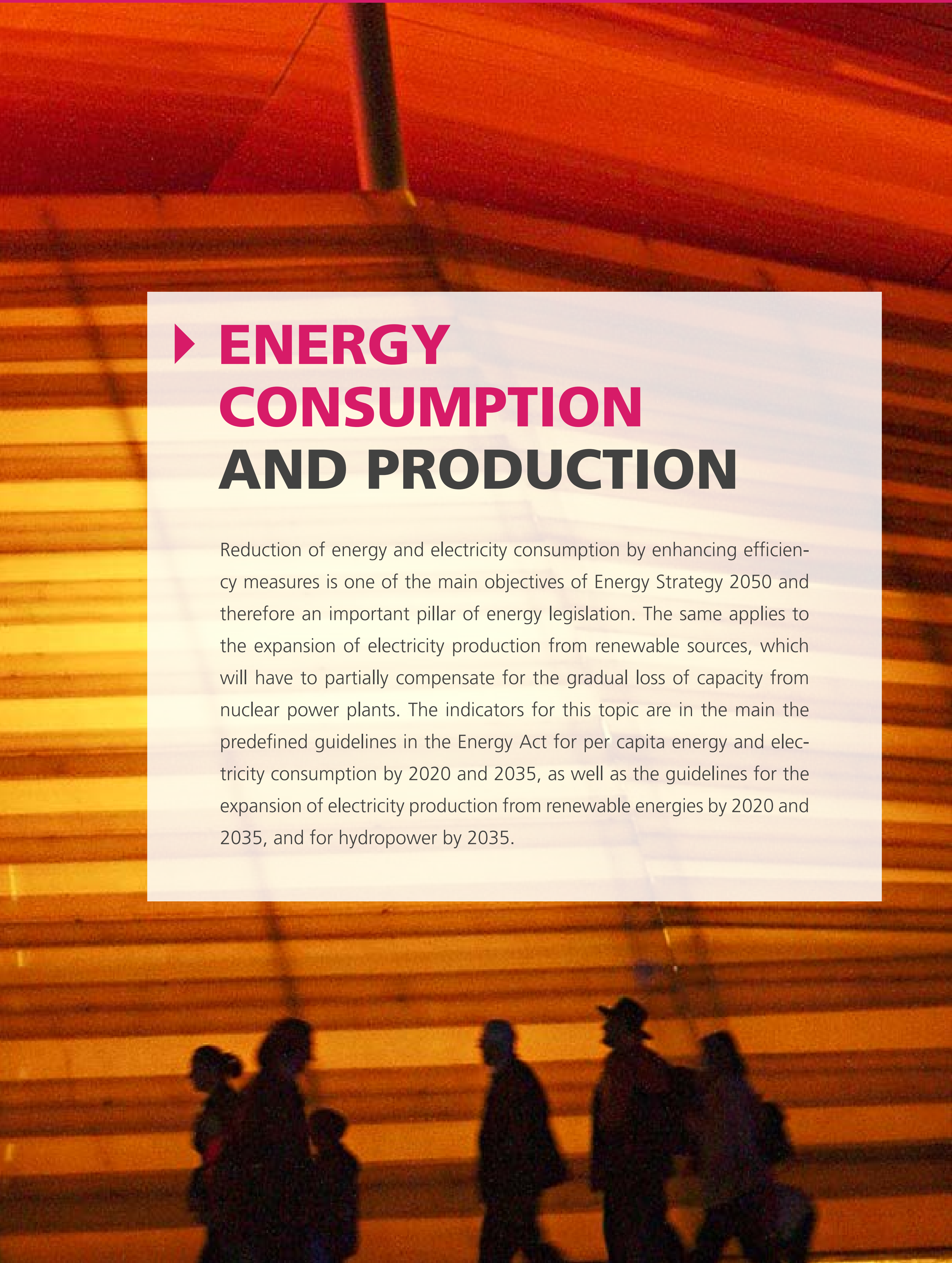
benefit of measures, and early intervention and steering of events based on facts in the case of undesirable developments. The legal bases for the monitoring procedure are provided in the new energy legislation and in particular Art. 55ff of the Energy Act (EnG) and Art. 69ff of the Energy Ordinance (EnV). Article 74A of the Nuclear Energy Act (KEG) is also relevant to reporting about the development of nuclear technology.

The current Monitoring Report for 2018 (abridged version, most data stem from before and up to 2017), deals first with selected indicators and contains a descriptive part containing the seven topics mentioned below derived from Energy Strategy 2050, the Energy Act and other State bills (which include the Electricity Grid Strategy, climate policy, and Swiss Coordinated Energy Research):

TOPIC	ENERGY CONSUMPTION AND PRODUCTION
TOPIC	GRID DEVELOPMENT
TOPIC	SECURITY OF SUPPLY
TOPIC	EXPENDITURE AND PRICES
TOPIC	CO_2 EMISSIONS FROM ENERGY SOURCES
TOPIC	RESEARCH AND TECHNOLOGY
TOPIC	INTERNATIONAL ENVIRONMENT

Further indicators can be found in **the full version of the Monitoring Report** (see **www.energymonitoring.ch**).

In addition, the Federal Council will report to Parliament every five years examining further questions and topics more deeply.



ENERGY CONSUMPTION AND PRODUCTION

Reduction of energy and electricity consumption by enhancing efficiency measures is one of the main objectives of Energy Strategy 2050 and therefore an important pillar of energy legislation. The same applies to the expansion of electricity production from renewable sources, which will have to partially compensate for the gradual loss of capacity from nuclear power plants. The indicators for this topic are in the main the predefined guidelines in the Energy Act for per capita energy and electricity consumption by 2020 and 2035, as well as the guidelines for the expansion of electricity production from renewable energies by 2020 and 2035, and for hydropower by 2035.

FINAL ENERGY CONSUMPTION PER PERSON AND YEAR

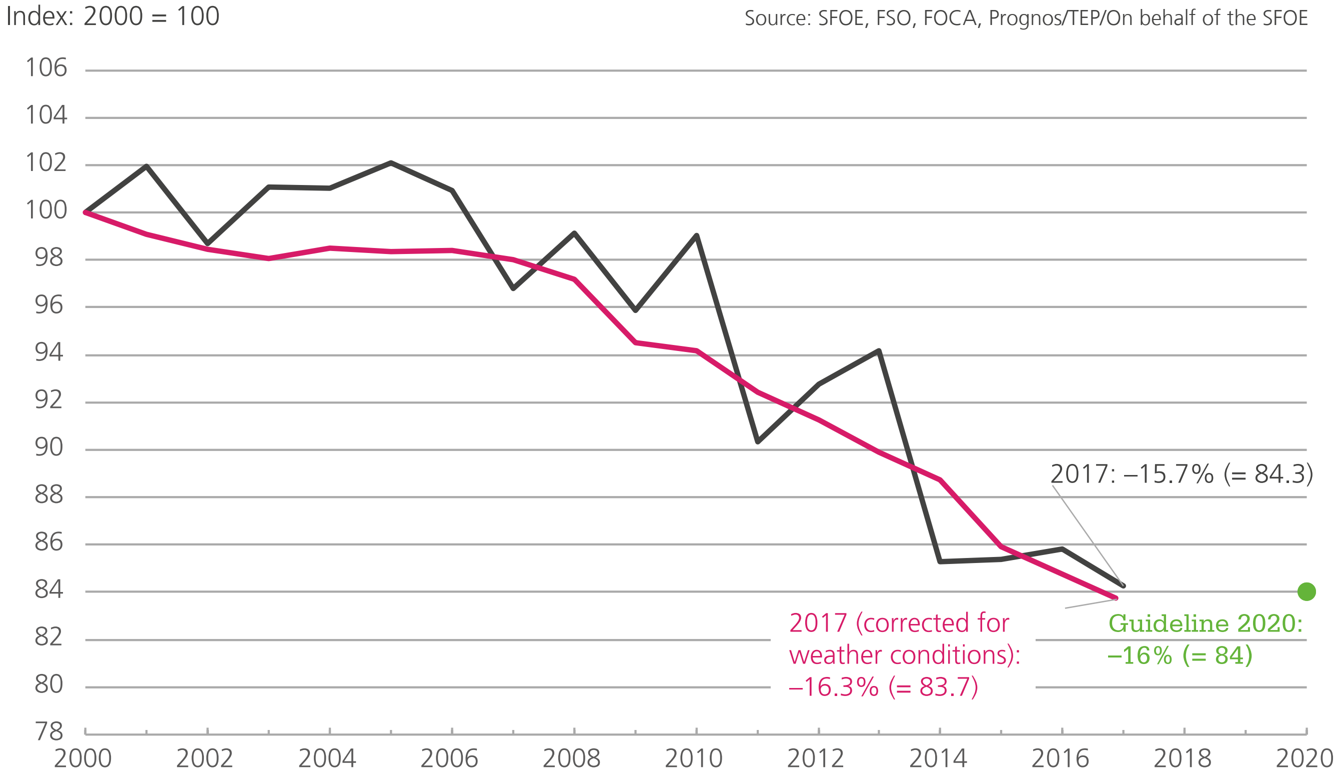


Figure 1: Development of per capita final energy consumption[1] since 2000 (indexed)

The per capita final energy consumption has fallen since 2000, as indicated in **figure 1**. The decline is a consequence of the lower absolute energy consumption in 2017 (-0.9 percent) compared to 2000 while at the same time the population increased by 17.6 percent. According to the Energy Act, the reduction target for 2020 is 16 percent in comparison to base year 2000, and 43 percent by 2035. In 2017 the per capita energy consumption was 90.7 gigajoules (0.025 GWh), and thus 15.7 percent lower than in 2000. When adjusted to take account of the weather the decline was 16.3 percent, thus undercutting the target for 2020 (cf. red curve). The slight fall in the final energy consumption in 2017 compared to 2016 was among other reasons a consequence of the warmer weather which led to a corresponding decline in demand for space heating. Over the entire period under consideration from 2000 to 2017, volume effects led to increased consumption; all "pure" growth effects were counted, such as the overall economic output (excluding structural effects), population, energy consumption area, and the number of motor vehicles. Effects which tended to increase consumption were compensated in particular by political measures and technological progress, which have increasingly led to a reduction in consumption since 2000. Substitution of heating oil with gas and the increasing use of district heating, ambient heat and wood tended to reduce consumption between 2000 and 2017. A trend toward substituting petrol with diesel fuel was also observable until 2017 (sources: SFOE, 2018a / FSO, 2018a / FOCA, 2018 / Prognos/TEP/Infras, 2018a+b).

1 Excluding international air traffic, excluding compressor gas consumption in the gas transit pipeline, excluding statistical difference and agriculture

ELECTRICITY CONSUMPTION PER PERSON AND YEAR

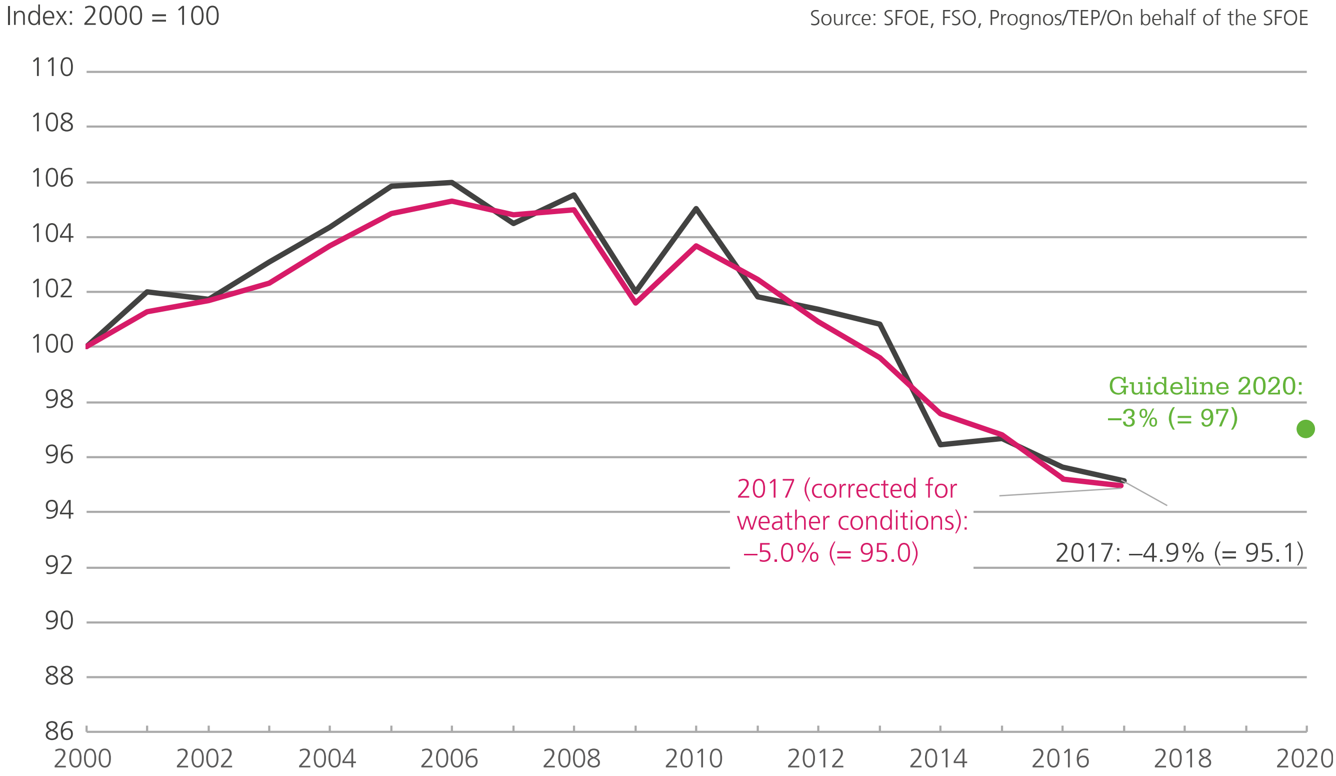


Figure 2: Development of per capita electricity consumption[2] since 2000 (indexed)

The per capita electricity consumption increased between 2000 and 2006 because the absolute electricity consumption rose by 10.3 percent while the population only increased by 4.2 percent. Since 2006 the trend has been reversed, as indicated in **figure 2**. Electricity consumption increased by only 1.2 percent between 2006 and 2017 while the population increased in the same time period by 12.0 percent. The major decline in per capita consumption in 2009 is a result of a clear cooling off in the economy. According to the Energy Act, the reduction guideline for per capita electricity consumption for 2020 is 3 percent in comparison to base year 2000, and 13 percent by 2035. In 2017 per capita electricity consumption was 24.5 gigajoules (0.007 GWh), and thus 4.9 percent less than in 2000. When adjusted to take account of the weather, the decline was 5.0 percent (cf. red curve) which means the guideline for 2020 has already been undercut. In 2017 the absolute electricity consumption increased slightly compared to 2016 because of volume effects (economic output, population, energy consumption area). The marginally warmer weather only had a minimal impact on electricity consumption. The long-term increase in electricity consumption during the entire monitoring period from 2000 to 2017 was mainly caused by volume effects and to a lesser degree structural effects (e.g., differing growth rates in individual branches of industry). Energy policy instruments and measures (e.g., political requirements and the voluntary measures from the SwissEnergy programme) and technological developments (construction measures such as insulation and use of more efficient heating plant, electrical devices, lighting, and machines, etc.) had the opposite effect and increasingly tended to reduce electricity consumption (sources: SFOE, 2018a / FSO, 2018a / Prognos/TEP/Infras, 2018a+b).

