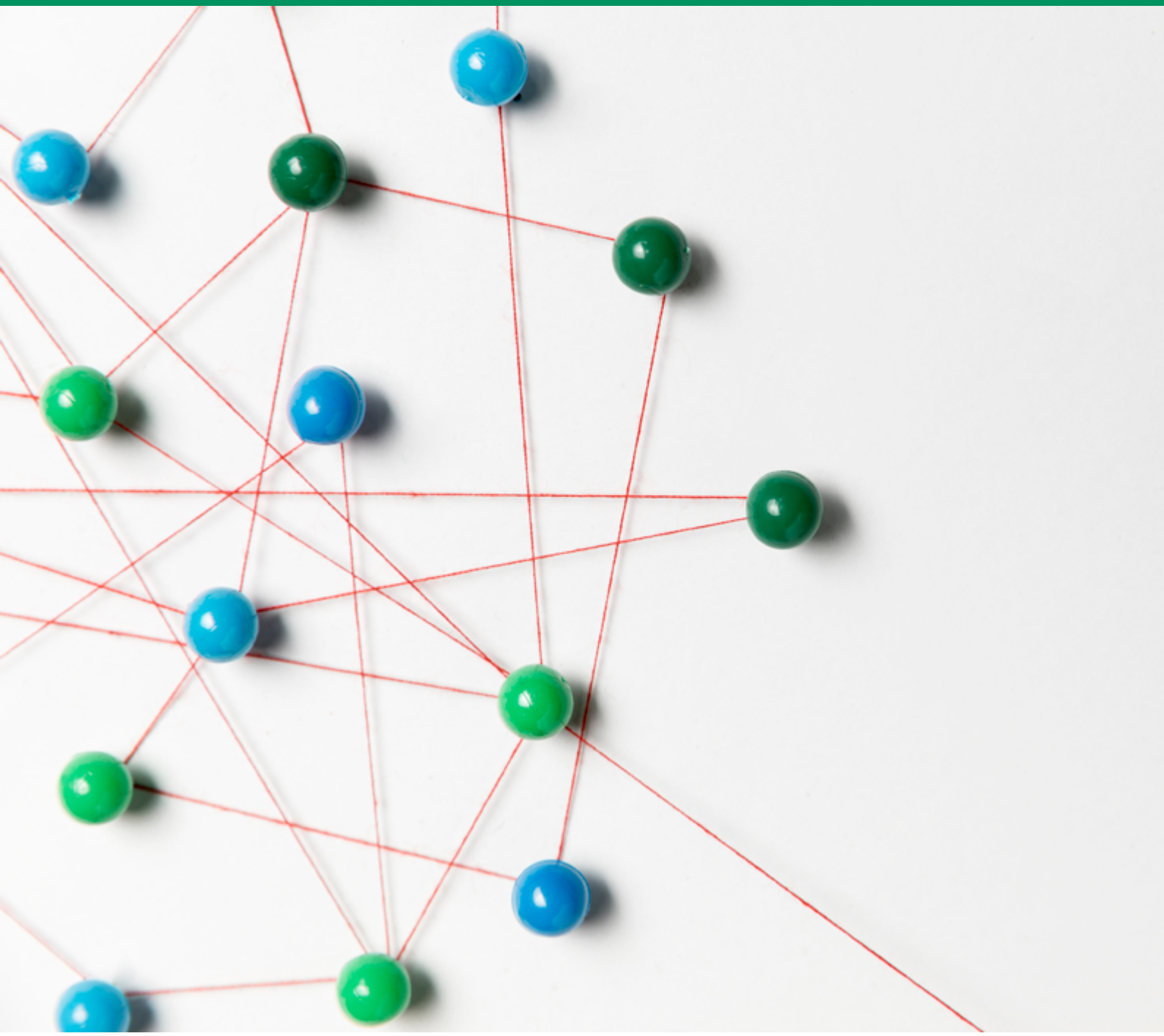


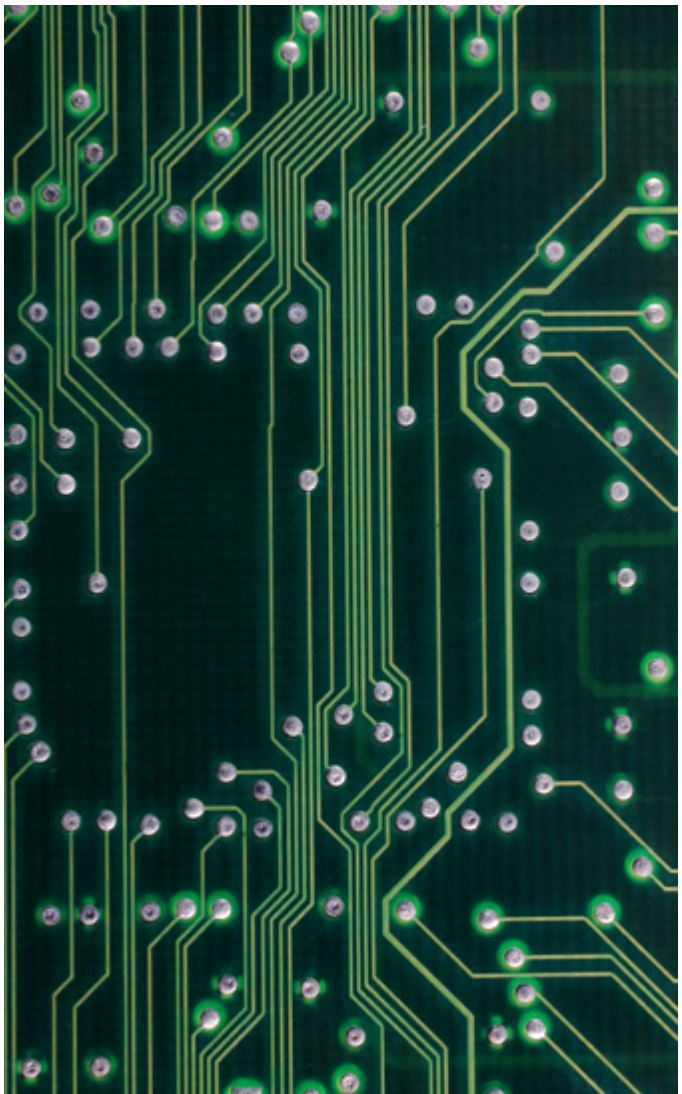
ENERGY STRATEGY 2050
MONITORING-REPORT 2021
ABRIDGED VERSION[1]

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

1 Majority of data as of 2020

CONTENTS



CONTENTS

INTRODUCTION

With Energy Strategy 2050, Switzerland is implementing the transformation of its energy system. The objectives of the energy strategy are to facilitate the gradual phasing out of nuclear energy, promote energy efficiency, increase the share of renewable energy and reduce energy-related CO_2 emissions, without endangering Switzerland's currently high level of supply security and affordable energy supply (Federal Council, 2013).

Continuation ▸ ▸ ▸

In the referendum of May 2017, Swiss voters accepted the new energy legislation, which has been in force since the beginning of 2018. **In its Dispatch to Parliament in June 2021 regarding a 'Federal Act on a Secure Electricity Supply with Renewable Energy', the Federal Council proposes further development of the Energy Strategy 2050.** With this move, it wants to rapidly and resolutely expand domestic electricity production from renewable energy, integrate it more effectively into the electricity system, and strengthen the long-term supply security (Federal Council, 2021b).

In mid-October 2021, the Federal Council took note of two reports dealing with **short- and medium-term electricity supply security** and cooperation with the EU in the electricity sector. These reports are intended to facilitate the preparation of the next steps to strengthen supply security, now that an electricity agreement with the EU is not on the table in the foreseeable future (Federal Council, 2021h). Furthermore, at the end of September 2021, following its debate on parliamentary initiative 19.443 (Girod), Parliament called for the **promotion and increased use of renewable energy as an interim solution** because the currently applicable system is limited until 2022.