2 Excluding statistical difference and agriculture

ELECTRICITY PRODUCTION FROM RENEWABLE ENERGIES (EXCLUDING HYDROPOWER)

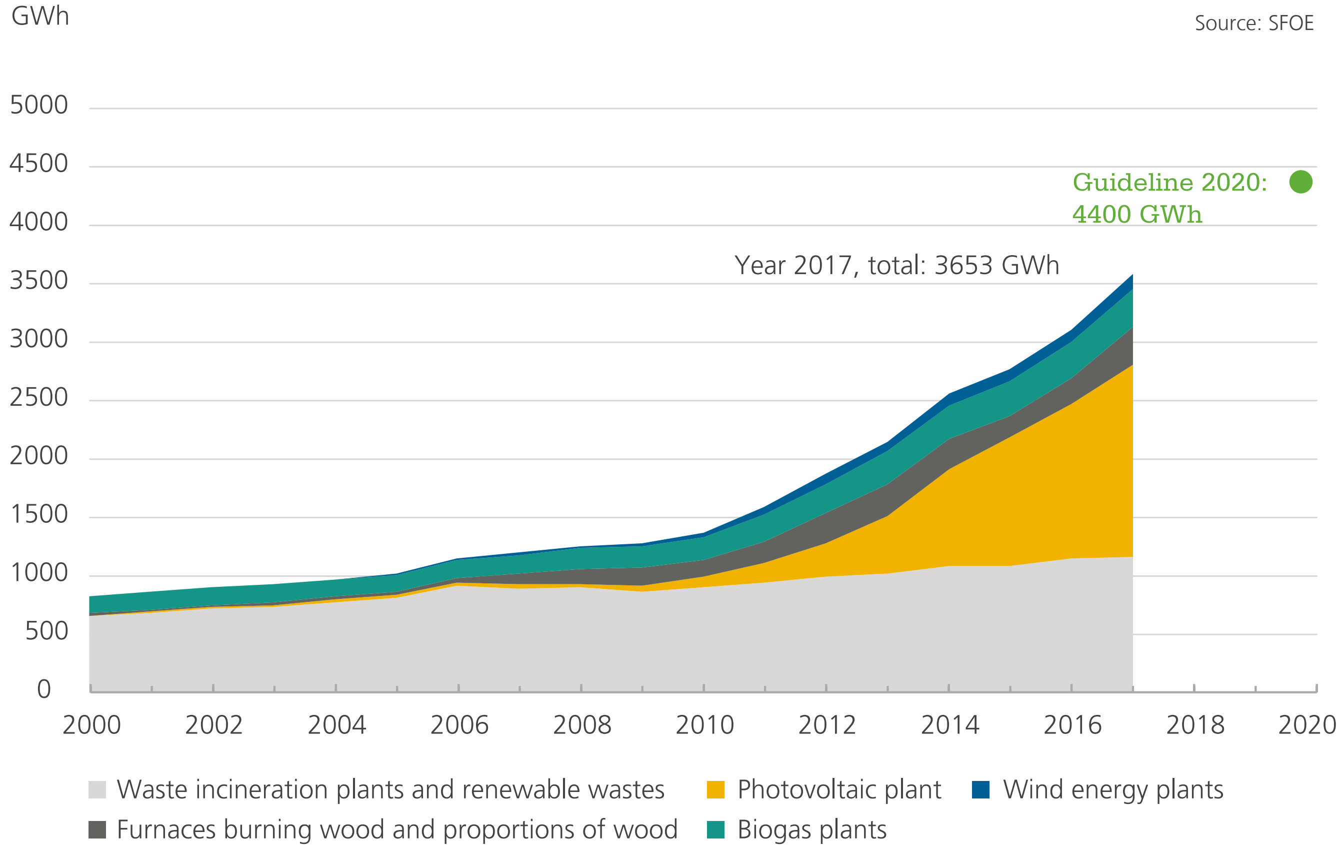


Figure 3: Development of electricity production from renewable energies (excluding hydropower) since 2000 (GWh)

Electricity production from renewable sources has increased since 2000, as indicated in **figure 3**. Production gained momentum from 2010 on. In 2017, 3653 gigawatt-hours (GWh) were produced; this corresponds to 6.4 percent of the overall net electricity production (excluding consumption by storage pumps). In base year 2010 electricity production from renewables was 1402 GWh. As a consequence, between 2010 and 2020 a net increase in capacity of about 3000 GWh will be striven for. Of this increase about 75.1 percent had already been attained in the reporting year. In 2017 the net increase in capacity compared to 2016 was 486 GWh; since 2011 an average increase of 322 GWh per year has been attained. On average an annual net additional capacity of 249 GWh will be required in the next few years to attain the guideline of 4400 GWh in 2020. The guideline for 2035 is 11 400 GWh. When broken down according to technology, it is apparent that the photovoltaic sector has increased strongly in absolute terms since 2010. Electricity production has also increased from waste incineration plants and renewable wastes as well as furnaces burning wood and proportions of wood. Production from biogas and wind has grown slightly less. No geothermal facilities for electricity production are being realised currently (source: SFOE, 2018a).

ELECTRICITY PRODUCTION FROM HYDROPOWER

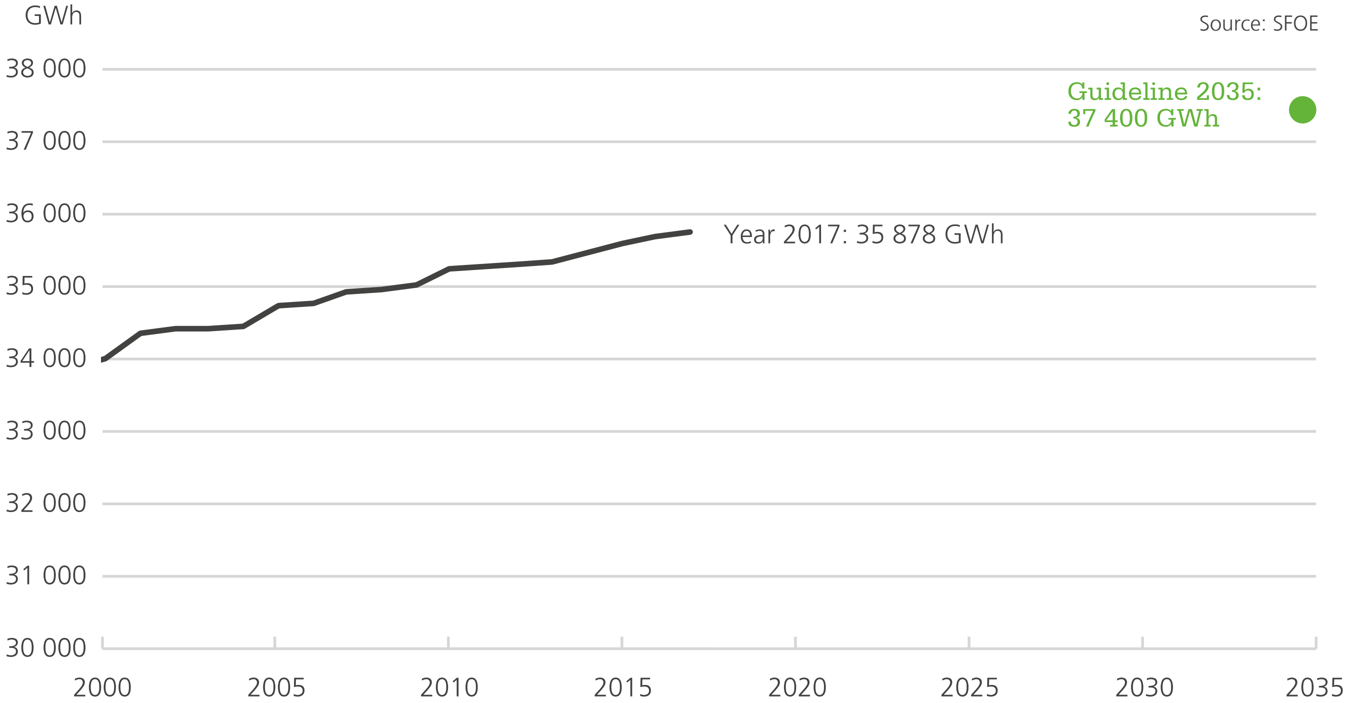
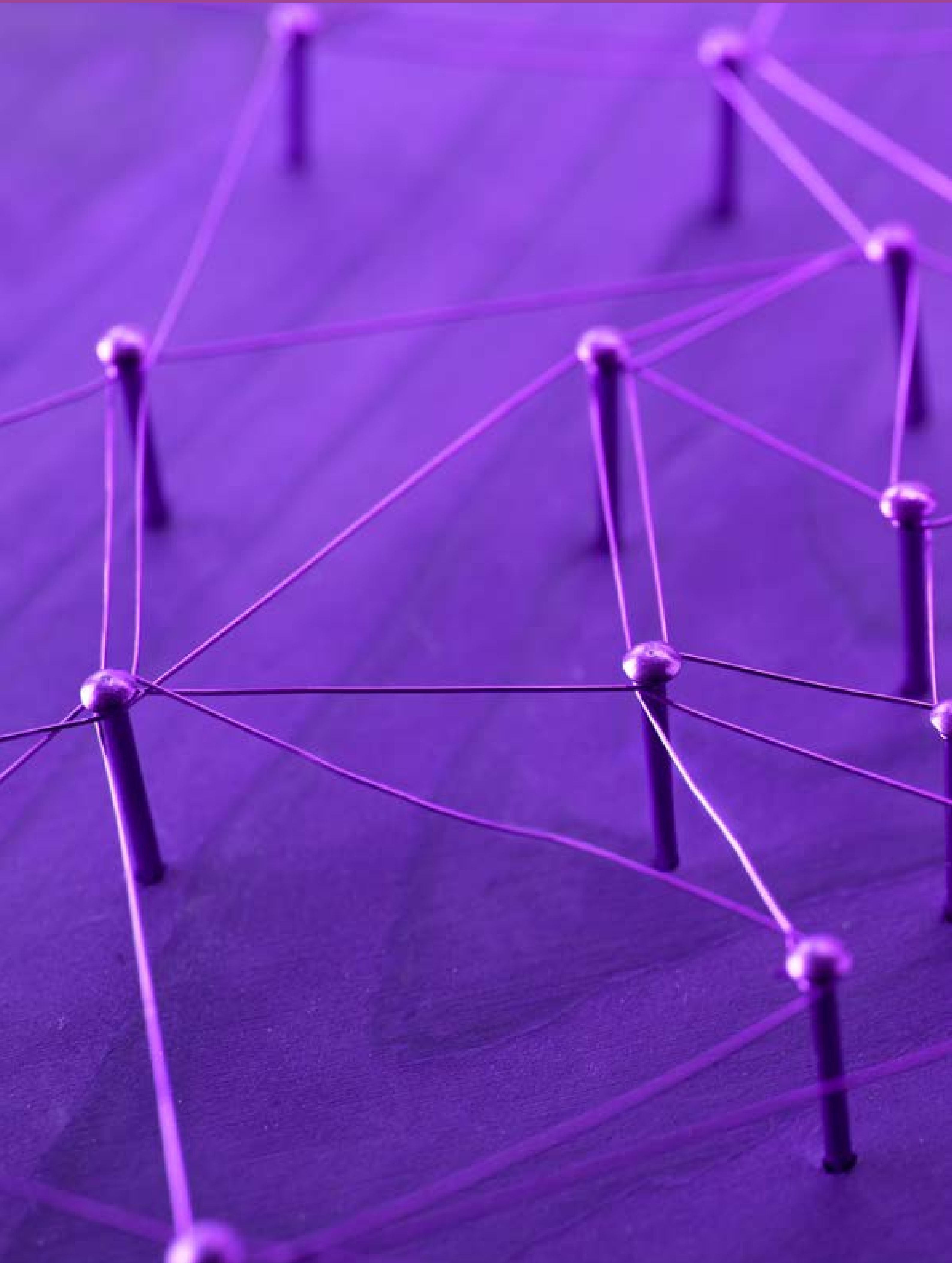


Figure 4: Development of anticipated average production[3] of electricity from hydropower since 2000 (in GWh)

Figure 4 (N.B. scale does not begin at zero) shows that electricity production from hydropower has grown continuously since 2000; this growth is primarily due to the addition of new facilities and expansion and optimisation of existing facilities. In 2017 (as at 1 January 2018) the anticipated average production was 35 878 GWh. In base year 2011 (as at 1 January 2012) the figure was 35 354 GWh. To achieve the guideline between 2011 and 2035 a net increase in capacity of about 2000 GWh will be striven for. In the reporting year about 25.6 percent of this increase had already been attained. In 2017 the net expansion in capacity compared to 2016 was 55 GWh; since 2011 this has been on average 87 GWh per year. To achieve the guideline by 2035, an average annual net increase in capacity of 85 GWh will be required over the coming years (source: SFOE, 2018b).

3 Anticipated average production including anticipated production from small power plants <300 kW (according to statistics for hydropower plant in Switzerland, WASTA). Excluding average energy required for all storage system pumps (an efficiency rate of 83% is assumed) and excluding electricity required for recirculation.

↗ More detailed indicators to the topic
ENERGY AND -PRODUCTION
(See the detailed version of
the Monitoring Report)



GRID DEVELOPMENT

The reorganisation of the energy system required in connection with Energy Strategy 2050 and the new international environment place new demands on the energy grid. Development of the electricity grid is crucial because it is the link between production and consumption. Grid development is also the focus of the dispatch on the Federal Act on the Transformation and Extension of the Electricity Grid (Electricity grid strategy), which is part of the energy strategy, but was handled in a separate bill (Federal Council, 2016). Parliament adopted the bill in the 2017 winter session. It is expected to go into force in the second quarter of 2019. The focus of the monitoring programme is firstly on the electricity grid.

STATUS AND DURATION OF GRID PLANS

Energy Strategy 2050 and the Electricity Grid Strategy create reliable conditions for a needs-based, targeted development of electricity grids to guarantee the security of the electricity supply. To this end the standards for assessing the need to expand and modernise Switzerland's electricity grid have been developed, the authorisation procedures for line projects optimised and the requirements for deciding whether to place cables underground or to use overhead transmission lines have been also elaborated. The intention of the new regulations is to increase transparency in the grid planning process and improve acceptance for grid plans in general. The focus will be on the Swiss transmission grid: It will have to guarantee the transmission of energy fed in from domestic production centres as well as imported energy over long distances to centres of consumption in a satisfactory and safe way. In addition the grid will have to compensate for fluctuating rates of energy fed in from renewable energies through imports and exports as well as cope with the complementary characteristics of various types of power plant.

PROCEDURE AND PHASES OF A GRID PLAN IN THE TRANSMISSION GRID

Preliminary project: As the basis for the sectoral plan procedure, the national grid company Swissgrid draws up a preliminary project with the key parameters of the grid plan and makes sure the concerns of the cantons affected by the project are considered as early as possible in the planning stage. For the purposes of the monitoring programme the preliminary project phase begins simply with the start of the project and ends when the application is submitted for the plan to be incorporated in the sectoral plan for transmission lines (German SÜL). If a plan is not yet in either the preliminary phase or construction project phase and thus in an early stage of planning, it is designated in the monitoring programme as a **project proposal**.

SÜL: If a grid transmission line project will have a substantial impact on the area and the environment, a sectoral plan procedure has to be carried out before the planning approval procedure begins (see below). The SÜL applies to the electrical power line sector. The Swiss Federal Office of Energy (SFOE) is responsible for the SÜL procedure and receives support from the Federal Office for Spatial Development (ARE). In the first stage of the sectoral plan procedure a **planning area** is determined and in the second stage a **planning corridor** is selected for the path of the transmission line. At the same time as the planning corridor is determined, a decision is made as to which **transmission technology** will be employed (overhead transmission line or underground cable). The SÜL phase begins when Swissgrid submits an application for an SÜL procedure and ends when the decision is taken on the planning corridor by the Federal Council in the appropriate coordination plan. This plan is binding on all authorities, which means they have to take it into consideration when approving the plan and in any other spatial development activities.