The energy policy objectives are closely linked to those of the climate policy, since around three-quarters of Switzerland's greenhouse gas emissions are attributable to the use of fossil fuels. Switzerland's aim is to no longer produce any greenhouse gases by 2050 that cannot be absorbed naturally or by technical means. The Federal Council declared its net zero target in 2019 (Federal Council, 2019a). The updated 'Energy Perspectives 2050+' of the Swiss Federal Office of Energy (SFOE) shows that Switzerland can restructure its energy supply by 2050 in harmony with this target, and simultaneously ensure its supply security (Prognos/ TEP/Infras/Ecoplan, 2020). The SFOE's 'Energy Perspectives 2050+' forms an important basis for 'Switzerland's Long-Term Climate Strategy', which the Federal Council adopted in January 2021 in order to consolidate its net zero target (Federal Council 2021a). Furthermore, in August 2021 the Federal Council adopted its Dispatch concerning the direct counterproposal to the 'Glacier Initiative'. Here, in line with this initiative it calls for the previously indicative net zero target to be adopted into the Federal Constitution as a binding objective (Federal Council, 2021b). Switzerland has undertaken a commitment to cut its greenhouse gas emissions by 50 per cent by 2030. The national implementation of this target and the corresponding measures were stipulated in the revised CO_2 Act, which the Swiss electorate rejected in the referendum that was held in June 2021. However, the reduction target for 2030 is still valid. In view of this, in September 2021 the Federal Council decided to submit a new version of the draft legislation for consultation which takes account of the result of the referendum and is intended to create as broad a basis as possible for Switzerland's future climate policy (Federal Council, 2021f). In order to prolong the undisputed measures that are due to expire at the end of 2021 and to continue to pursue the

↗ **www.energiestrategie2050.ch**

declared reduction target until 2024, Parliament is currently also debating the initiative submitted by the National Council Environment, Spatial Planning and Energy Committee (21.477).

The restructuring of Switzerland's energy system in accordance with Energy Strategy 2050 is a long-term project, **which in view of the lengthy timeframe requires a monitoring process.** This makes it possible to observe the relevant developments and progress, measure the degree to which the various targets are attained, examine the economic benefits and costs of the various measures, and intervene early and steer events based on facts in the case of undesirable developments. The legal bases for the monitoring procedure are primarily provided in the energy legislation (Articles 55ff of the Energy Act and Articles 69ff of the Energy Ordinance).

This monitoring report for 2021 (abridged version, majority of data as of 2020) deals with selected indicators and contains descriptive sections on the following seven topics:

- **TOPIC** **ENERGY CONSUMPTION AND PRODUCTION**
- **TOPIC** **NETWORK DEVELOPMENT**
- **TOPIC** **SUPPLY SECURITY**
- **TOPIC** **EXPENDITURE AND PRICES**
- **TOPIC** **CO_2 EMISSIONS**
- **TOPIC** **RESEARCH AND TECHNOLOGY**
- **TOPIC** **INTERNATIONAL ENVIRONMENT**

↗ Additional indicators are dealt with in the **full version of the monitoring report:** **www.energymonitoring.ch**.

In addition, the Federal Council will prepapare a report for the attention of Parliament every five years containing indepth analyses of further problems and topics thus facilitating a review of energy policy.

ENERGY CONSUMPTION AND PRODUCTION

Reducing energy and electricity consumption by enhancing efficiency measures is one of the main objectives of Energy Strategy 2050 and is 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 targets in the Energy Act for per capita energy and electricity consumption, as well as the goals for the expansion of electricity production from renewable energy and for hydropower.

END ENERGY CONSUMPTION PER PERSON AND YEAR

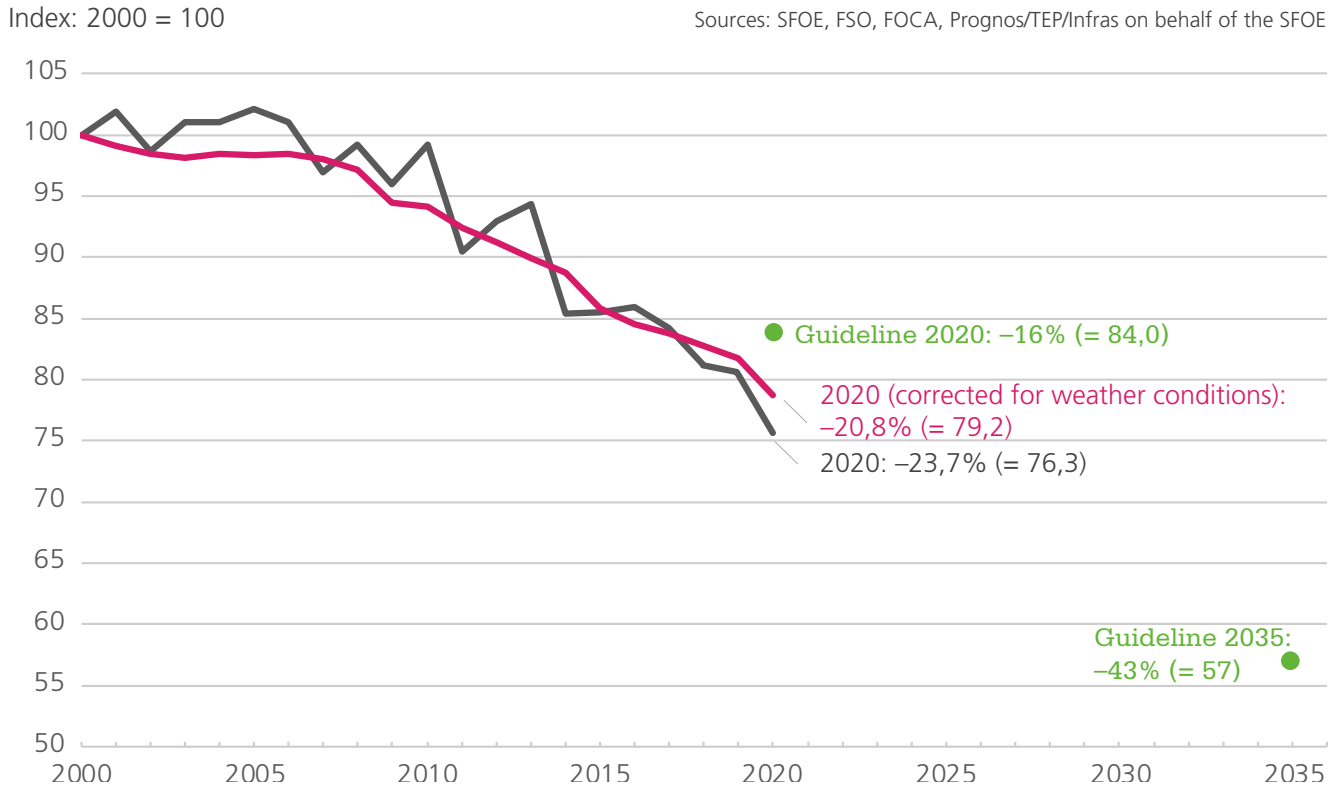


Figure 1: Development of per capita end energy consumption[2] since 2000 (indexed)

Per capita end energy consumption has fallen since 2000, as shown in **Figure 1**. The decline is a consequence of the lower absolute energy consumption in 2020 (-11.8 per cent) versus 2000, while at the same time the population increased by 20.2 per cent. The sharp decline in end energy consumption in 2020 is primarily attributable to the significant fall in fuel demand in the transport sector due to the COVID-19 pandemic. The decline in end consumption in accordance with the delimitation of the guidelines in the Energy Act is 8.2 per cent lower, because international aviation (and thus the sharp decline in demand for kerosene) is not taken into account here. According to the applicable Energy Act, the targeted per capita energy consumption versus reference year 2000 is 16 per cent by 2020 and 43 per cent by 2035. In 2020, per capita energy consumption was 82.2 gigajoules (0.023 GWh), and thus 23.7 per cent lower than in 2000. When adjusted to take account of the weather, the decline was 20.8 per cent, thus undercutting the target for 2020 *(cf. red curve)*. The applicable target in the Energy Act for 2020 was already undercut in the last three years prior to the COVID-19 pandemic. The trend in volume-driving factors in the past few years (e.g. population, GDP, vehicle inventory) does not indicate that end energy consumption in 2020 would have sharply increased versus the previous year without the pandemic. It is therefore highly likely that the applicable target in the Energy Act for 2020 would also have been achieved without the influence of the pandemic. Per capita end energy consumption (adjusted to take account of the weather) will in future have to fall by 2.2 per cent per annum to ensure that the target for 2035 can be achieved. The average annual reduction in the last 10 years is approximately 1.7 per cent, and 1.4 per cent if only the 10 years prior to the pandemic up to and including 2019 are taken into account.