In April 2015, the national grid company Swissgrid submitted a strategic grid plan[4] which took into consideration the gradual phasing out of nuclear power in accordance with Energy Strategy 2050 including suitable projects to upgrade and expand the transmission grid by 2025. The current monitoring process will follow the status and duration of grid plans at transmission grid level included in the Strategic Grid 2025 plan (excluding plans initiated by third parties) and the Nant de Drance connection. The focus will be on the transmission line projects mentioned in **figure 5.**

4 vgl. www.swissgrid.ch/netz2025

Construction project: Once the planning corridor has been determined, Swissgrid's grid plan is elaborated in a concrete construction project. The company has to guarantee that the line will be built using the transmission technology determined and that the line route lies within the planning corridor that has been laid down. In the current monitoring procedure the construction project phase begins with the determination of the planning corridor (corresponds to the end of the SÜL phase). In projects for which no SÜL is employed, the start of the construction project is as laid down in the appropriate SIA standard.

Planning approval procedure (German PGV): Swissgrid now submits the elaborated construction project (detailed project) together with the application for planning approval to the Federal Inspectorate for Heavy Current Installations (ESTI). This signals the start of the planning approval procedure (PGV). ESTI is responsible for checking the dossier and for issuing planning approval. During the PGV checks are made to ensure compliance with safety regulations and legal stipulations, in particular environmental and spatial planning legislation. Additionally, checks are made of the grid plan to ensure conformity with the interests of private persons (landowners, neighbours). If ESTI is unable to resolve all the objections or cannot handle all the differences with the various state authorities concerned, the dossier is entrusted to the SFOE. The SFOE then proceeds with the planning approval procedure and issues planning approval provided the grid plan is in conformity with the legal requirements. A decision is also made on any other objections (for example objections to compulsory purchase). The parties involved can appeal to the Federal Administrative Court (BVGer) and thereafter in certain cases to the Federal Tribunal (BGer). If the SFOE approves the application for planning approval and no other objections are submitted within the legal deadlines, planning approval becomes final and Swissgrid can realise the transmission line project.

Realisation: For monitoring purposes the start of the realisation phase is counted as the date of the legally valid decision on planning approval. The realisation phases ends when the grid plan goes into operation.

GRID PROJECT	DESCRIPTION AND MAIN AIMS	CURRENT STATUS[5]	PLANNED OPERATION[6]
1. Chamoson–Chippis	▪ New 30 km long 380 kV overhead transmission line between Chamoson and Chippis ▪ Dismantling of almost 89 km of power lines in the Rhone plain ▪ Transfer production from hydropower plants in Valais ▪ Improved connection between Valais and the Swiss and European high tension grid ▪ Contribution to grid security in Switzerland	Realisation	2021
2. Bickigen–Chippis (Gemmi line)	▪ Modernisation of substations at Bickigen and Chippis and of the existing 106 km route by increasing current to 380 kV ▪ Installation of a 220/380 kV grid coupling transformer in the Chippis switchgear facility ▪ Improved transfer of electricity production from Valais ▪ Contribution to security of supply	PGV SFOE	2021
3. Pradella–La Punt	▪ Increase voltage from 220 to 380 kV on existing 50 km route ▪ Modification of switchgear at Pradella and increase of voltage to 380 kV ▪ Elimination of existing bottleneck ▪ Contribution to Swiss and European grid security	Realisation	2021
4. Chippis–Lavorgo 4.1. Chippis–Mörel 4.2. Mörel–Ulrichen (Gommer line) 4.3. Chippis–Stalden 4.4. Airolo–Lavorgo	▪ Increase voltage to 380 kV on 124 km Chippis-Mörel-Lavorgo axis (Chippis-Stalden remains at 220 kV) ▪ Dismantling of existing lines over 67 km ▪ Supplements the main supply route for Ticino ▪ Elimination of a critical supply bottleneck	4.1. Construction project 4.2. BVGer (Mörel-Ernen)/ Realisation (Ernen-Ulrichen) 4.3. PGV SFOE (Agarn-Stalden)/Construction project (Chippis-Agarn) 4.4. Construction project	2024
5. Beznau–Mettlen 5.1. Beznau–Birr 5.2. Birr–Niederwil 5.3. Niederwil–Obfelden 5.4. Obfelden–Mettlen	▪ Optimisation of existing route over 40 km by increasing current to 380 kV and upgrading on a stretch of 24 km ▪ Elimination of a structural bottleneck ▪ Creation of the conditions needed to combine domestic hydropower plants with fluctuating energy from wind and photovoltaic plant to respond to demand	5.1. Realisation 5.2. Preliminary project 5.3. SÜL 5.4. Preliminary project	2025

GRID PROJECT	DESCRIPTION AND MAIN AIMS	CURRENT STATUS[5]	PLANNED OPERATION[6]
6. Bassecourt–Mühleberg	▪ Upgrading of the existing line over a length of 45 km by increasing the voltage level to 380 kV because decommissioning Mühleberg nuclear power plant will lead to withdrawal of some feed-in at the 220 kV grid level ▪ Contribution to Swiss grid security and security of supply	PGV SFOE	2025 From the end of 2019 technically ready for provisional change to 380 kV if required in compliance with the original authorisation for the line
7. Magadino	▪ Installation of transformers between the 220 kV and 380 kV grids ▪ The aim is to improve the transfer of energy generated in Maggiatal by hydropower ▪ Contribution to security of supply in Ticino	Project idea	2024
8. Génissiat–Foretaille	▪ Upgrading of (replacement of cable) the existing 220 kV twin lines over a length of 17 km ▪ Eliminates frequent bottlenecks which occur for imports from France	In operation	Concluded in 2018 and in operation
9. Mettlen–Ulrichen 9.1. Mettlen–Innertkirchen 9.2. Innertkirchen–Ulrichen (Grimsel line)	▪ Upgrade the existing 220 kV line over 88 km to cope with a future increase to 380 kV ▪ Important for the connection of new pump storage power plants to the 380 kV grid and transfer of energy to the rest of Switzerland	Preliminary project	2030
Anschluss Nant de Drance NdD_1 Le Verney/Rosel–Bâtiaz NdD_2 Bâtiaz–Châtelard NdD_3 Châtelard–Nant de Drance	▪ Connection of pump storage power plant Nant de Drance to the high tension grid ▪ Part of the strategic grid in the Swissgrid initial grid ▪ Contribution to integrate new renewable energy sources	NdD_1 Realisation NdD_2 in operation NdD_3 Realisation/partly operational	2017–2019

Figure 5: Overview of grid projects, status and proposed date of operation (as at 17.10.2018)

5 As at 17 October 2018

6 According to Swissgrid plans

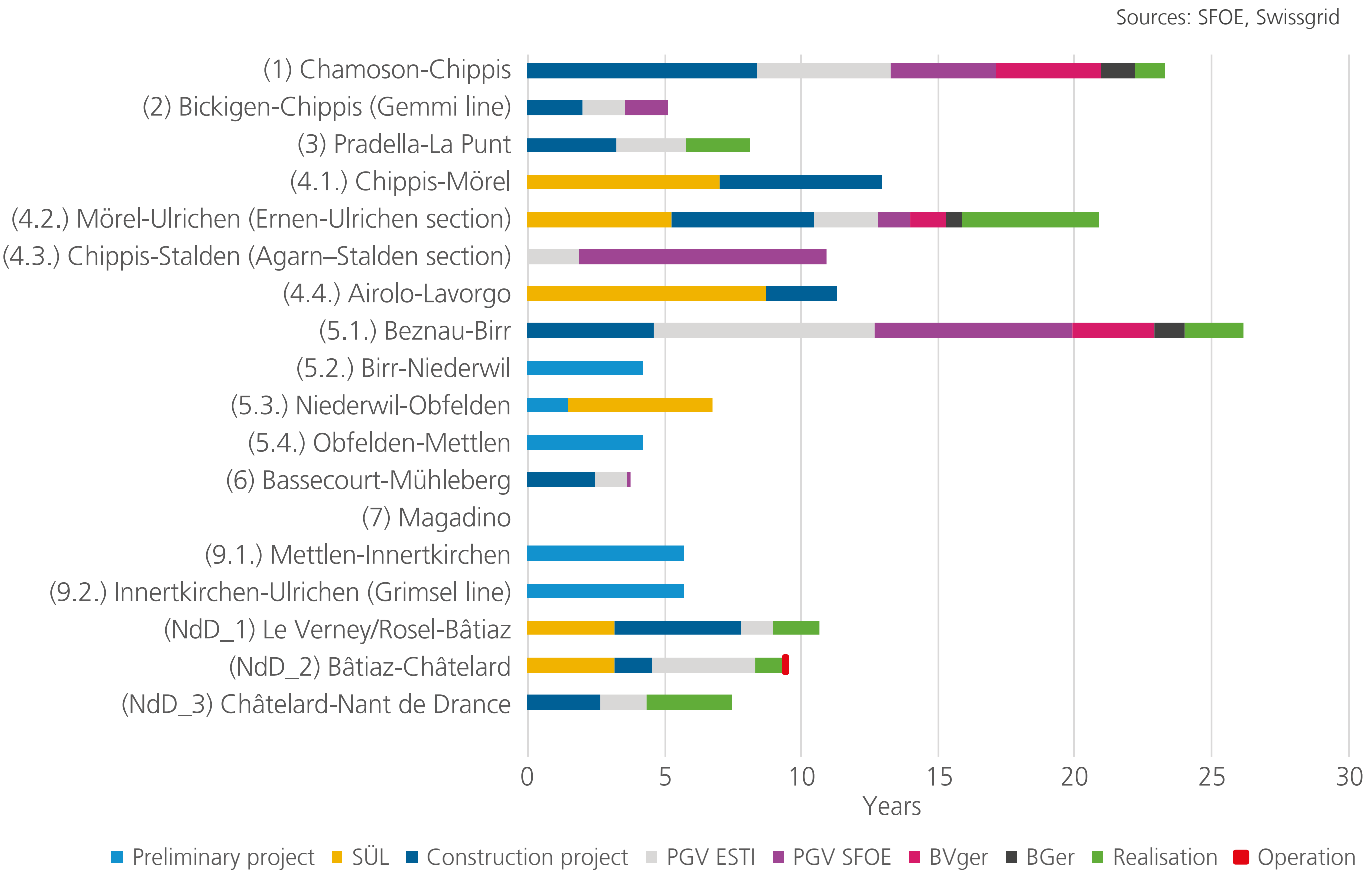


Figure 6: Accumulated duration of project phases of selected grid plans in years on grid level 1 as at 17 October 2018[7]

Figure 6 presents the duration of each individual project phase for the grid projects listed above. The duration is presented in a simplified manner in that any supplementary loops in the course of the project (that is if the procedure is returned to the SFOE after a decision by the Federal Administrative Court and/or the Federal Tribunal) are not shown separately. If specific project phases have to be gone through again as a result of a court decision, the overall duration of single project phases is presented as if each was unique and proceeded linearly. The figure corresponds to the initial position as it appears according to current legislation. No statement is implied as to whether or not Energy Strategy 2050 and the Electricity Grid Strategy will be able to further optimise the procedures as anticipated at present because the corresponding legislation will only come into force completely in mid-2019. The new stipulations are intended to optimise and streamline the authorisation procedures

7 Remarks on the method used: a) In the case of grid plans with a long preliminary period the duration was calculated from the relaunch of the project concerned; b) in the case of plans with a long preliminary period, it is not always possible to establish the preliminary project phase and the construction project phase, which is why they are not shown in the figure in some cases; c) assumptions were made in agreement with Swissgrid about some dates which are no longer known; d) when the courts refer a PGV decision to the SFOE, half of the supplementary duration of the procedure is allotted to the PGV phase and half to the construction project phase.

BRIEF DESCRIPTION OF EACH GRID PLAN (AS AT 17 OCTOBER 2018):

1. Chamoson–Chippis
Construction of the new line from Chamoson to Chippis in the Canton of Valais was initiated before the transmission grid sectoral plan (SÜL) was elaborated and the project was the subject of planning and authorisation phases for many years. An important milestone was reached in 2017: in its decision of 1 September 2017 the Federal Tribunal dismissed the appeals against the decision of the Federal Administrative Court of 14 December 2016 and confirmed the PGV decision of the SFOE of 19 January 2015. Since then Swissgrid has been preparing to construct the new overhead transmission line. Construction started in 2018. As before there is still strong resistance to the project among the population. Two former appellants have each lodged appeals and one petition has been made to the Federal Tribunal to grant the appeal suspensive effect, however the Federal Tribunal rejected the request for suspensive effect in October 2018. Decisions on the appeals are still pending. Operation of the line is planned for 2021.

2. Bickigen–Chippis
The SÜL procedure could be dispensed with for the project to increase the voltage and modernise the existing line between Bickigen and Chippis because the project only had a modest effect on the area. After a construction project phase of about two years, the PGV procedure started with an application to ESTI in mid-2015, and almost two years later the dossier was passed on to the SFOE. The PGV is currently pending at the SFOE. Operation of the line is planned for 2021.

3. Pradella–La Punt
As part of the project to increase grid capacity a second continuous 380-kV circuit will be added to the 50 km line between Pradella and La Punt. The transfer of energy on the existing 220-kV overhead transmission line between Zernez and Pradella from the Ova Spin power plant will be substituted by a 380-kV circuit. The energy generated at Ova Spin power plant will be transported over a new 110-kV valley cable, which still has to be constructed. No SÜL procedure was necessary because of the minimal effect on the area. The construction project and PGV phases each lasted about three years. The project has been in the process of realisation since mid-2016 because there was no opposition to the ESTI planning approval procedure. The line should go into operation in 2021.

4. Chippis–Lavorgo
The Chippis-Lavorgo grid project consists of a number of sub-projects: The project for the construction of the new *Chippis to Mörel line (4.1.)* was subject to an SÜL procedure lasting almost seven years and the construction project phase has been under way for just over six years. The project for new construction of the *Mörel-Ulrichen (4.2.)* line was subject to a planning and authorisation procedure lasting many years; between Ernen and Ulrichen construction of the new line is in progress according to plan; in the Mörel-Ernen section the Federal Tribunal ordered that a study on the use of a cable should be made for the "Binnegga-Binnachra-Hockmatta-Hofstatt" area (crossing the Binna) and this has been submitted to the SFOE; the SFOE approved the overhead line version on 23 December 2016 and turned down all objections. Appeals against the decision have been submitted to the Federal Administrative Court and these are still pending. The planning approval procedure for the additional line from *Chippis-Stalden (4.3.)* in the Agarn-Stalden sector is being

processed by the SFOE (procedure under former law, no SÜL procedure was carried out). However, in 2012, it was determined in the sectoral plan procedure for the line from Chippis–Mörel that the Chippis–Agarn section would have to be led through the planning corridor parallel to the Rhone Valley line. A construction project is now in preparation. The project for the construction of the new line from *Airolo-Lavorgo (4.4.)* was subject to an SÜL procedure lasting almost nine years and the construction project phase has been under way for just over two and a half years. It is still planned for the entire Chippis-Lavorgo grid project to be operational in 2024.

5. Beznau–Mettlen

The Beznau-Mettlen grid plan consists of a number of sub-projects: the *Beznau-Birr line (5.1.)* with partial underground cabling of “Gabihübel" at Riniken was initiated before the SÜL was elaborated and went through planning and authorisation phases lasting many years. A significant milestone was reached in 2016: planning approval given by the SFOE became final, so realisation of the project was initiated. However, contrary to the original plan, construction work could only begin in August 2018. The *Birr-Niederwil (5.2)* line is currently in the preliminary project phase. The same applies to the *Obfelden-Mettlen (5.4.)* section. The *Niederwil-Obfelden (5.3.)* project to increase the voltage level went through a preliminary project phase lasting about one and a half years and an SÜL procedure has been in progress for a number of years; a significant interim stage was reached in 2016 with the determination of the planning area. Operation of the overall Beznau-Mettlen grid project is planned for 2025.

6. Bassecourt–Mühleberg

The Bassecourt-Mühleberg high tension line was authorised by ESTI to operate at a voltage of 380 kV in 1978, however it has been operating at 220 kV up to now. No SÜL procedure was required for the envisaged increase in voltage because of the minimal effect the project would have on the area. After a construction project phase lasting about two and a half years, Swissgrid submitted the PGV dossier to ESTI on 30 June 2017. A number of objections to the project have been submitted. ESTI handed the dossier over to the SFOE on 24 August 2018. Operation of the line is planned for 2025 depending on the progress made with the current proceedings. The technical conditions required to potentially operate at 380 kV in the Bassecourt (increase to 380 kV) and Mühleberg (new 380/220 kV dome transformer) substations should be established by 2019.

7. Magadino

The project is still in the early stages and has been submitted as a project proposal. According to Strategic Grid 2025 operation was originally foreseen for 2018, however, according to updated plans it is now proposed for 2024.

8. Génissiat–Foretaille

Swissgrid has adapted the scope of the project and reduced it to resolving the bottlenecks between France and Switzerland. The original plan to strengthen the Foretaille-Verbois line on the Swiss side has been abandoned. Additional cables on the French side of the Génissiat-Verbois line and the corresponding modification of protection for the line in Switzerland and France are sufficient in the opinion of Swissgrid; the bottleneck in France has been eliminated. The project was concluded in 2018 and the line is in operation..

9. Mettlen–Ulrichen

The plan, which includes the sections *Mettlen-Innertkirchen (9.1.)* and *Innertkirchen-Ulrichen (9.2., Grimsel line)*, has been the subject of a preliminary project to prepare the SÜL procedure for a number of years. According to Strategic Grid 2025 operation was planned for 2025 but 2030 is envisaged at present.

Anschluss Nant de Drance

Connection of the Nant de Drance pump storage power plant to the high tension grid will contribute to integrating new renewable energies thus making it important with respect to Energy Strategy 2050. The project consists of three sub-projects. The first two sub-projects went through an SÜL procedure lasting about three years, followed by the construction project phase (almost five and one and a half years respectively) and the planning approval procedure (over one year and then almost four years). Both sub-projects were realised in 2016: the overhead line from Châtelard-La Bâtiaz was completed and became operational in 2017. The third sub-project has been under construction since July 2015 following on relatively quick construction project and PGV phases of two and a half and just under two years respectively (no SÜL procedure was necessary). Operation of the complete Nant de Drance connection is planned in stages beginning in 2018 (sources: SFOE/Swissgrid, 2018, Swissgrid 2015).

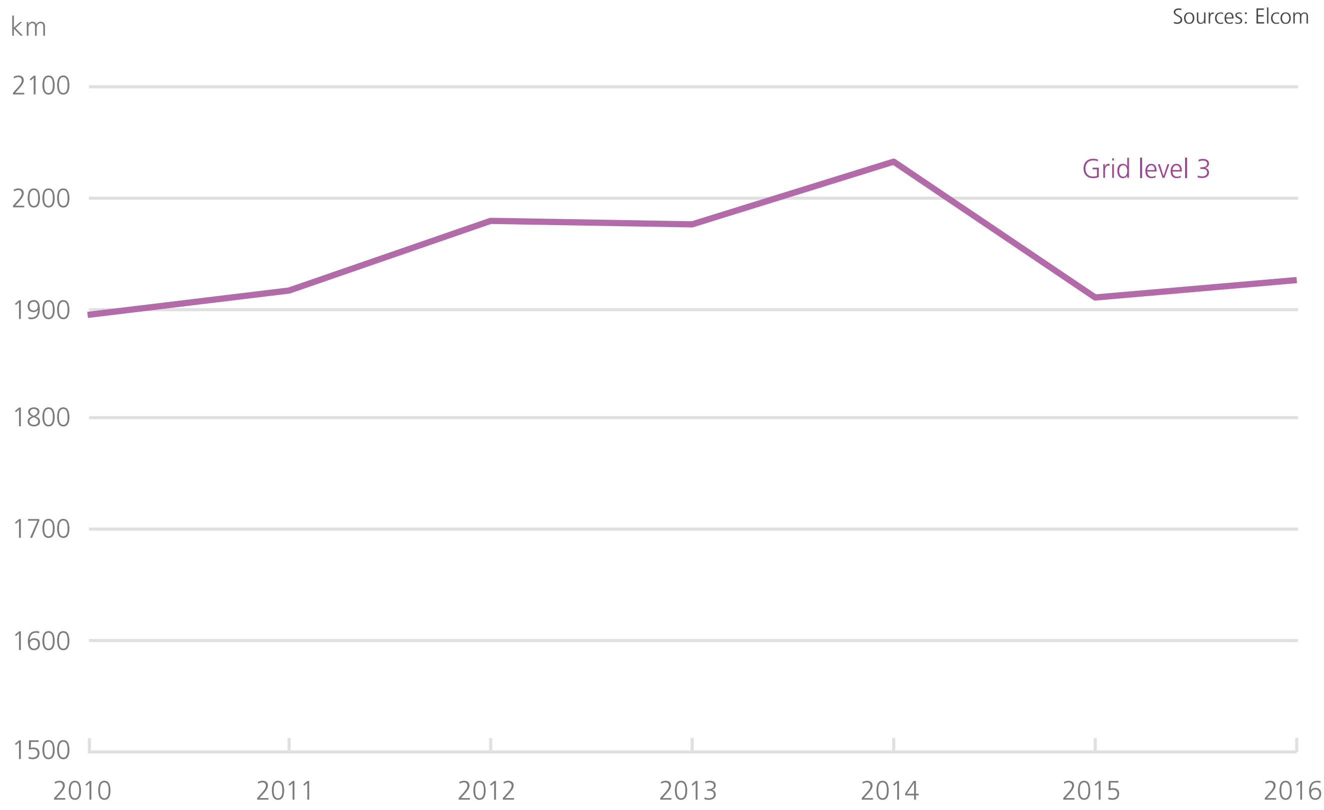
PLACING CABLES UNDERGROUND

Whether to construct a transmission grid cable (grid level 1) as an overhead line or place it underground has to be decided on the basis of objective criteria[8] on a case to case basis. Placing electricity cables underground can contribute to greater acceptance of line construction by the population meaning projects can be completed quicker. As a rule the quality of the countryside is improved. According to the Federal Act on the Transformation and Extension of the Electricity Grid (Electricity Grid Strategy), which is expected to go into force in the second quarter of 2019, distribution grid lines (grid levels 3, 5 and 7) will be placed underground provided a specific cost factor is not exceeded (cost overrun factor). For this reason development of the use of underground cable at distribution grid level is a subject of the monitoring process. This will also provide information about the impact of the cost overrun factor.

More cables have been placed underground at all grid levels of the distribution grid to varying extents since 2010, as indicated in **figure 7**. In general, there is more underground cable in use at lower grid levels; grid level 7 in particular consists almost entirely of underground cable. At grid level 5 cabling has advanced, in particular in urban areas. In contrast, only a slight increase in the number of underground lines can be observed at grid level 3, but to a lesser degree than at all other grid levels (cf. purple curve in the upper graph with differing scale). The trend toward underground cabling is not so pronounced at this level. In addition, between 2014 and 2015 a decline was observed the reasons for which are not yet clear. Overall, the three distribution grid levels are 196,639 km in length including domestic connections), of which almost 86 percent consists of underground cable. Up to now very few transmission grid (6.629 km in length) lines have been laid underground (grid level 1) (source: ElCom, 2018a).

8 cf. SFOE evaluation scheme for transmission grid lines: www.bfe.admin.ch

More detailed indicators on the topic of **GRID DEVELOPMENT** (See the detailed version of the Monitoring Report)



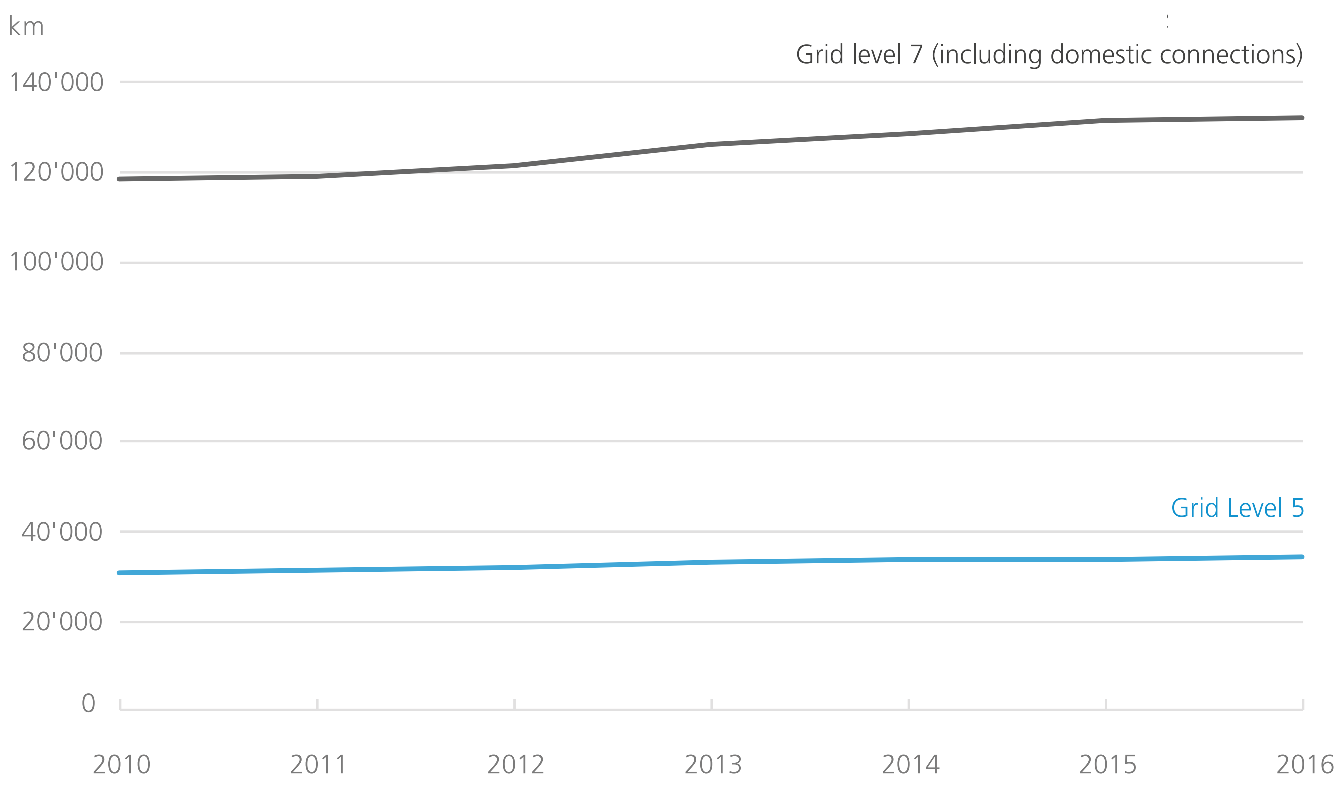


Figure 7: Inventory of cables in the distribution grid (in km)

SECURITY OF SUPPLY

One of the purposes of Energy Strategy 2050 is to guarantee the current high level of security of supply in the long term. The topic of security of supply is established in the energy article of the Federal Constitution and the Energy Act. By categorising energy carriers (diversification) and dependence on foreign supplies, the monitoring process observes indicators which characterise significant aspects of development in the field of security of supply from the overall energy perspective. With the phasing out of nuclear power, the expansion of use of renewable energies and increased energy efficiency, the electricity sector is also a centre of focus.

DIVERSIFICATION OF THE ENERGY SUPPLY

Figure 8 indicates that petroleum products (combustibles, vehicle fuel, including aircraft fuel in international traffic) constituted about half of the final energy consumption in 2017. Electricity accounted for about one quarter of the final energy consumption and gas accounted for about 14 percent of this energy. Since 2000, these shares in the mix of energy sources have remained relatively stable. However, some changes have been recorded: for example, between 2000 and 2017 the share of petroleum products in the energy mix fell by 10 percent because of a reduction in the volume of petroleum combustibles used. The shares of gas (+3%), electricity (+2.5%), wood and charcoal (+1.3%), other renewable energies (+2.4%) and of district heating (+0.8%) have increased. This development points up the tendency to broader diversification in the mix of energy carriers and a slightly reduced dependency on fossil energy; both factors contribute to the high degree of security of supply in Switzerland (source: SFOE, 2018a).

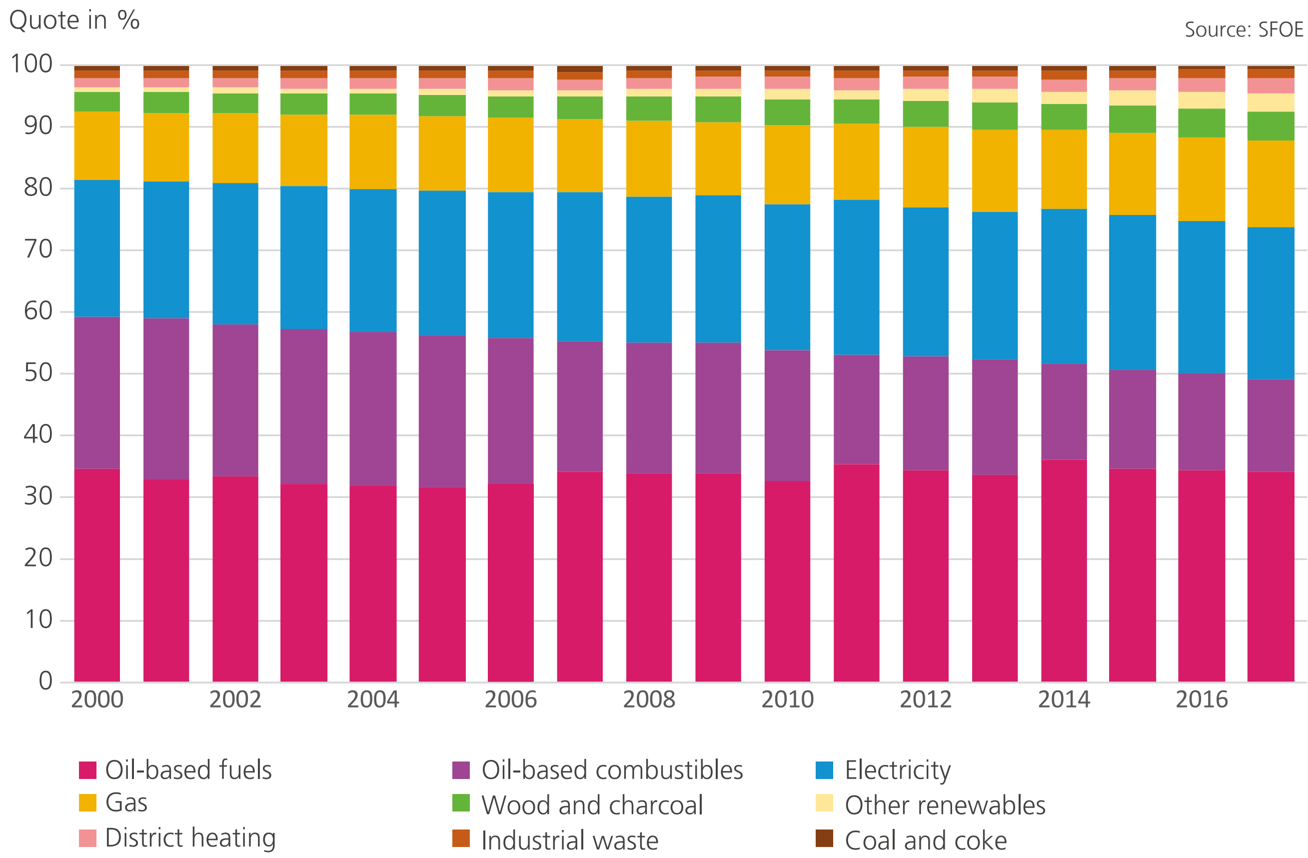


Figure 8: Diversification of the energy supply: share of energy carriers in final energy consumption

DEPENDENCY ON OTHER COUNTRIES

Figure 9 indicates that the import surplus tended to rise between 2000 and 2006, after which it fell, although one or two strong fluctuations were seen. At the same time the trend in domestic production has been toward increase since 2000. Gross imports were composed in particular of fossil energy carriers and nuclear fuel, that is energy from non-renewable sources. The most significant domestic energy source remains hydropower while the other renewable energies continue to grow. As indicated by the black curve in the graph, the share of imports in gross energy consumption (dependency on other countries) grew from 2000 to 2006 and has declined since then, however this share remains at a high level: in 2017 the share of imports in gross energy consumption was 75.3 percent (2016: 75.8%). This ratio has to be interpreted with caution because there are a number of different factors which influence it. In general it can be said that energy efficiency measures that lower consumption, and thus imports of fossil energy in particular, and the expansion of domestic energy production from renewable sources reduce dependency on other countries and have a positive effect on security of supply (sources: 2018a / FSO/FOEN/ARE 2018).