END ENERGY CONSUMPTION PER PERSON AND YEAR

The absolute end energy consumption in 2020 was 10.6 per cent lower than in the previous year (or 5.1 per cent lower in accordance with the delimitation of the guidelines in the Energy Act). Alongside the consequences of the COVID-19 pandemic, this was primarily attributable to the warmer weather, which led to a corresponding decrease in demand for space heating. Over the entire period under review (from 2000 to 2020), volume effects led to increased consumption; all 'pure' growth effects were calculated, such as the overall economic output (excluding structural effects), population, energy reference areas and the motor vehicle inventory. Effects that tended to increase consumption were compensated by political measures and technological progress. Substitution of heating oil with gas and the increasing use of district heat, ambient heat and wood tended to reduce consumption between 2000 and 2020. In the fuels sector, the trend to substitute petrol with diesel fuel was noted until 2016, but since then the effect of this change has become less significant as a consequence of the exhaust emissions scandal (sources: SFOE, 2021a / FSO, 2021 / FOCA, 2021 / Prognos/TEP/Infras 2021a+b).

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

ELECTRICITY CONSUMPTION PER PERSON AND YEAR

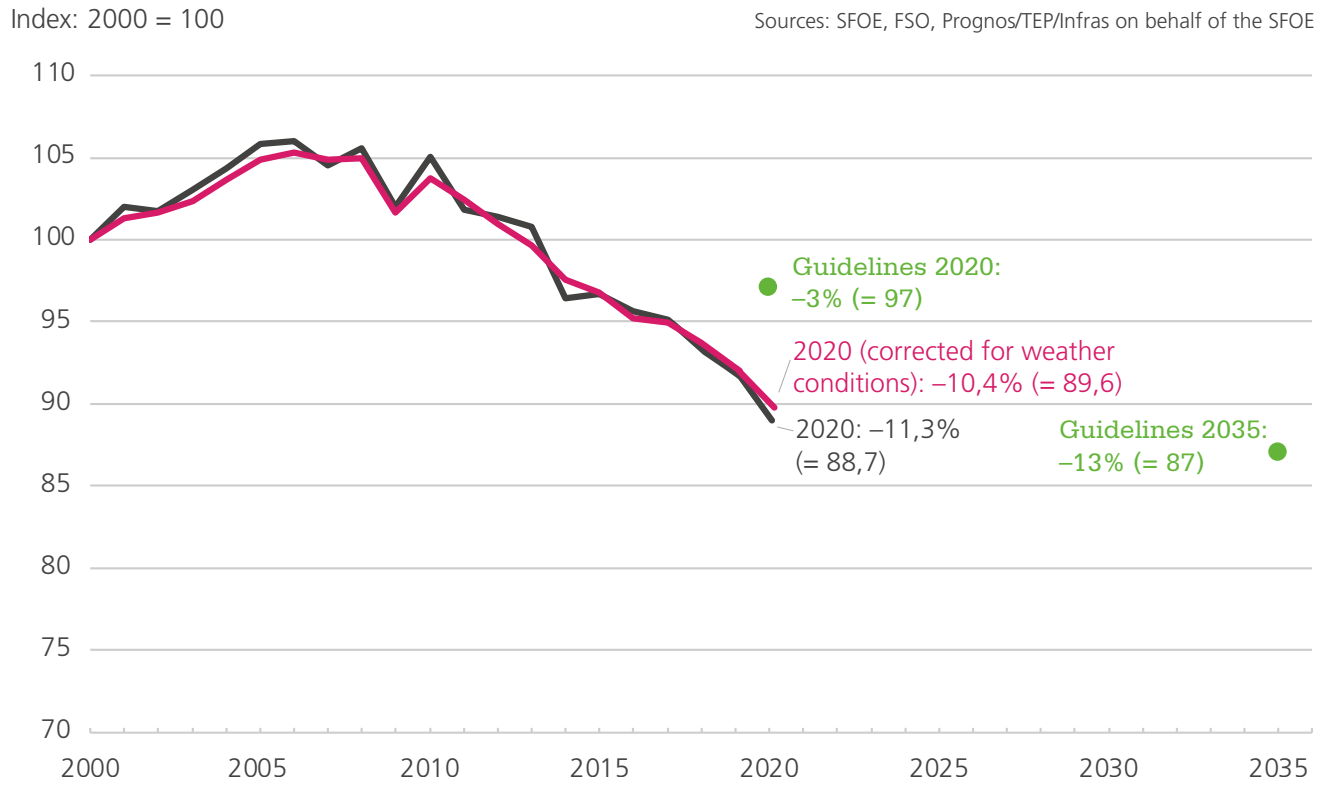


Figure 2: Development of per capita electricity consumption[3] since 2000 (indexed)

Per capita electricity consumption increased between 2000 and 2006 because absolute consumption rose by 10.4 per cent, while the population only increased by 4.2 per cent. Since 2006, the trend has been downward, as we can see from **Figure 2.** Electricity consumption decreased by 3.6 per cent between 2006 and 2020, while the population increased during the same period by 15.4 per cent. The sharp decline in per capita consumption in 2009 is a result of a clear economic slow-down. Compared with end consumption, the COVID-19 pandemic only had a minor effect on electricity consumption throughout 2020. The impacts were largely temporary, from the beginning of lock-down in mid-March through to the initial easing of measures at the end of April. According to the applicable Energy Act, the targeted per capita electricity consumption versus reference year 2000 is 3 per cent by 2020 and 13 per cent by 2035. In 2020, per capita electricity consumption was 22.8 gigajoules (0.006 GWh), and thus 11.3 per cent lower than in 2000. When adjusted to take account of the weather, the decline was 10.4 per cent *(cf. red curve)*. The target for 2020 was thus undercut. This would probably have been the case even without the impact of the COVID-19 pandemic. Per capita electricity consumption has been below the target for 2020 since 2015. In the past 10 years, the average annual decline after adjustment for the weather was around 1.4 per cent. Even if electricity consumption were to continue to decline at this rate, the target for 2035 (-13 per cent) will not be achievable without further efforts. In order to achieve the declared climate objective of net zero greenhouse emissions by 2050, according to 'Energy Perspectives 2050+' a significant increase in electricity demand has to be anticipated in the medium term, and this will make it more difficult to achieve the target (electric mobility, standard heat pumps, new consumers such as electrolysers for hydrogen production, large-scale heat pumps, and in the long term, negative emission technologies and systems for CO_2 capture and storage). This means that further significant efficiency increases in electricity consumption will be required in the medium

ELECTRICITY CONSUMPTION PER PERSON AND YEAR

and long term in order to offset the additional electricity consumption resulting from the electrification of the energy system. In 2020, the absolute electricity consumption decreased by 2.6 per cent versus 2019. The main reasons for this decline are the COVID-19 pandemic and the warmer weather compared with the previous year. The long-term increase in electricity consumption during the entire monitoring period from 2000 to 2020 was mainly due to volume effects and, to a lesser degree, to structural effects (e.g. differing growth rates in individual industry sectors). Energy policy instruments and measures (e.g. political requirements and the voluntary measures from the SwissEnergy programme) and technological developments (structural measures such as insulation and use of more efficient heating systems, electrical appliances, lighting, machines, etc.) had the opposite effect and increasingly tended to reduce electricity consumption (sources: SFOE, 2021a / FSO, 2021 / Prognos/TEP/Infras, 2020a+b / Prognos/TEP/Infras/Ecoplan, 2021).