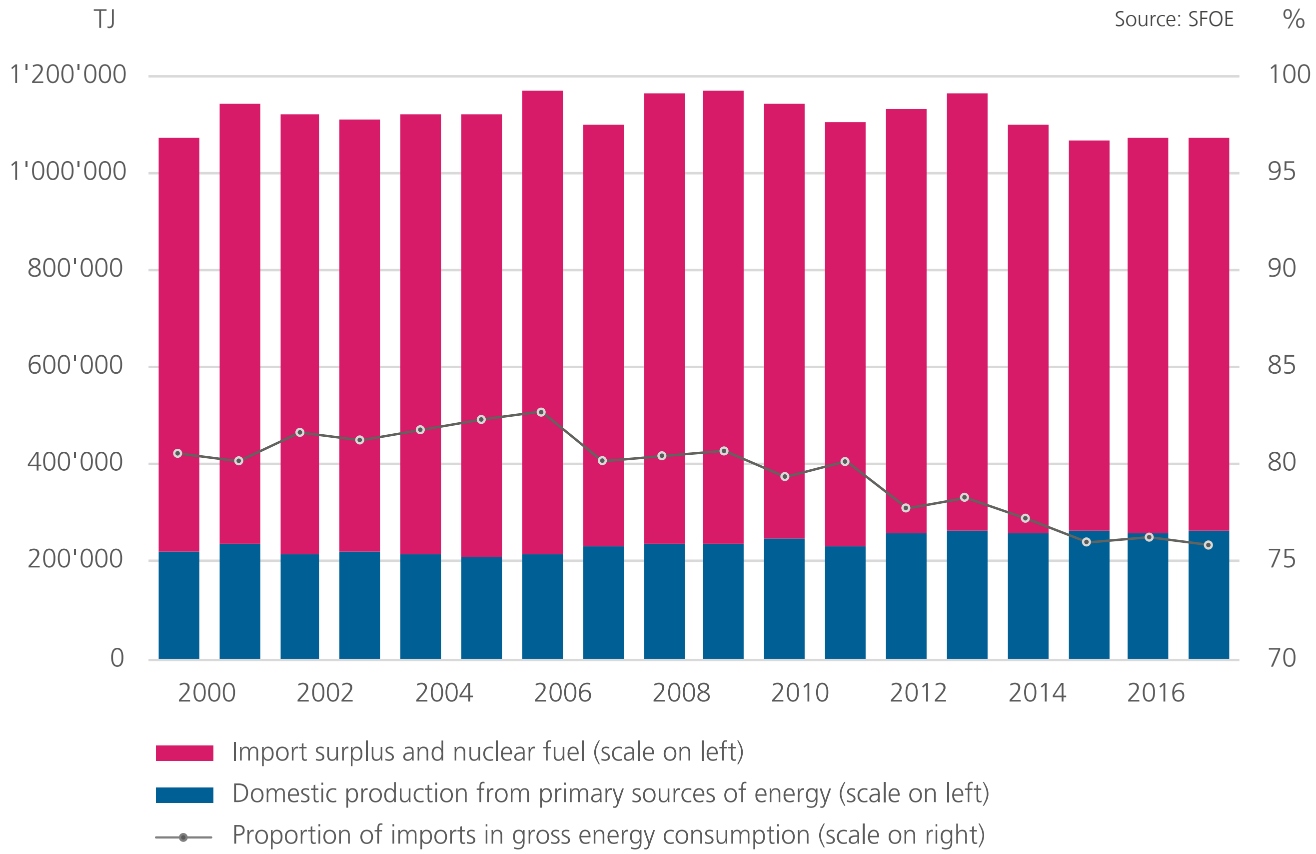


Figure 9: Import surplus and inland production (in TJ) and share of energy imports in gross energy consumption (in %)

SYSTEM ADEQUACY

Guaranteeing the **security of the electricity supply** in Switzerland is also based on the interplay between power plant capacity and the grid, which makes transmission and distribution of the energy produced possible. The grids supplement domestic power plant capacity and are equally important for ensuring security of supply. As a strongly networked country Switzerland is also dependent on the circumstances in neighbouring states. Close international cooperation is indispensable to the security of supply. However, because countries are rearranging their strategies (above all in the EU) the situation changes over time so periodic overall analyses of system adequacy are required to evaluate the security of supply. That means using a new modelling approach for the security of supply situation which looks at the strategic direction taken in the sectors generation, consumption and the grid infrastructure required. An analysis published at the end of 2017 by ETH Zurich and the University of Basel on behalf of the SFOE studied the future situation with respect to the security of the electricity supply in Switzerland taking into consideration different scenarios involving weather, power plants, demand and the electricity grid infrastructure. The findings show that the security of supply in Switzerland can be categorised as non-critical until 2035 provided Switzerland is integrated into the European electricity market. The findings also show the importance of timely expansion of the transmission grid. With a view to assessing the short and medium-term risks, ElCom has made calculations to assess system adequacy for 2025 that are not based on a final agreement with the EU on electricity supplies, parallel to the scenarios looked into by the SFOE. According to the report published at the end of May 2018, Switzerland's supply is guaranteed for 2025 in a probable scenario, even when some stressors are taken into consideration. The situation will become more strained, according to the calculations for stress scenarios, if only limited imports are available at the borders, if power plant capacity in France is only available to a limited extent and if, in addition, the two major Swiss nuclear power plants Leibstadt and Gösgen are not in operation. According to the study the likelihood of this scenario occurring is minimal. The Mid-term Adequacy Forecast concerning the period from 2020 to 2025 issued by the European Network of Transmission System Operators for Electricity (ENTSO-E) in October 2018 is consistent with the studies carried out by the SFOE and ElCom. This estimation of the medium term supply situation is further supplemented by a report published at the beginning of 2018 by the transmission grid operators that are members of the Pentalateral Energy Forum. They have also studied the medium-term (that is for 2023/24) security of the electricity supply for the central-west region of Europe. In the period mentioned no serious problems were apparent for Switzerland in particular even in very demanding supply scenarios (sources: University of Basel/ETHZ, 2017/ElCom, 2018b/ENTSO-E, 2018/PLEF SG2, 2018).

↗ More detailed information on the topic of **SECURITY OF SUPPLY:**

- See the detailed version of the Monitoring Report
- SFOE report on system adequacy in Switzerland
- ElCom report on system adequacy
- ENTSO-E Mid-term Adequacy Forecast
- PLEF SG2 generation adequacy assessment report
- ElCom report on the security of the electricity supply in Switzerland
- ElCom report on the quality of the electricity supply

EXPENDITURE AND PRICES

In addition to safety and environmental compatibility, a further significant dimension in a sustainable energy supply is economic viability. Energy article 89 of the Constitution and article 1 of the Energy Act determine the need to strive for a sufficient, diversified, safe, economic and environmentally compatible energy supply. The purpose of Energy Strategy 2050 is to successively reorganise Switzerland's energy systems without jeopardising the international competitiveness of Switzerland as a business location. Therefore the focus of annual monitoring in this area is on final consumer expenditure for energy and energy prices.

FINAL CONSUMER EXPENDITURE FOR ENERGY

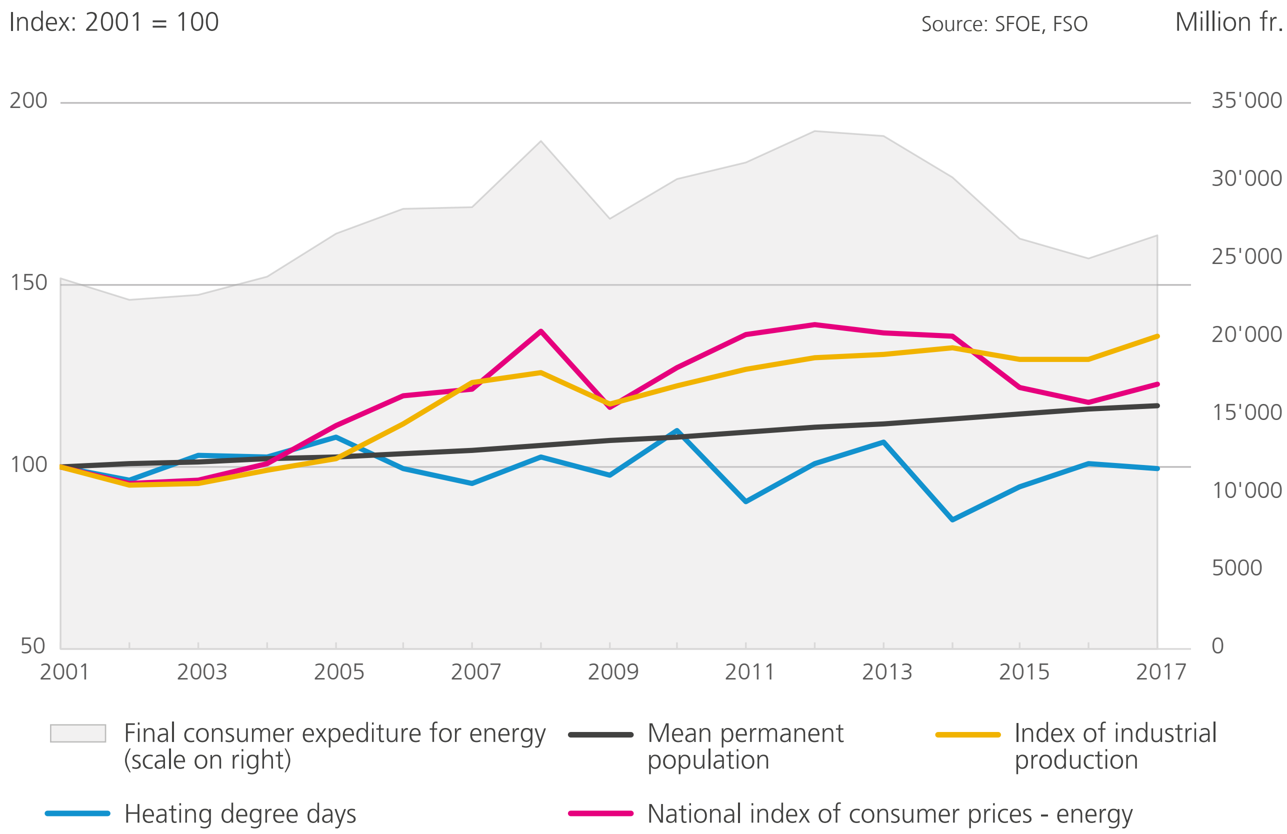
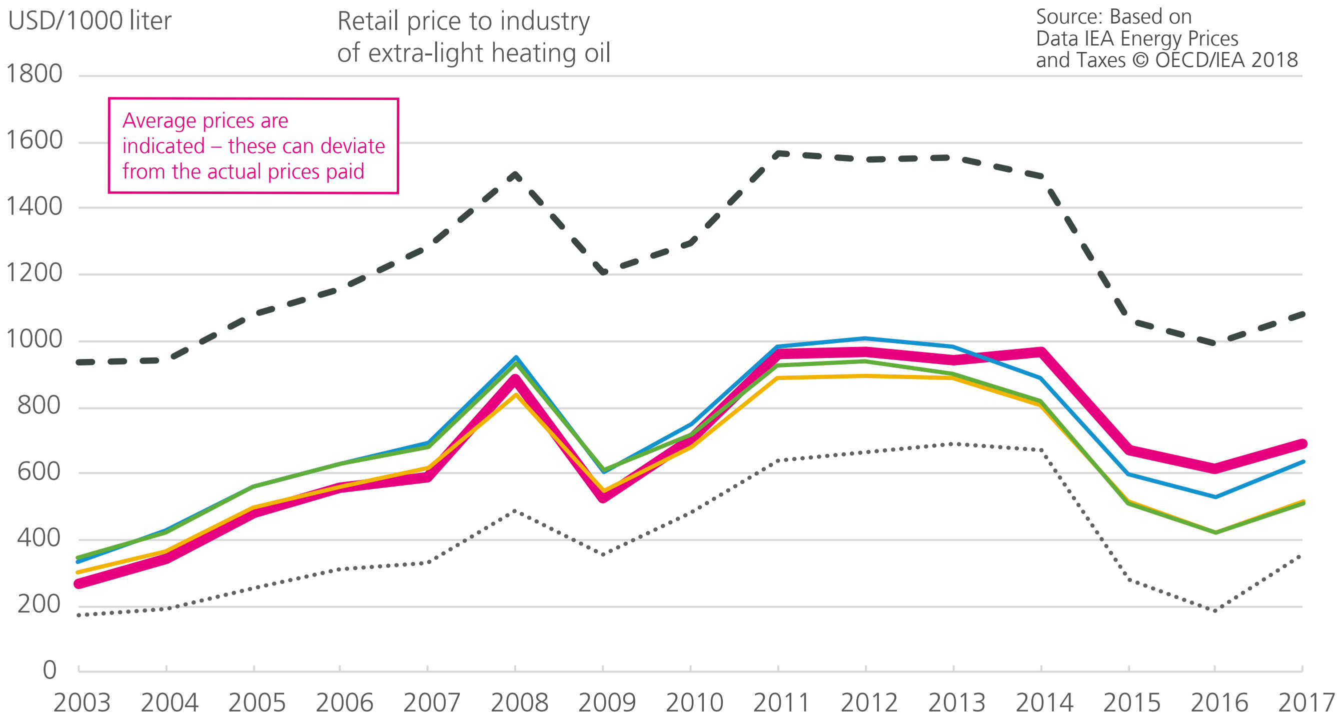


Figure 10: Final consumer expenditure for energy (in million francs) and significant influencing factors (indexed)

Figure 10 indicates the development of final consumer expenditure for energy in Switzerland, which has increased from 23.8 billion francs in 2001 to almost 26.5 billion francs in 2017. Almost half of the expenditure was for petroleum products, one third for electricity, about 10 percent for gas, and the remainder for solid combustibles and district heating. Between 2001 and 2017 this constituted an average increase of 0.7 percent per annum. During the same time period growth has been seen in industrial production (1.9% per annum), the population (1.0% per annum) and the Swiss consumer price index for energy (1.3% per annum). What is noticeable is the similarity between the progression of final consumer expenditure and the consumer price index for energy. Among other reasons, this is because energy prices have little influence on consumer behaviour in the short term because this behaviour depends more on other existing and comparatively constant factors, such as the number of vehicles and homes. This constitutes an example of low, short-term price elasticity. Further, in 2008, a significant increase in final consumer expenditure and energy prices can be seen, followed by a drop in the next year; this can be partially explained by the improvement in the economy and the slump that followed as a result of the financial and economic crisis. In 2017 final consumer expenditure rose slightly compared to 2016; this increase is attributable to slight price increases. Meanwhile, improved energy efficiency measures can put a damper on energy consumption and therefore on final consumer expenditure (sources: SFOE, 2018a/FSO, 2018a).

ENERGY PRICES FOR SECTORS OF INDUSTRY IN INTERNATIONAL COMPARISON



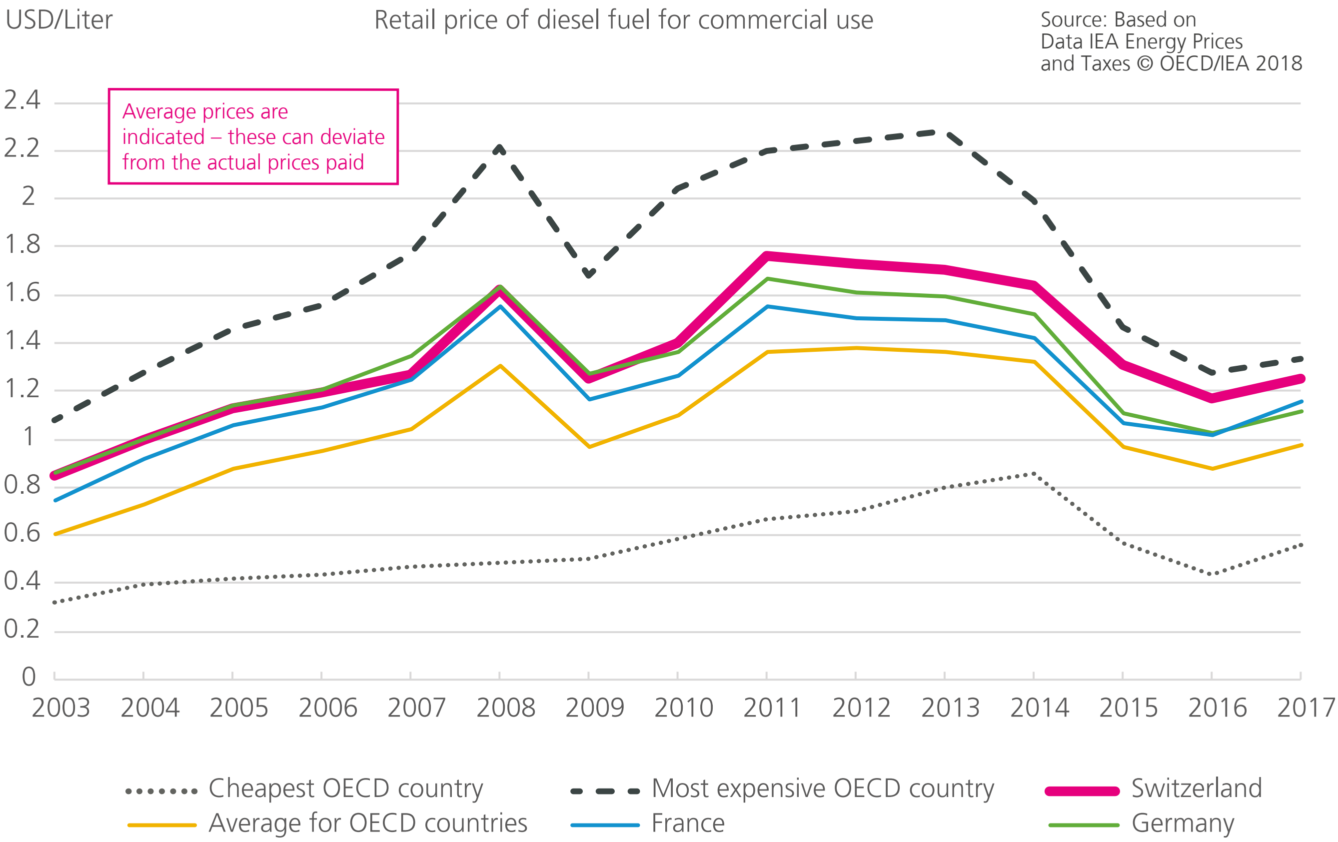
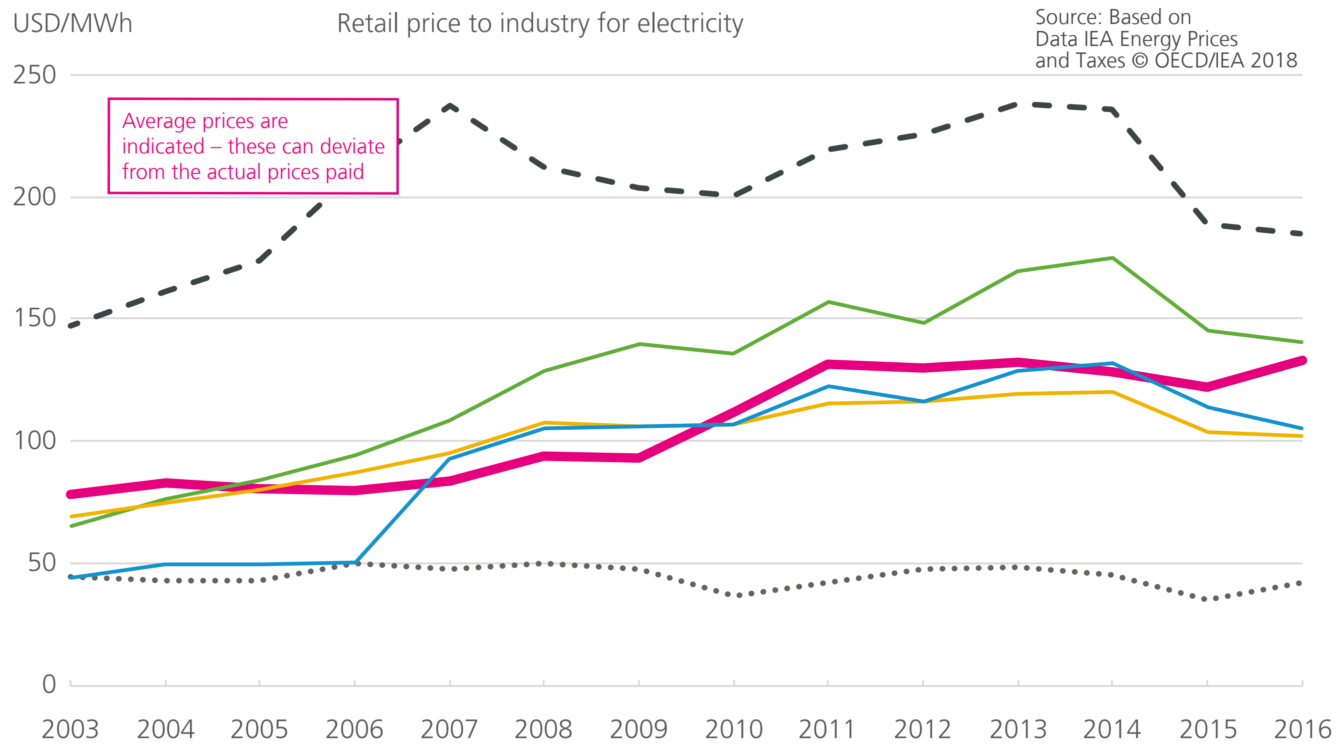


Figure 11: Average nominal end-user prices for heating oil and diesel fuel including taxes for the industrial sector in USD (calculated on the basis of market exchange rates)

Oil as a raw material and the energy carriers resulting from the refining process, such as **heating oil** and **diesel**, are traded on the global market. This partly explains the similar development of prices in most of the countries indicated in the graphic (**cf. figure 11**). In 2017 the price for Swiss heating oil was above the OECD average, and the prices increased slightly in the OECD and in Switzerland. One possible explanation for the increase in Swiss prices for heating oil in relation to other countries could at least partly be the gradual increase in the CO_2 levy since it was introduced in 2008 from 12 to 84 francs per tonne of CO_2 in 2016 and 2017; this increase was implemented because the interim biannual targets determined by the Federal Council for reduction of emissions from fossil combustibles were not attained[9]. The price level for diesel in Switzerland is higher than in France and Germany or about average compared to OECD countries. The picture for petrol as a vehicle fuel may differ because diesel is more heavily taxed in Switzerland than in other countries. Information about comparative international petrol prices is not monitored in the report because petrol is less significant to industry. The diesel price in Switzerland is nearer to that in the most expensive rather than the cheapest OECD country (source: OECD/IEA, 2018a).

9 Per Increase from 84 to 96 francs per tonne CO_2 as of 1 January 2018

ENERGY PRICES FOR SECTORS OF INDUSTRY IN INTERNATIONAL COMPARISON



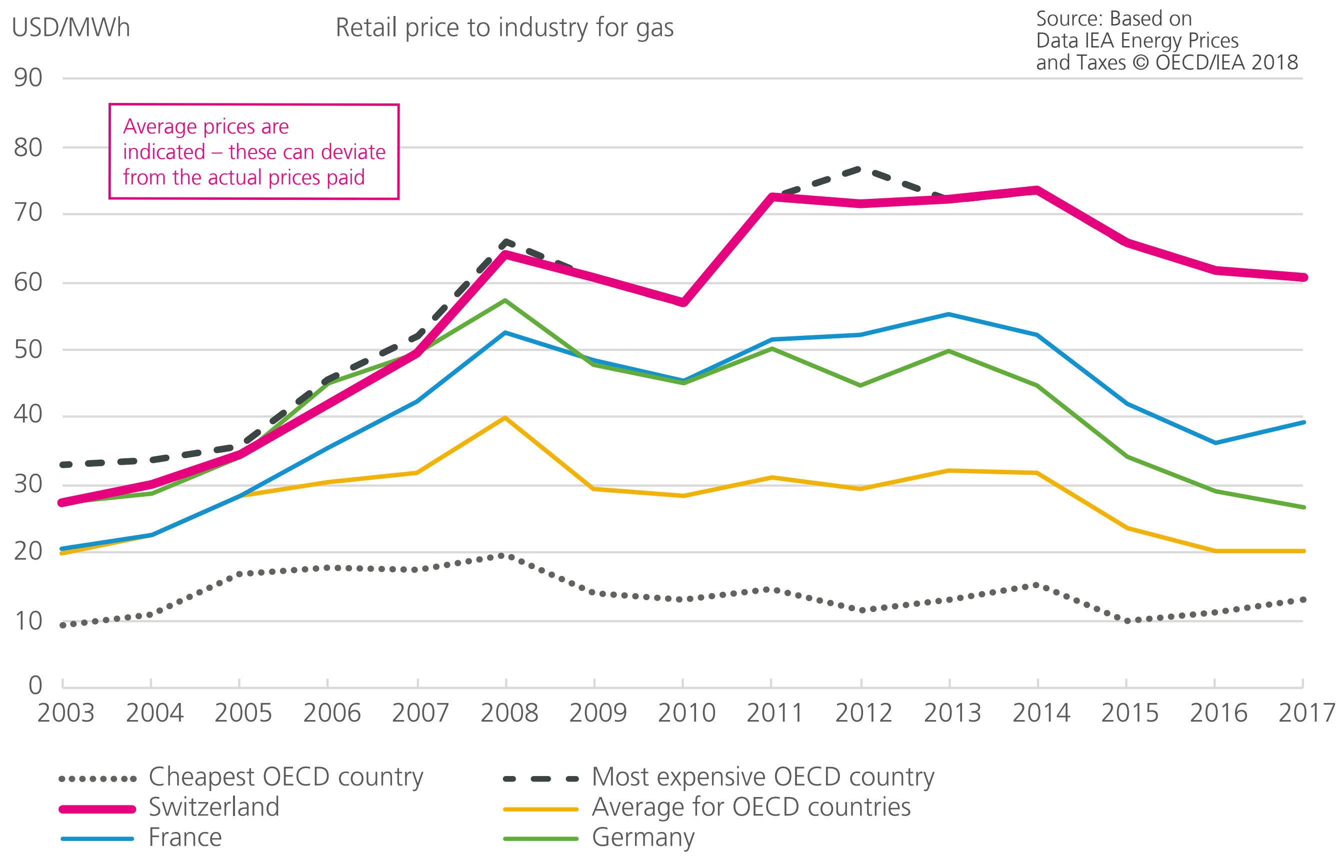


Figure 12: Average nominal retail price for electricity and gas including taxes for the industrial sector in USD (calculated on the basis of market exchange rates)

The **electricity price** depends on many factors, including the technology used in generation, the production and transport costs, capacity of the grids, market structures and levies. The same tendency as seen in Germany, France and the average OECD country can be seen in the development of electricity prices in Switzerland, however, prices in Switzerland in 2016 increased slightly (**cf. figure 12**). Nevertheless, the price level in Switzerland lies close to the OECD average and is lower than that in Germany, or above all that of Italy (Italy had the highest electricity prices throughout the entire time period). The differences in price levels should be interpreted cautiously because companies that consume large amounts electricity can be exempted from paying levies contained in prices and the data base is incomplete. In fact, the prices in Switzerland for those industrial customers who cover their needs on the open market are not compiled. The share of these industrial customers has risen steadily since the market was liberalised. Domestic prices for **gas** are much higher than in Germany and France and about average for OECD countries. In 2005, 2010, and 2011 and since 2013 Switzerland has been the most expensive OECD country in this respect. The difference to the other OECD countries is substantial, and in contrast to Canada in particular, the country with the lowest prices since 2009. There are a number of possible explanations for the difference in prices. The CO_2 fee on combustibles was increased and this is reflected in the figures. It should also be noted that some companies are able to gain exemption from the fee if they undertake to reduce emissions in return – however this is not shown in the current figures. In fact such companies pay the end-user price but they are able to apply for a refund of the fee. The situation around the CO_2 fee is only a partial explanation for the relatively high prices and is no explanation for the figures before 2008. Further potential explanations could be the higher grid costs (arising because there are only a low number of connections per kilometre) and the current intensity of competition. For example, the gas markets in the countries to which Switzerland is compared are all liberalised. In Switzerland, in 2012, gas sales conditions were regulated for major industrial customers on the basis of an association agreement (source: OECD/IEA 2018a).

↗ More detailed indicators on the topic of **EXPENDITURE AND PRICES** (See the detailed version of the Monitoring Report)

CO_2 EMISSIONS

There is a close relationship between energy policy and climate policy because about three quarters of all greenhouse gas emissions in Switzerland are caused by the use of fossil energy carriers. Energy Strategy 2050 should contribute toward lowering the consumption of fossil energy as well as greenhouse gas emissions from energy sources. The most significant greenhouse gas in volume is carbon dioxide (CO_2), which arises mainly when fossil combustibles and fuels are burnt (heating oil, gas, petrol, diesel fuel). The annual monitoring process traces the development of CO_2 emissions from energy sources. The most important source for indicators is Switzerland's greenhouse gas inventory which is compiled annually by the Federal Office for the Environment (FOEN) in compliance with the requirements of the UNO climate convention.