3 Excluding statistical differences and agriculture

ELECTRICITY CONSUMPTION FROM RENEWABLE ENERGY (EXCLUDING HYDROPOWER)

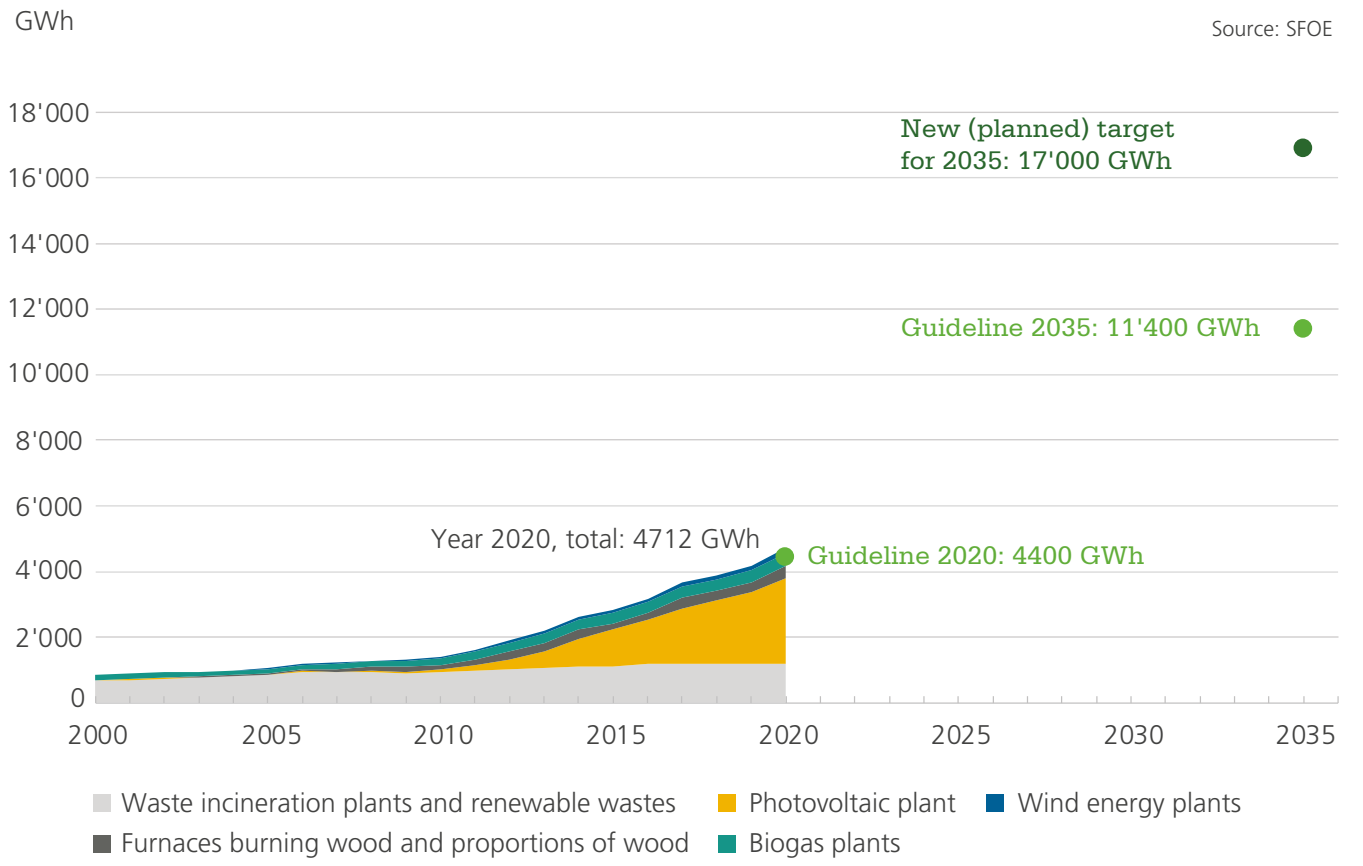


Figure 3: Development of electricity production from renewable energy (excluding hydropower) since 2000 (in GWh)

The guidelines stipulated in absolute figures in the applicable legislation (Energy Act, Article 2, paragraph 1) refer to domestic production, which corresponds to the sphere of influence of the legal instruments. Here it should be noted that these targets are no longer compatible with the climate objective of net-zero greenhouse gas emissions by 2050. Based on 'Energy Perspectives 2050+', the aim is to significantly increase the medium- and long-term figures and incorporate them into the legislation as binding targets, not only for 2035, but now also for 2050. The Federal Council is proposing this move in its Dispatch to Parliament regarding a 'Federal Act on a Secure Electricity Supply with Renewable Energy'. Figure 3 and the comments below thus also refer to these new targets.

Electricity production from renewable sources has increased since 2000, as indicated in **Figure 3**. Production gained momentum from 2010 onwards. In 2020, it reached 4,712 gigawatt-hours (GWh), which corresponds to 7.2 per cent of the overall net electricity production (excluding consumption by storage pumps). In reference year 2010, electricity production from renewable energy was 1,402 GWh. Between 2010 and 2020 a net increase of 3,000 GWh was targeted, and an increase of 3,309 GWh was achieved. Thus the target of 4,400 GWh in 2020 was fully met.

In 2020, the net increase versus 2019 was 526 GWh; since 2011 it has averaged 309 GWh per annum. In accordance with the current Energy Act, the target for 2035 is 11,400 GWh. In order to achieve this target, an average net increase of 446 GWh per annum will be required. A significantly higher increase of 819 GWh per annum is required for the target of 17,000 GWh that is compatible with the net zero goal in accordance with the Dispatch regarding the 'Federal Act on a Secure Electricity Supply with Renewable Energy' (sources: SFOE, 2021a / Federal Council, 2021b).

ELECTRICITY PRODUCTION FROM HYDROPOWER POWER PLANTS

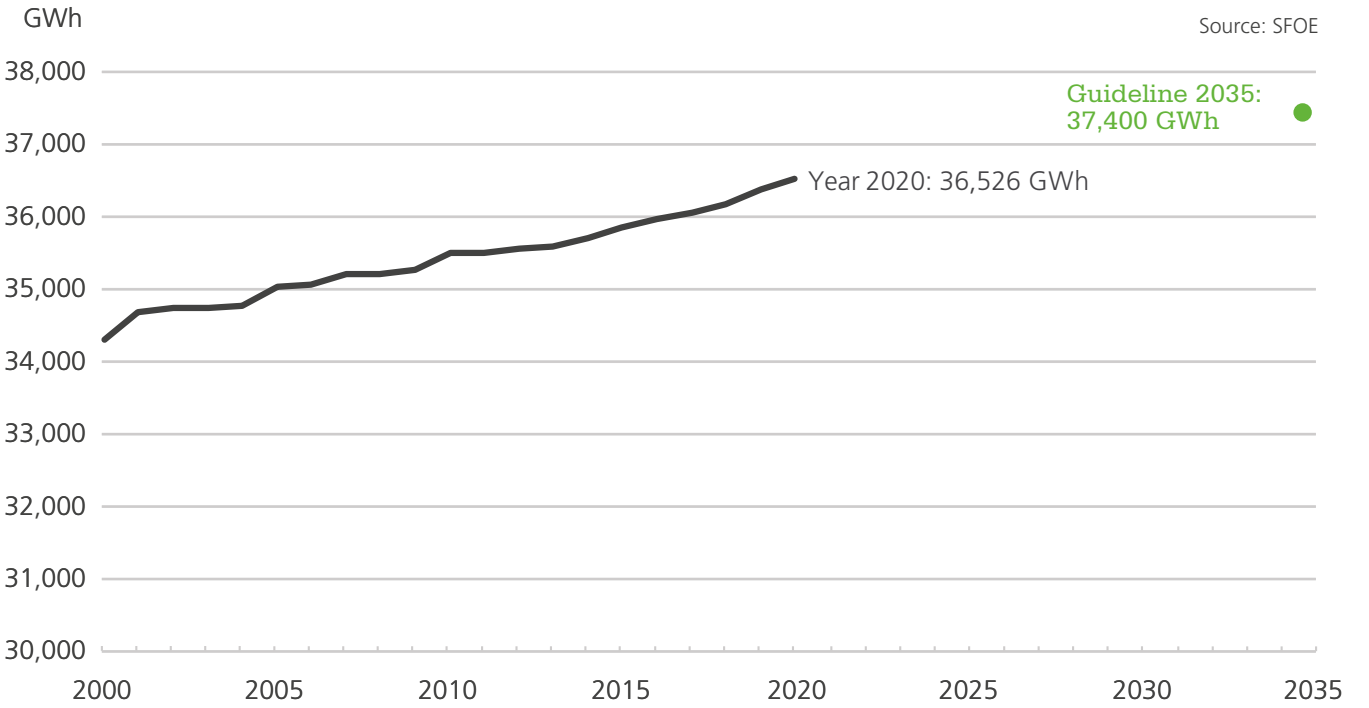
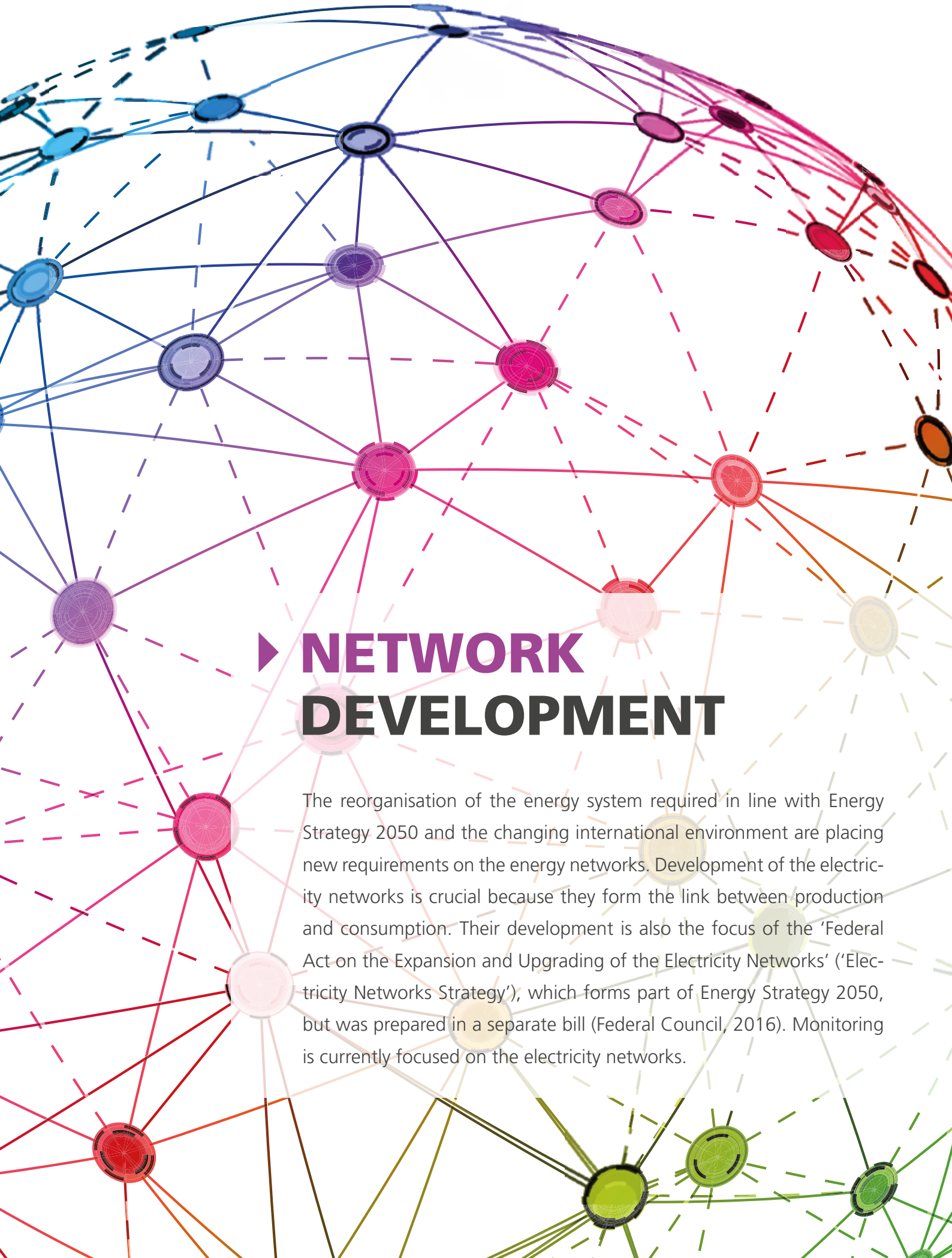


Figure 4: Development of the anticipated average production[4] of electricity from hydropower plants (in GWh) since 2000

Figure 4 (NB: scale does not start at zero) shows that electricity production from hydropower plants has grown continuously since 2000; this growth is primarily due to the addition of new plants and the expansion and optimisation of existing facilities. In 2020 (as at 1 January 2021), the anticipated average production was 36,526 GWh. In reference year 2011 (as at 1 January 2012), the figure was 35,488 GWh. To achieve the reference value, between 2011 and 2035 a net increase of around 1900 GWh will be required. In the year under review, 54.0 per cent of this increase had been attained. In 2020, the net increase versus 2019 was 167 GWh; since 2012 it has averaged 98 GWh per annum. To achieve the reference level in 2035, an average annual net increase of 58 GWh will be required (source: SFOE, 2021b).

4 Anticipated average production including anticipated production from small hydropower plants <300 kW (according to statistics for hydropower plants in Switzerland, WASTA), excluding average energy requirement for all storage system pumps (for which an efficiency rate of 83 per cent is assumed) and excluding electricity required for recirculation. NB: The reference year, time series and chart were subsequently adjusted on the basis of an extraordinary correction by WASTA (cf. SFOE press release of 5 May 2022).

↗ For more detailed indicators regarding **ENERGY CONSUMPTION AND PRODUCTION,** see the full monitoring report



NETWORK DEVELOPMENT

The reorganisation of the energy system required in line with Energy Strategy 2050 and the changing international environment are placing new requirements on the energy networks. Development of the electricity networks is crucial because they form the link between production and consumption. Their development is also the focus of the 'Federal Act on the Expansion and Upgrading of the Electricity Networks' ('Electricity Networks Strategy'), which forms part of Energy Strategy 2050, but was prepared in a separate bill (Federal Council, 2016). Monitoring is currently focused on the electricity networks.

STATUS AND DURATION OF PLANS FOR THE TRANSMISSION NETWORK

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

PROCESS AND PHASES OF A TRANSMISSION NETWORK PROJECT

PRELIMINARIY PROJECT: As the basis for the sectoral plan procedure, national grid operator Swissgrid draws up a preliminary project with the key parameters of the grid plan and ensures that 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 as a rule with the initiation of the project, and ends when the application is submitted for the project to be incorporated in the sectoral plan for transmission lines. If a plan is not yet in either the preliminary or the construction project phase, and is thus in an early stage of planning, it is designated in the monitoring programme as a **project proposal**.

TRANSMISSION LINES SECTORAL PLAN (SÜL): If a 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 can be initiated (see below). The Transmission Lines sectoral plan applies to the power lines network. The Swiss Federal Office of Energy (SFOE) is responsible for this sectoral plan, with the support of the Federal Office for Spatial Development (ARE). In the first stage of the sectoral plan procedure, a **planning zone** 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 defined, a decision is made as to which **transmission technology** is to be employed (overhead line or underground cable). The sectoral plan procedure begins when Swissgrid submits a corresponding application, and ends when the decision is taken on the planning corridor by the Federal Council in the corresponding detailed plan. This plan is binding for all authorities, which means they have to take it into consideration when approving the project and in any other spatial development activities.

CONSTRUCTION PROJECT: Once the planning corridor has been defined, Swissgrid's plan is developed within the scope of a detailed construction project. The company has to guarantee that the line will be

In April 2015, national grid operator Swissgrid submitted a strategic network plan , 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 network by 2025. The current monitoring process will follow the status and duration of plans at the transmission network level, including Swissgrid's Strategic Network Plan 2025 (sections 1 to 10), as well as other projects, some of which are initiated by third parties **(cf. Figure 5)**. In the future, the energy scenario framework legally introduced with the Electricity Networks Strategy will form a central basis for network planning. This framework provides operators at network levels 1 and 3 with useful suggestions for future network development, and thus represents a significant basis for determining the necessary expansion requirements and defining or updating their own long-term planning. The Federal Council has initiated the consultation procedure on the first scenario framework in November 2021. After the scenario framework has been approved by the Federal Council, it becomes binding for the authorities and will be reviewed and updated every four years (Federal Council, 2021i).

5 vgl. www.swissgrid.ch > Strategic Grid

constructed using the specified transmission technology and that the route lies within the defined planning corridor. In this monitoring procedure, the construction project phase begins as a rule with the definition of the planning corridor (which corresponds to the end of the sectoral plan phase) and ends when Swissgrid submits the planning approval application to the Federal Inspectorate for Heavy Current Installations (ESTI). In projects for which no sectoral plan is used, the start of the construction project is based on the corresponding standard of the SIA (Swiss Association of Engineers and Architects).