PER CAPITA CO_2 EMISSIONS FROM ENERGY SOURCES

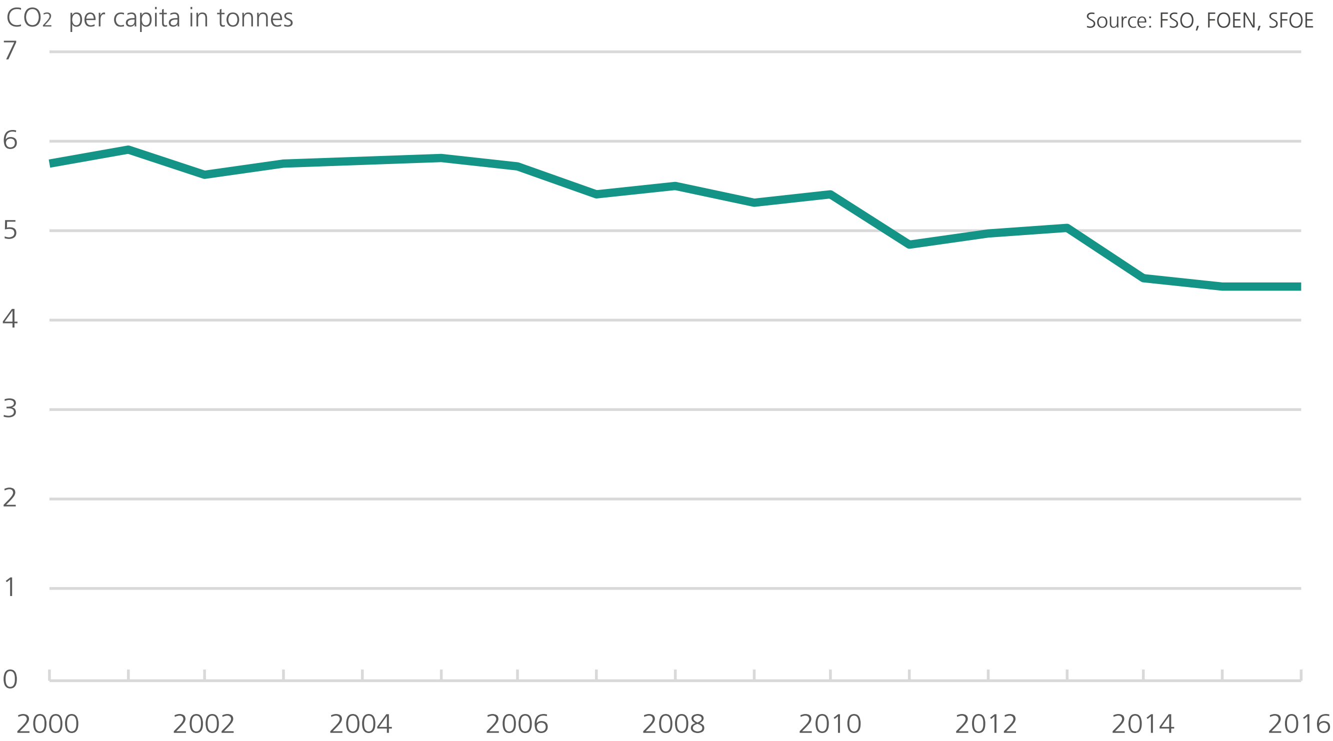


Figure 13: Per capita CO_2 emissions from energy sources (in t CO_2 per capita)

Per capita CO_2 emissions from energy sources have been falling constantly since 2000, as indicated in **figure 13**. Because CO_2 emissions from energy sources have fallen slightly since 2000 (**c.f. figure 14**) and the population of the country has increased in the same time period, there appears to be a decoupling of the factors population growth and CO_2 emissions. In 2016 domestic per capita emissions were about 4.4 tonnes. When compared internationally, per capita CO_2 emissions from energy sources in Switzerland are relatively low because Switzerland's electricity production is largely CO_2 free and the service sector contributes a major share of the added value.

A further continuous decline at per capita level is required to be able to attain the long-term, strategic, overall objective in accordance with the dispatch on the first set of measures for Energy Strategy 2050 (reduction of CO_2 emissions to 1 to 1.5 tonnes by 2050) (sources: FOEN, 2018a/FSO, 2018a/SFOE, 2018a).

CO_2 emissions from energy sources (**see figure 14**) amounted to almost 37 million tonnes in 2016 and were thus more than 10 percent lower than in the year 2000. The greatest share can be allotted to transport (excluding international air traffic; 2016: 41%), where emissions mainly stem from motorized vehicles . Between 2000 and 2016 CO_2 emissions in the transport sector fell by 0.7 million tonnes. The decline in the trend of visitors from neighbouring countries filling up their vehicles in Switzerland accounts for most of the fall seen since 2015. This trend stopped after the Swiss National Bank decided to abolish the minimum exchange rate for the Swiss franc against the euro. In *Industry* (share 2016: 23%) CO_2 emissions mainly originate from manufacture of goods and to a lesser extent from building heating. A slight decline has been reported since 2000, showing the effectiveness of the measures implemented as well as increases in energy efficiency and to some extent a decoupling of the factors CO_2 output and industrial production. In addition, an interruption in operations at

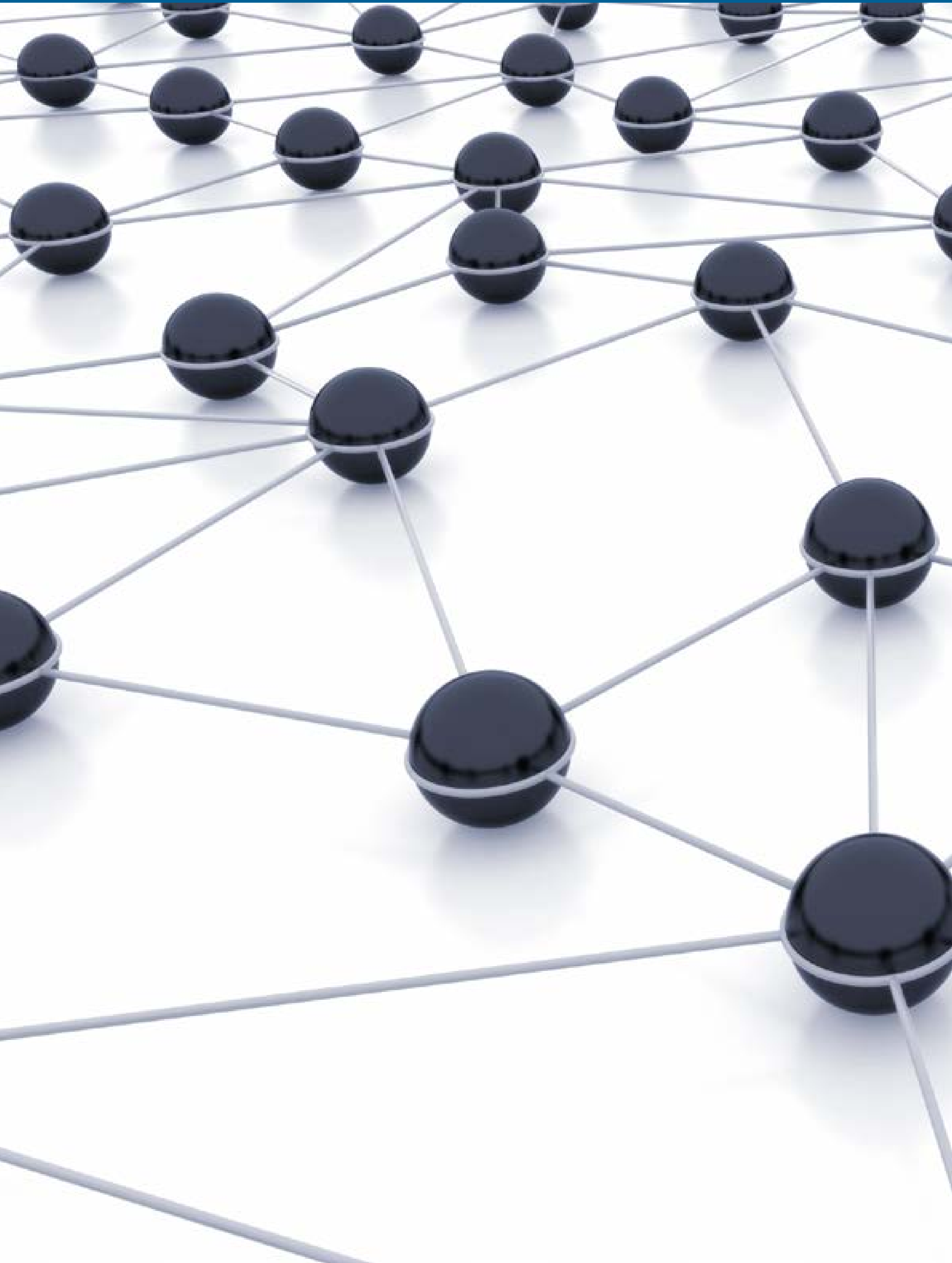
CO_2 EMISSIONS FROM ENERGY SOURCES OVERALL AND BY SECTOR

Figure 14: CO_2 emissions from energy sources in total and by sector (in million tonnes CO_2 excluding international air traffic)

a refinery led to a perceptible decline in 2015. The variations over the course of time are due to the state of the economy and climatic conditions. In the *Household* sector (share 2016: 24%) emissions originate in the main from heating and hot water heating. Since 2000 emissions have fallen although the dwelling area to be heated has increased. This also shows there has been an increase in efficiency and a tendency to employ technology creating lower emissions of CO_2. However, development of annual emissions is strongly influenced by the climate; dependency on fossil fuel heating systems is as large as ever. The same applies to the *Services* sector (share 2016: 12%): here, too, CO_2 emissions from energy sources have been declining slightly since 2000. In *Agriculture* CO_2 emissions from energy sources have remained more or less unchanged since 2000 while the overall share in CO_2 emissions is also very low (2016: 1%). In this sector the greenhouse gas emissions from non-energy sources are significant, in particular those from methane and nitrogen dioxide. Overall the share of each sector has changed only little since 2000. Emissions from the Transport sector have increased slightly (from 38% to 41%) while Households and Services contributed slightly less (sources: FOEN, 2018 a+b / SFOE, 2018a / Ecoplan, 2017 / Ecoplan/EPFL/ FHNW, 2015).

10 The SFOE publishes the share of traffic in overall greenhouse gas emissions in specific publications. Currently this is about one third (32%).

↗ More detailed indicators on the topic of **CO_2-EMISSIONS** (See the detailed version of the Monitoring Report)



RESEARCH + TECHNOLOGY

It is assumed that the short-term guidelines in the Energy Act and in Energy Strategy 2050 could be attained with the technology available today. However, attaining the long-term goals will require new developments in the technology sector. To stimulate further development, the Federal Council and Parliament have allocated significantly more resources to energy research and new research activities have commenced and existing efforts have been reinforced. Progress in research and technology cannot generally be measured directly with an indicator. For this reason the annual monitoring process focuses on public expenditure for energy research as an indicator for efforts being made in the energy research sector.

PUBLIC EXPENDITURE FOR ENERGY RESEARCH

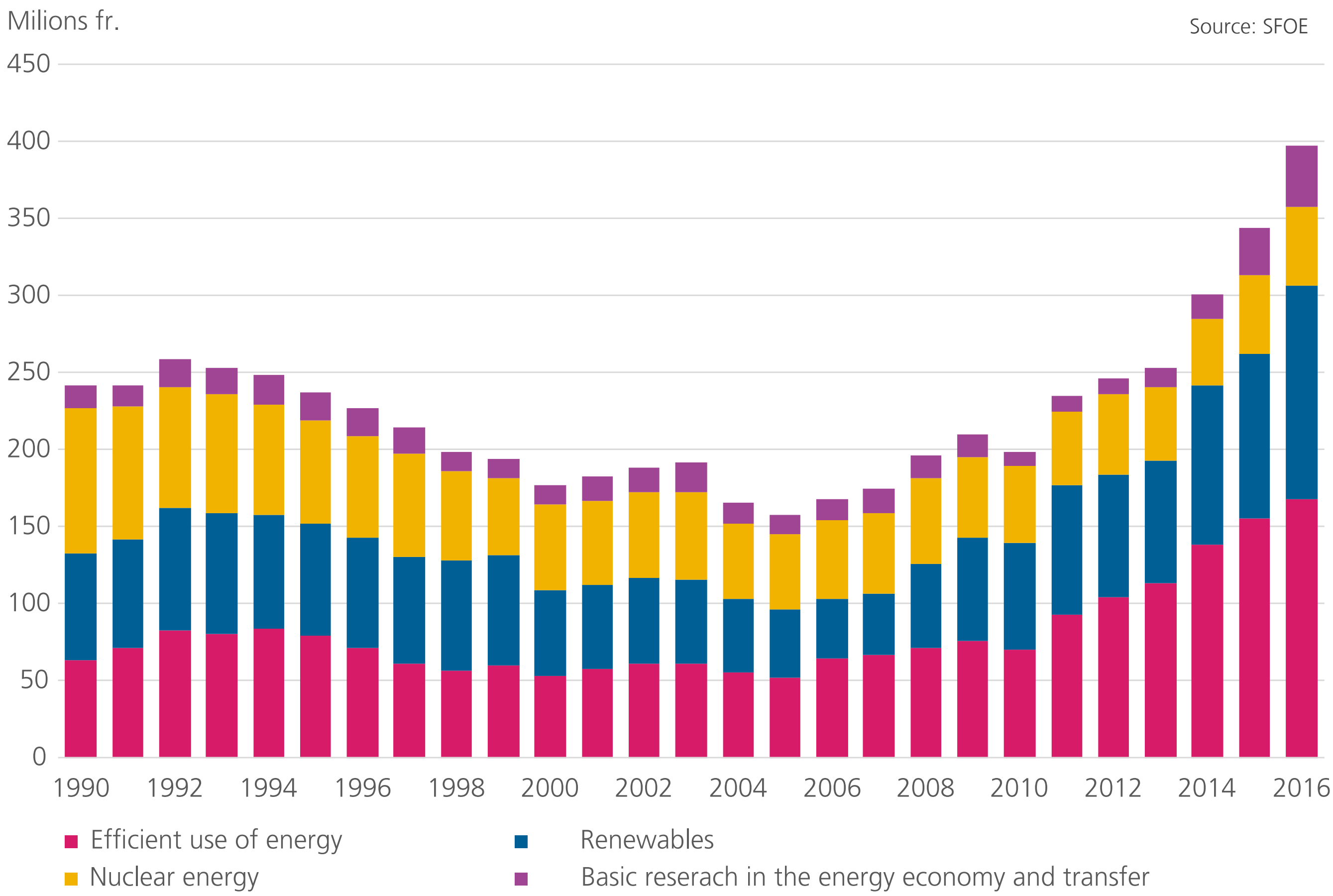


Figure 15: Public expenditure for energy research by field of research (in million francs, actual sum)[11]

Since 2005, public funding for energy research has increased continuously, as indicated in **figure 15**. Above all a significant increase in expenditure has been seen since 2014 within the framework of Energy Strategy 2050 and the Coordinated Energy Research in Switzerland action plan. A major contribution has been made by the establishment of the Swiss Competence Centers for Energy Research (SCCER) by Innosuisse, new National Research Programmes in the energy sector (NRP 70 and 71) by the Swiss National Science Foundation, and targeted expansion of pilot, demonstration and lighthouse activities by the Swiss Federal Office of Energy. In 2016 public expenditure in the sector increased over the previous year overall to the actual sum of 396.9 million francs (2015: 343.7 million francs). In accordance with the priorities of Energy Strategy 2050, the greater part flowed into the research fields *Energy efficiency* (share 2016: 42.5%) and *Renewable energies* (share: 2016 34.7%). Absolute expenditure for *Nuclear energy* research fields (*nuclear fission and atomic fusion*) has remained stable since 2004, however, the share of total expenditure has fallen and amounted to 12.9 percent in 2016. The share in expenditure of the research field *Basic research in the energy economy and transfer* was 9.9 percent in 2016 (source: SFOE, 2018d).

11 Expenditure includes a share in overheads (indirect research costs) of the research institutes.

↗ More detailed indicators on the topic of **RESEARCH + TECHNOLOGY** (See the detailed version of the Monitoring Report)

INTERNATIONAL ENVIRONMENT

The international environment is important to Switzerland because the country is closely integrated into the international energy markets due to its central position in Europe on the one hand and because Switzerland is strongly dependent on energy imports on the other. On the regulatory level the developments in Europe in particular are crucial to Switzerland. Changes in the international environment cannot be measured with any indicator. For this reason annual monitoring focusses on a descriptive overview of substantial developments.