PLANNING APPROVAL PROCEDURE (PGV): Swissgrid now submits the detailed construction project to ESTI, together with the application for planning approval. This signals the start of the planning approval procedure. ESTI is responsible for examining the dossier and granting planning approval. In the planning approval procedure, projects are closely examined in order to verify that they comply with the relevant safety requirements and legal provisions, especially those of environmental and area planning legislation. At the same time, the procedure examines network projects to ensure that they are reconcilable with the interests of private individuals (property owners, local population). If the Inspectorate is unable to deal with all objections or settle disputes between the involved federal authorities, it forwards the documentation to the SFOE, which then proceeds with the planning approval procedure and grants planning approval provided the project is in conformity with the legal requirements. A decision is also made on any objections (e.g. concerning expropriation orders). The parties involved can appeal against such decisions to the Federal Administrative Court, and subsequently in certain cases to the Federal Supreme Court. If the SFOE approves the application for planning approval and no other objections are submitted within the legally binding deadlines, planning approval becomes final and Swissgrid can realise the transmission line project.

REALISATION: For monitoring purposes, the start of the realisation phase corresponds to the date of the legally binding planning approval decision, and ends when the facility is put into operation.

NETWORK PROJECT	DESCRIPTION AND MAIN AIMS	CURRENT STATUS[6]	PLANNED DATE OF OPERATION[7]
1. Chamoson–Chippis	▪ New 30 km 380-kV overhead transmission line between Chamoson and Chippis ▪ Dismantling of almost 89 km of power lines in Rhône plain ▪ Transfer of production from hydropower plants in Valais ▪ Improved connection between Valais and the Swiss and European ultra-high-voltage networks ▪ Contribution towards network security in Switzerland	Realisation	2022
2. Bickigen–Chippis (Gemmi line)	▪ Modernisation of Bickigen and Chippis substations and the existing 106 km route by increasing the level to 380 kV ▪ Installation of a 220/380 kV coupling transformer in the Chippis switching facility ▪ Improved transfer of electricity production from Valais ▪ Contribution towards network security in Switzerland	PGV BFE	2027
3. Pradella–La Punt	▪ Increase of the level on the existing 50 km route from 220 to 380 kV ▪ Modification and expansion of Pradella switching system for 380 kV ▪ Elimination of existing bottleneck ▪ Contribution towards network security in Switzerland and Europe	Realisation	2022
4. Chippis–Lavorgo 4.1. Chippis–Mörel (Rhône Valley line) 4.2. Mörel–Ulrichen (Gommer line) 4.3. Chippis–Stalden 4.4. Airolo–Lavorgo	▪ Increase of level to 380 kV on 124 km Chippis-Mörel-Lavorgo axis (Chippis–Stalden remains at 220 kV) ▪ Dismantling of existing lines over 67 km ▪ Supplements main supply axis for Ticino ▪ Elimination of a critical supply bottleneck	4.1. SFOE planning approval procedure 4.2. Realisation (Mörel–Ernen) / in operation (Ernen–Ulrichen) 4.3. SFOE planning approval procedure (Agarn–Stalden) / SFOE planning approval procedure (Chippis–Agarn) 4.4. ESTI planning approval application	2032
5. Beznau–Mettlen 5.1. Beznau–Birr 5.2. Birr–Niederwil 5.3. Niederwil–Obfelden 5.4. Mettlen–Obfelden	▪ Optimisation of existing 40 km route by increasing level to 380 kV and upgrading of 24 km stretch ▪ Elimination of structural bottlenecks ▪ Creation of necessary conditions for combining the flexibility of domestic hydropower with fluctuating energy from wind and photovoltaic plants	5.1. in operation 5.2. Preliminary project 5.3. Sectoral plan procedure 5.4. Preliminary project	2031

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2021)

6 Status: 15 October 2021

7 According to Swissgrid planning

NETWORK PROJECT	DESCRIPTION AND MAIN AIMS	CURRENT STATUS[6]	PLANNED DATE OF OPERATION[7]
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 network security and supply security	Realisation	2023
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 proposal	2035
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 of the existing 220 kV line to accommodate a future increase to 380 kV ▪ Important for the connection of new pump storage power plants to the 380 kV network and transfer of energy to the rest of Switzerland	9.1. Sectoral plan procedure 9.2. Sectoral plan procedure	2035
10. All'Acqua–Vallemaggia–Magadino	▪ New 220 kV line through the Maggia Valley ▪ Existing line built in the 1960s will be dismantled, thus lessening the impact on the protected areas in Upper Ticino ▪ Increase of capacity to convey energy generated in hydropower plants in Maggia Valley ▪ Greater security of supply in the southern Alps – today, production at power plants has to be curbed	Sectoral plan procedure	2035
Nant de Drance connection NdD_1 Le Verney/ Rosel–Bâtiaz NdD_2 Bâtiaz–Châtelard NdD_3 Châtelard–Nant de Drance	▪ Connection of Nant de Drance pump storage power plant to the ultra-high-voltage network ▪ Part of the strategic network in the initial Swissgrid network ▪ Contribution towards integration of new renewable energy sources	NdD_1 Realisation NdD_2 in operation NdD_3 in operation	2022
ASR (Axe Stratégique Réseau) in the Geneva area	▪ Underground cabling of existing 220 kV line from Foretaille–Verbois over a length of about 4.5 km alongside Geneva airport	Realisation	2024

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2021)

6 Status: 15 October 2021

7 According to Swissgrid planning

NETWORK PROJECT	DESCRIPTION AND MAIN AIMS	CURRENT STATUS[6]	PLANNED DATE OF OPERATION[7]
Obfelden–Samstagern OS_1 Schweikrüti (Mast 46)–Kilchberg OS_2 Kilchberg–Wollishofen (Frohalp) OS_3 Wollishofen (Frohalp)–Waldegg OS_4 Waldegg–Obfelden OS_5 Siebnen–Samstagern	▪ Expansion and/or substitution of the existing 150 kV line between the Obfelden substation, the planned substation at Waldegg, and the Samstagern substation with a 380/220 kV line. ▪ Improvement to the energy supply of the consumer centres of Zurich and the region of Thalwil.	OS_1 Realisation OS_2 Construction project OS_3 Construction project OS_4 Preliminary project OS_5 SFOE planning approval procedure	2030
Grynau–Siebnen	▪ Replacement of existing 220 kV line with a 380 kW line (closing the gap in the 380 kV network) ▪ Improvement of supply security in the Lake of Zurich region/Linth plain and increase in import capacity from the north	SFOE planning approval procedure	2028
Amsteg–Mettlen AM_1 Lauerz AM_2 Eyschachen bei Altdorf	▪ AM_1: Swissgrid places the line outside landslide area above Lauerz (SZ) ▪ AM_2: Swissgrid and Swiss Federal Railways to install ultra-high-voltage lines in the Uri valley floor. This will relieve the burden on the developed areas in Attinghausen and the Werkmatt developed area in Uri.	AM_1 Construction project AM_2 in operation	2030
Airolo–Mettlen	▪ Bundling of infrastructure in the second tube of the Gotthard Road Tunnel ▪ Cabling of the existing 220 kV line from Airolo-Mettlen in the Gotthard sector planned over a length of 18 km ▪ Important element of the north-south connection for electricity supply in Switzerland and Europe ▪ Dismantling of existing overhead line over a 23 km with more than 60 masts that currently traverse the Gotthard Pass and run through the Schollenen Gorge in the canton of Uri	Preliminary project	2029
Marmorera–Tinzen	▪ Ultra-high-voltage line between Marmorera and Tinzen in the Albula region (canton of Graubünden) no longer corresponds to latest status of technology and needs to be replaced (220 kV as today). ▪ This line plays a significant role in the transfer of energy from Bergell hydropower plants to consumer centres in the central plateau.	Sectoral plan procedure	2030

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2021)