DEVELOPMENT OF GLOBAL ENERGY MARKETS

Oil: In its medium-term forecast the International Energy Agency (IEA) states that it expects the global demand for oil to grow annually on average by 1.2 million barrels per day peaking at about 104.7 million barrels per day by 2023. In 2017, the supply of oil available increased over 2016 by 0.5 million barrels per day to 97.4 million barrels per day. Demand rose by 1.4 million barrels per day to 97.8 million barrels per day. Following on the crash in prices to about 30 US dollars per barrel in the second half of 2014 which continued into 2015, the price of oil recovered once again as a result of solid demand in 2017 and because of the continuation of the cap on output imposed by OPEC and other countries, such as Russia, and by mid-2018 the price for Brent crude, the reference type for prices, had reached 79.44 dollars per barrel and that for WTI a price of 74.15 dollars per barrel. In June 2018 OPEC and other countries agreed to fully exploit the limit on output set at the end of 2016. In the meantime, at the end of September it was decided not to expand the output volume which led to quotations for Brent crude rising to more than 85 dollars per barrel at the beginning of October, making it more expensive than it had been for four years; the price fell again in the course of the month (sources: OECD/IEA 2018b+g).

Natural gas: In its medium-term forecast the IEA assumes that global demand for gas will grow on average by 1.6 percent per annum reaching about 4,100 billion cubic metres by 2023. According to provisional figures from the IEA, in 2017 global gas production increased by 3.6 percent over 2016 to 3,768 billion cubic meters. Demand thus increased by 3.2 percent to 3,757 billion cubic meters. In the period between 2015 and the beginning of 2018 gas prices remained relatively constant and lay at about 2 to 3 US dollars per British Thermal Unit (mmbtu) on the US market (Henry Hub) and at about 4 to 8 US dollars per mmbtu on the European market (TTF spot)[12]. In the first quarter of 2018 spot prices rose on the European market compared to the same period in 2017 by about 10 percent to 20.5 euros/MWh (sources: OECD/IEA, 2017 / OECD/IEA, 2018c+d / EU, 2018a).

Coal: In its medium-term forecast the IEA makes the assumption that the annual demand for coal will more or less stagnate until 2022 and reach a level of 5,530 billion tonnes. According to provisional figures from the IEA global coal production rose in 2017 by 3.1 percent after a period of three years in which production had fallen. Global coal consumption rose by one percent above all because of the increase in consumption in non-OECD countries. Driven by the dynamics of the market in Asia and as a result of China introducing measures to restrict domestic coal production, coal prices rose significantly in the second half of 2016. By July 2018, the CIF ARA spot price was 100 US dollars per tonne, the highest price since 2012[13] (sources: OECD/IEA, 2017 / OECD/IEA, 2018e).

CO_2: After the price for CO_2 emission rights in the European Emission Trading Scheme had remained at about 5 euros per tonne of CO_2 equivalent (tCO_2e) since 2013, it rose between mid-2017 and September 2018 and in the meantime has reached in excess of 25 euros/tCO_2e. Since then it has fallen again[14].

Electricity: Electricity production increased globally between 1974 and 2016 from 6,298 TWh to 25,082 TWh, corresponding to an average annual growth rate of 3.3 percent according to the IEA. In 2016 production was 2.9 percent higher than in 2015. The European Power Benchmark (index for the average wholesale power price on the European market) fell in February 2016 to 30 euros/MWh, which constitutes the lowest monthly average price since March 2007. In winter 2016/2017 prices recovered and the index rose to over 50 euros/MWh. In summer 2017 the index price fell again to about 30 euros/MWh and rose again in winter 2017/2018 to almost 50 euros/MWh. Between May and August 2018 the price for baseload electricity (Phelix, physical electricity index for Germany and Austria) increased from about 40 euros/MWh to 60 euros/MWh. The baseload price for Switzerland (Swissix) followed suit (sources: OECD/IEA, 2018f / EU, 2018).

12 Platts in the Quarterly Report on European gas markets, first quarter 2018
13 Argus Gas Connection
14 EEX

DEVELOPMENTS IN THE EU: CLEAN ENERGY PACKAGE

To implement the Energy Union, on 30 November 2016 the European Commission presented a comprehensive package of measures including eight legal proposals as well as reports on the design of the electricity market, renewable forms of energy (RES), security of supply, energy efficiency and governance. The main aims of the Clean Energy for All Europeans package are to organise the internal market in electricity and renewable energies for the future and to achieve the climate and energy targets set by the EU. The core elements of the package are as follows:

Design of the electricity market: The revised version of the Directive for the internal market in electricity, which arose from the third internal market in energy package adopted in 2009, was drawn up with the intention of creating a market-based, consumer centred, flexible electricity market. The purpose of revising the Regulation on the internal market in electricity, which also arose from the third internal market in energy package, is to establish new regulations for the European internal market in electricity which will be adapted to the increasingly decentralised, fluctuating generation of electricity. Votes on the bills on the design of the electricity market should be handled by the EU's political institutions (the trilogy of the Council, Parliament and the Commission) by the end of 2018 if things go as expected. How the EU internal market in electricity functions in the future is significant to Switzerland.

Agency for the Cooperation of Energy Regulators (ACER): As a result of the new version of the ACER Regulation, the role of the agency is to be adapted to comply with the new legal framework for the design of the electricity market and the security of the electricity supply. The overall aim is to strengthen the role played by ACER. It is planned that the bill will be considered by the trilogy of Council, Parliament and Commission of the EU at the end of 2018. In view of the fact that Switzerland is surrounded by the domestic EU electricity market, ACER's work has an effect on Switzerland's electricity market and is of particular relevance to ElCom.

Energy efficiency: In the field of energy efficiency the Commission has submitted proposals for the revision of the directives for energy efficiency and building efficiency. As a result of the Paris Convention targets for the *energy efficiency directive* were modified to conform to the energy policy framework for 2030. In June 2018, Commission, Council and Parliament came to an agreement about a non-compulsory efficiency target for the Union of 32.5 percent. The purpose of the updated *building efficiency directive* is to make buildings more "intelligent" and provide more support for building refurbishment. The final version of the directive was published in June 2018 and went into force on 9 July 2018. Switzerland is not affected by the directives.

Renewable forms of energy: The revised *Directive on the promotion of the use of energy from renewable sources* should lead to further increasing the share of renewable energies in the overall energy mix by 2030. After intensive negotiations a binding target of 32 percent will be set for renewables throughout the Union. Council and Parliament will have to formally adopt the compromise before it can go into force as proposed in 2019.

Security of the electricity supply: The purpose of the new *Regulation on risk-preparedness in the electricity sector* is to prepare member states to manage energy crisis situations which could be caused by extreme weather circumstances, cyber-attacks, or a fuel shortage. It is planned that the bill will be considered by the trilogy of Council, Parliament and Commission of the EU at the end of 2018. The wording and implementation of the new regulation are relevant to Switzerland because of the close ties to the EU in the energy sector.

Governance of the Energy Union: The aim of the proposed *Governance Regulation* is to create a mechanism to plan, report and monitor achievement of targets set by the Energy Union. Council and Parliament reached an agreement on the new regulation in June 2018. Council and Parliament will have to formally adopt the compromise before it can go into force as proposed in 2019.

(Sources: COM [2016] 860 final / Council of the European Union, 2018)

INTERNATIONAL CLIMATE POLICY

After years of negotiation on the part of the international community and as a milestone in the history of international climate policy, the **Paris Convention** was concluded in December 2015 and went into force on 4 November 2016. It continued on from the second commitment period of the Kyoto Protocol. The Paris Convention obliges all states to adopt measures to reduce greenhouse gas emissions holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels. The further aims of the Convention entail improving adaptability to the non-avoidable consequences of climate change and making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. In the meantime all 197 parties to the United Nations Framework Convention on Climate Change (UNFCCC) have adopted the Convention and 181 have already ratified it. On 1 June 2017, the President of the United Sates Donald Trump announced the USA wanted to withdraw from the Paris Convention. Thus the USA would become the only contracting party that will not participate in the Convention. However, formal exit from the convention is only possible in November 2020 because of the effective notice period. Until then the USA is legally party to the Convention.

Switzerland ratified the Convention on 6 October 2017 after the Federal Assembly had given its approval on 16 June 2017. By approving the Convention the Federal Assembly also voted in favour of reducing greenhouse gases overall by 50 percent by 2030 in comparison to levels in 1990. The proviso was added that allocation of the reduction between the domestic share and the reduction achieved abroad would be determined in the process of national implementation. Since the ratification of the Convention Switzerland has been legally obliged to introduce measures to contain emissions and adapt to climate change. In addition a bi-annual report has to be submitted as before to the Secretariat of the UNO Convention on Climate Change about the development of greenhouse gas emissions, measures planned to reduce emissions and adapt to climate change, and the contributions made to financing international climate policy. The Paris Convention has to be implemented in national law. On 1 December 2017 the Federal Council submitted the bill on the total amendment of the CO_2 Act which is currently under consideration by Parliament (source: Federal Council, 2017).

INTERNATIONAL COOPERATION IN THE ENERGY SECTOR

Progress was made in the **negotiations with the EU about a bilateral electricity agreement** in the period covered by this report. In the main these concerned an agreement about granting mutual access to the electricity market. The content and scope of the agreement have been largely defined. Various questions in different sectors of the agreement are still the subject of negotiations. The conclusion of the negotiations from the EU standpoint is dependent on progress on the framework agreement between Switzerland and the EU.

In the field of **regional cooperation**, since February 2011 Switzerland has been participating as an observer at the extended Pentalateral Energy Forum which discusses the topics of market integration, security of supply and flexibility in the electricity sector. In June 2017 the Pentalateral countries (Germany, France, Austria, Benelux States, Switzerland as an observer) signed a memorandum of understanding with the intention of improving regional cooperation in the fields of emergency planning and crisis management.

The numerous interdependencies with neighbouring countries in the energy sector call for deepening of **bilateral relations**. Contacts to a number of countries were expanded in the reporting period. A mutual energy and climate agenda will be elaborated with Germany as agreed at a meeting between Federal Councillor Doris Leuthard and Germany's Minister of the Economy Peter Altmair. In 2018 Federal Councillor Leuthard and an official delegation travelled to Vietnam and to Thailand, and visits were made to Argentina and Peru in 2017. Further, in 2017 and 2018 memoranda of understanding were signed with China and Morocco about increased cooperation in the energy sector.

In the field of **multilateral cooperation** Switzerland is active within the multilateral energy institutions including the International Energy Agency and the Energy Charter. Switzerland also cooperates with the International Atomic Energy Agency of the UNO and the International Renewable Energy Agency.

(Sources: Federal Council, 2018 a+b/DETEC, 2017+2018)

↗ More detailed information on the topic **INTERNATIONAL ENVIRONMENT** (See the detailed version of the Monitoring Report)

LITERATURE AND BIBLIOGRAPHY

COM (2016) 860 final:	Communication from the European Commission, Clean Energy for All Europeans.
DETEC (2017):	Department of the Environment, Transport, Energy and Communication, diverse press releases.
DETEC (2018):	Department of the Environment, Transport, Energy and Communication, diverse press releases.
Ecoplan (2017):	Estimate of the effectiveness of the CO_2 levy, updated until 2015. On behalf of FOEN.
Ecoplan/EPFL/FHNW (2015):	Estimate of the effectiveness of the CO_2 levy. On behalf of FOEN.
ElCom (2018b):	Federal Electricity Commission, Final report on system adequacy 2025. Study on the security of supply in Switzerland in 2025.
ElCom, (2018a):	Federal Electricity Commission, 2017 report on activities.
ENTSO-E (2018):	Mid-term Adequacy Forecast 2018.
EU (2018a):	European Commission, Directorate-General for Energy: Market Observation for Energy 2017.
Federal Council (2013):	Dispatch on the first package of measures for Energy Strategy 2050 (Amendment of the Energy Act) and on the popular initiative “For an orderly withdrawal from the nuclear energy programme (Nuclear Withdrawal Initiative)" BBl 2013 7561.
Federal Council (2015):	Dispatch on the constitutional article concerning a Climate and Energy Incentive System, BBl 2015 7877.
Federal Council (2016):	Dispatch on the Federal Act on the Transformation and Extension of the Electricity Grid (amendment of the Federal Electricity Act and the Energy Act), BBl 2016 3865.
Federal Council (2017):	Dispatch on the complete revision of the CO_2 Act after 2020, BBl 2018 247.
Federal Council (2018a):	Foreign policy report 2017, BBl 2018 1791.
Federal Council (2018b):	Press releases on negotiations with the EU of March 5 and September 28, 2018.
Federal Council (2018c):	Consultation procedure on the revision of the Energy Act (complete liberalisation of the electricity market, storage reserves and modernisation of grid regulations), BBl 2018 6391.
FOCA (2018):	Data extract on international air traffic 2017 within the framework of the inventory of greenhouse gases.
FOEN (2018a):	Federal Office for the Environment, Inventory of greenhouse gases 2016.
FOEN (2018b):	Federal Office for the Environment, Switzerland’s seventh national communication and third biennial report under the UNFCCC.
FSO (2018a):	Federal Statistical Office, Population and Households Statistics (STATPOP) 2017.
FSO (2018b):	Federal Statistical Office, National accounts of Switzerland 2017.

FSO (2018b):	Federal Statistical Office, Swiss Consumer Price Index, Average prices for energy and fuels 2017.
FSO/FOEN/ARE (2018):	Indicator system for monitoring sustainable development MONET.
OECD/IEA (2017):	International Energy Agency, Coal 2017: Analysis and Forecasts to 2022.
OECD/IEA (2018a):	International Energy Agency IEA, Energy Prices and Taxes 2017.
OECD/IEA (2018b):	International Energy Agency, Oil Market Reports, Annual Statistical Supplement 2017.
OECD/IEA (2018c):	International Energy Agency, Gas 2018: Analysis and Forecasts to 2023.
OECD/IEA (2018d):	International Energy Agency, Natural Gas Information: Overview 2018.
OECD/IEA (2018e):	International Energy Agency, Coal Information: Overview 2018.
OECD/IEA (2018f):	International Energy Agency, Electricity Information: Overview 2018.
OECD/IEA (2018g):	Oil 2018: Analysis and Forecasts to 2023.
PLEF SG2 (2018):	Pentalateral Energy Forum Support Group 2, Generation Adequacy Assessment.
Prognos (2012):	The energy perspectives for Switzerland until 2050. On behalf of SFOE.
Prognos (2015):	Adjustment for climatic conditions on the basis of heating degree days and solar radiation. On behalf of SFOE.
Prognos/TEP/Infras (2018a):	Ex-post analysis of Swiss energy consumption 2000 to 2017 according to the main factors. On behalf of SFOE.
Prognos/TEP/Infras (2018b):	Analysis of Swiss energy consumption 2000 to 2017 according to the use. On behalf of SFOE.
SFOE (2018a):	Swiss Federal Office of Energy, Swiss overall energy statistics 2017.
SFOE (2018b)	Statistic of Switzerland's hydropower plants (WASTA) 2017.
SFOE (2018b):	Swiss Federal Office of Energy, Energy research statistics 2016.
SFOE (2018c):	Swiss Federal Office of Energy, Swiss overall energy statistics 2017.
SFOE/Swissgrid (2018):	Information on the status of grid projects.
Swissgrid (2015):	Strategic Grid 2025.
University of Basel/ETHZ (2017):	Research Centre for Sustainable Supply of Energy and Water, University of Basel, Research Centre for Energy Networks ETHZ, Modelling the System Adequacy of the Swiss Electricity Supply. On behalf of SFOE.

LIST OF FIGURES

IMPRINT

NOVEMBER 2018

Publisher:
Swiss Federal Office of Energy SFOE

Mühlestrasse 4, CH-3063 Ittigen

Postal address:
Mühlestrasse 4, CH-3003 Bern

Tel. +41 58 462 56 11
Fax +41 58 463 25 00

contact@bfe.admin.ch
www.bfe.admin.ch
twitter.com/bfeenergeia

Images: www.shutterstock.com

↗ **www.energymonitoring.ch**