6 Status: 15 October 2021

7 According to Swissgrid planning

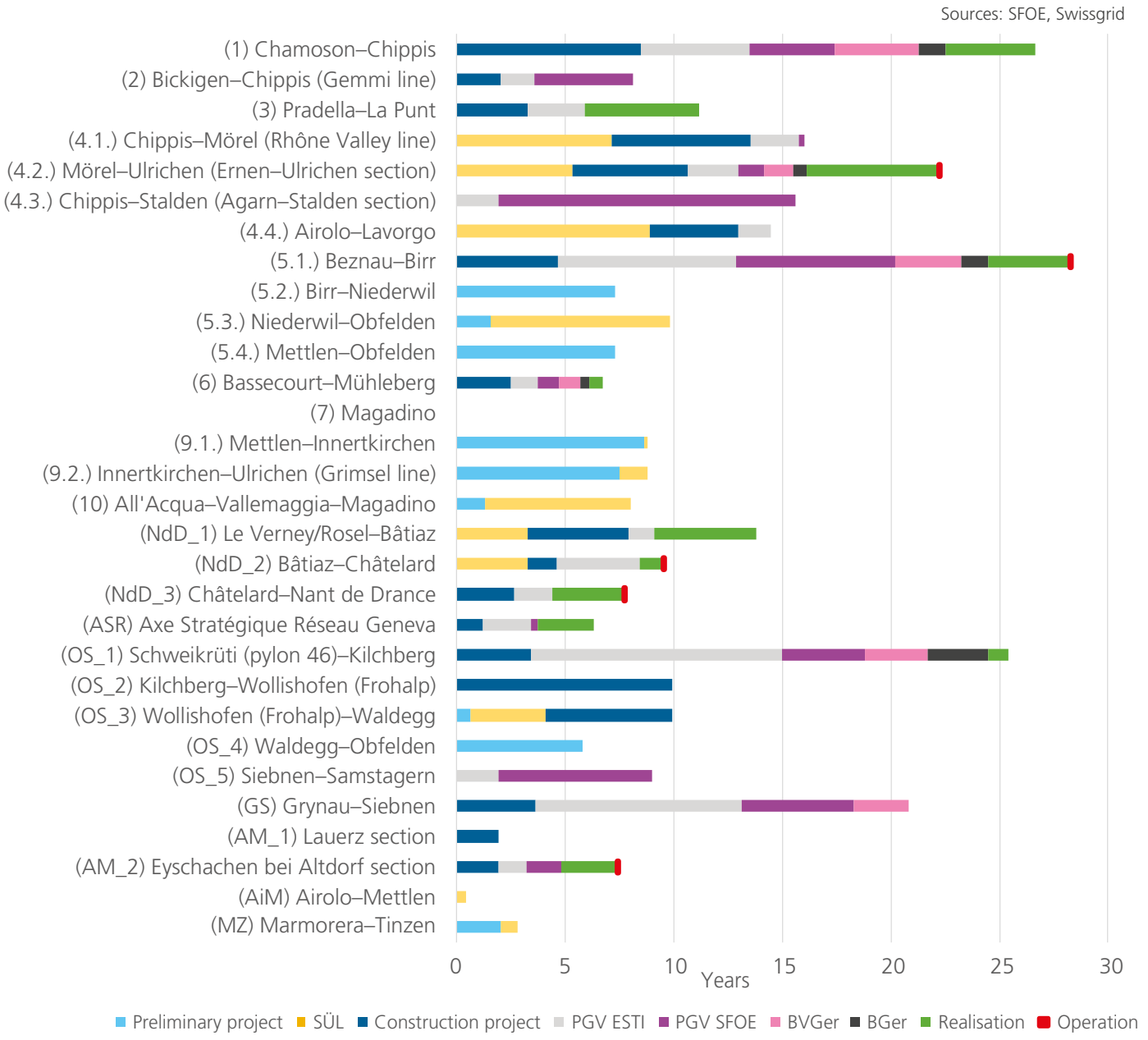


Figure 6: Accumulated duration of project phases of selected network plans in years at network level 1 as at 15 October 2020[8]

Figure 6 above shows the duration of projects, status and proposed date of operation. The duration is presented in a simplified manner in that any supplementary loops in the course of the project (i.e. if the procedure is returned to the SFOE after a decision by the Federal Administrative Court and/or the Federal Supreme Court) 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 illustration does not permit any interpretation with regard to the extent to which Energy Strategy 2050 and the Electricity Networks Strategy produce the desired effect of a further optimisation of the procedures. Most of the corresponding legislation only entered into force at the beginning of June 2019.

8 **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 planning approval procedure decision to the SFOE, half of the supplementary duration of the procedure is allotted to the planning approval procedure phase and half to the construction project phase.

BRIEF DESCRIPTION OF EACH NETWORK PROJECT (STATUS, 15 OCTOBER 2021):

1. Chamoson–Chippis
Construction of the new line from Chamoson to Chippis in the canton of Valais was initiated before the Transmission Lines sectoral plan was developed, and the project was the subject of planning and approval phases for many years. An important milestone was reached in 2017: in its decision of 1 September 2017, the Federal Supreme Court dismissed the appeals against the ruling of the Federal Administrative Court of 14 December 2016 and confirmed the decision by the SFOE of 19 January 2015 concerning the planning approval procedure. Swissgrid then proceeded with the realisation of the new overhead transmission line project. Construction commenced in 2018 and according to Swissgrid is now well advanced. Even in the realisation phase there is still strong resistance to the project among the population. Operation of the line was originally planned for 2021; in the meantime, Swissgrid has changed the deadline to 2022 because conditions for access to some sites where masts are located have to be further clarified. Meanwhile, the proceedings regarding access to the mast locations and those concerning over-voltages have been concluded. Operation is scheduled to commence in 2022.

2. Bickigen–Chippis
The Transmission Lines sectoral plan 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 impact on the area. After a construction project phase of around two years, the planning approval procedure commenced with an application to ESTI in mid-2015, and almost two years later the dossier was passed on to the SFOE. The planning approval procedure is currently pending at the SFOE. Operation is scheduled to commence in 2027.

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 sectoral plan procedure was necessary because of the minimal impact on the area. The construction project and planning approval procedure phases each lasted about three years. The project has been in the process of realisation since mid-2016 because there was no opposition to ESTI planning application procedure. The line should go into operation at the end of 2022.

4. Chippis–Lavorgo
Operation of the entire Chippis-Lavorgo network project is scheduled for 2032. It consists of several sub-projects, the current status of which is described below:

4.1. Chippis–Mörel (Rhône Valley line)
The project for the construction of the new line underwent a sectoral plan procedure lasting almost seven years, and the construction project took almost six and a half years. The planning application procedure was initiated by ESTI at the end of March 2019. In June 2021, ESTI passed on the application to the SFOE. Within the scope of the planning approval procedure, the SFOE is examining the application from the canton of Valais, together with sectoral plan related issues in the Agarn-Mörel segment due to a new cabling study.

4.2. Mörel–Ulrichen
The project for the construction of the new line was subject to a planning and approval procedure lasting many years; the section between Ernen and Ulrichen was put into operation in mid-October 2019; in the Mörel-Ernen section the Federal Supreme Court ordered that a study on the use of an underground cable should be made for the 'Binnegga-Binnachra-Hockmatta-Hofstatt' area (crossing the Binna) and this was submitted to the SFOE, which approved the overhead line version on 23 December 2016 and turned down all objections. Objections to the decision were submitted to the Federal Administrative Court, which confirmed on 26 March 2019 that the overhead

power line variant would be implemented. No appeal was lodged with the Federal Supreme Court, and the ruling is now legally binding. Construction of the line is in progress.

4.3. Chippis–Stalden
The planning approval procedure for the Agarn-Stalden segment is being processed by the SFOE. This concerns a procedure under former legislation for which no sectoral plan procedure could be initiated. In 2012, it was determined in the sectoral plan procedure for the line from Chippis to Mörel that the Chippis-Agarn segment (Rhône Valley line) would have to be fed parallel to the Rhône Valley line through the Pfyn forest. Accordingly, the planning application for the construction of this segment was submitted to ESTI at the end of March 2019, together with the planning application for the Rhône Valley line. In June 2021, ESTI passed on the procedure to the SFOE. The planning approval procedure for the Chippis-Agarn segment is currently in the hands of the SFOE.

4.4. Airolo–Lavorgo
The project for the construction of the new line underwent a sectoral plan procedure lasting almost nine years and the construction project planning took a full four years. At the end of April 2020, Swissgrid submitted the planning application dossier to ESTI.

5. Beznau–Mettlen
Operation of the overall Beznau-Mettlen project is planned for 2031. It comprises several sub-projects, the current status of which is described below:

5.1. Beznau–Birr
The line with partial underground cabling of 'Gabihübel' at Riniken was initiated before the Transmission Lines sectoral plan was developed, and went through planning and approval phases lasting many years. An important milestone was reached in 2016, when the planning approval granted by the SFOE became legally binding and the realisation of the project was initiated. Contrary to the original plan, construction work for the cable route could only commence in August 2018. Since then, work has progressed rapidly and on 19 May 2020, Swissgrid began to operate the line, including the cited partially cabled section in which a longer section of the 380 kV ultra-high-voltage line was placed underground.

5.2. Birr–Niederwil
This section is currently in the preliminary project phase.

5.3. Niederwil–Obfelden
The project to increase the voltage level went through a preliminary phase lasting about one and a half years and a sectoral plan procedure has been in progress for a number of years; a significant interim stage was reached in 2016 with the definition of the planning zone. The corridor and the choice of technology will be determined in the next stage.

5.4. Mettlen–Obfelden
This section is currently in the preliminary project phase.

6. Bassecourt–Mühleberg
The Bassecourt-Mühleberg ultra-high-voltage line was licensed by ESTI to operate at 380 kV in 1978, but it has been operating at 220 kV to date. No sectoral plan procedure was required for the envisaged increase in voltage because of the minimal impact the project would have on the area. After a construction project phase lasting about two and a half years, Swissgrid submitted the planning application dossier to ESTI on 30 June 2017. A number of objections to the project were submitted. ESTI handed the dossier over to the SFOE on 24 August 2018 and the plan was approved on 22 August 2019. A number of objectors lodged appeals against this decision with the Federal Administrative Court. In its ruling of September 2020, latter dismissed the objections it examined. The ruling was

referred to the Federal Supreme Court, which in turn dismissed the objections in its ruling dated 23 March 2021. According to Swissgrid, construction is scheduled to commence in 2022 and will last for around one year. Operation is scheduled to commence in 2023.

7. Magadino
This project is still in the early planning stage and has been submitted as a project proposal. According to Network Strategy 2025, operation was originally foreseen for 2018, but according to updated plans it is now planned for 2035.

8. Génissiat–Foretaille
Swissgrid has adapted the scope of the project and reduced it to eliminating the bottlenecks between France and Switzerland. The original plan to strengthen the Foretaille-Verbois line on the Swiss side with a transmission line facility 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
Operation of the overall project is currently planned for 2035. It comprises two sub-projects, the current status of which is described below:

9.1. Mettlen–Innertkirchen
This segment was in the preliminary project phase for a number of years. At the end of June 2020, Swissgrid applied to the SFOE to initiate a sectoral plan procedure for a new line into Innertkirchen substation. However, at the beginning of June 2021 the project was cancelled at the request of the applicant because the line is now to be integrated into the sectoral plan procedure for the complete stretch. The sectoral plan procedure for the complete line was initiated at the end of June 2021.

9.2. Innertkirchen–Ulrichen (Grimsel line)
Upgrading of the existing 220 kV line to 380 kV between Innertkirchen and Ulrichen (Grimsel line) along its full length is a key element in Network Strategy 2025. Swissgrid applied for a sectoral plan procedure for this line at the beginning of July 2020.

10. All'Acqua–Vallemaggia–Magadino
Planning of the line project in the All'Acqua-Maggiatal-Magadino area (and of sub-project *4.4. Airolo-Lavorgo* mentioned above) is based on a comprehensive study carried out in 2013 concerning the reorganisation of the ultra-high-voltage network in Upper Ticino to coordinate the refurbishment and modernisation of lines in coordination with spatial planning. Subsequently, the preliminary project phase was prepared, and the sectoral plan procedure was initiated in 2015. In 2016, a significant stage in the project was attained when the planning area was defined. In view of its length, the project was divided into three segments for the implementation of the sectoral plan procedure so that it could be carried out in manageable stages. However, the definition of the planning corridor on the Avegno to Magadino stretch has been delayed due to the question concerning the location of the Magadino substation, which is in the perimeter of the 'Piano di Magadino' biosphere reserve. Operation of the new 220 kV line is planned for 2035. The lines that are no longer needed will then be dismantled.

(Sources: SFOE/Swissgrid, 2021 / Swissgrid, 2015).

↗ Description of other selected projects: cf. **full version of the monitoring report.**

UNDERGROUND CABLING

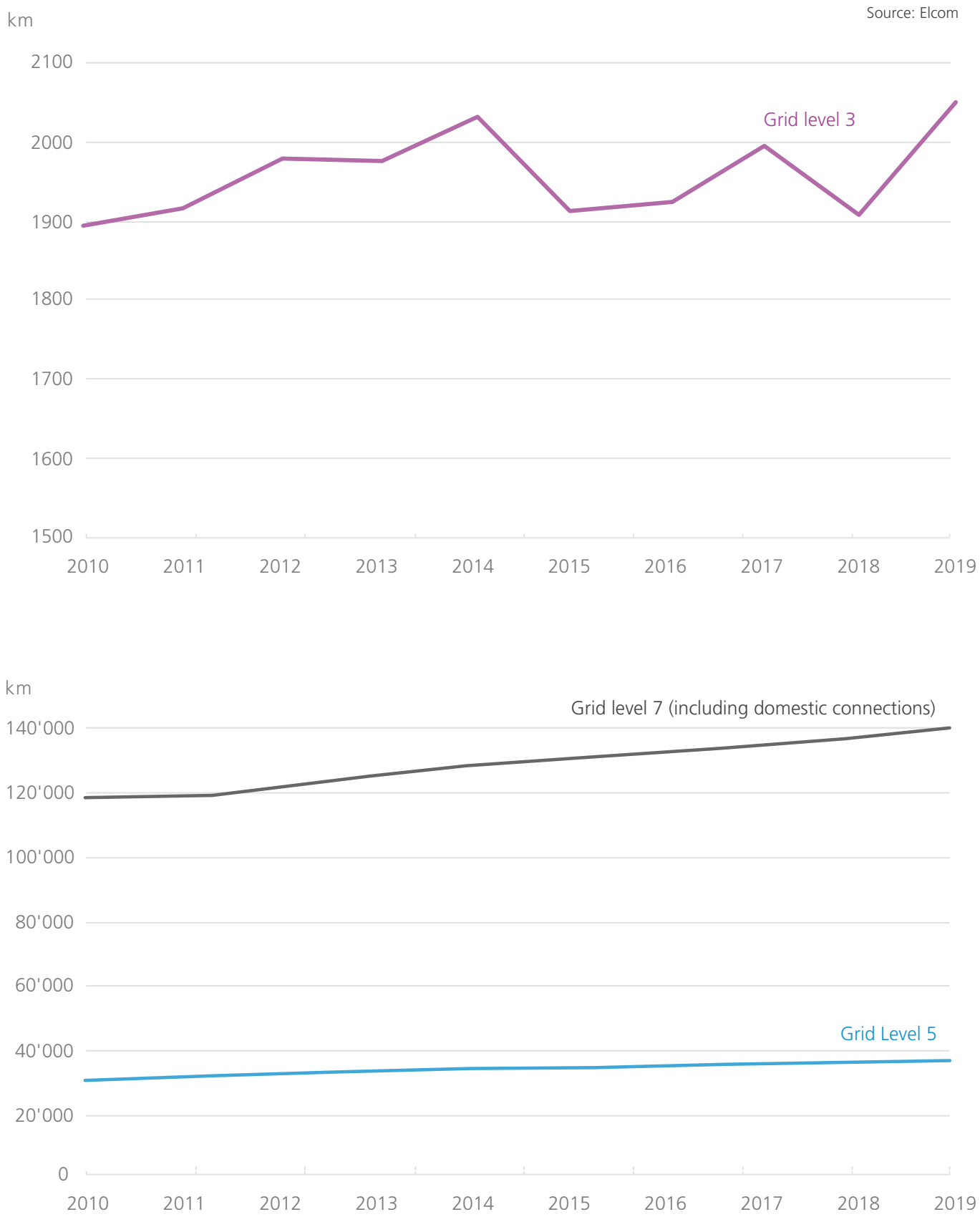


Figure 7: Inventory of underground cabling in the distribution network (in kilometres)

UNDERGROUND CABLING

Placing electricity cables underground can contribute to greater acceptance of line construction by the population so that projects can be completed more quickly. Furthermore, as a rule the quality of the landscape is improved and the risks of electrocution and of birds colliding with installations can be avoided. However, whether to construct a transmission line (network level 1) as an overhead line or place it underground has to be decided on the basis of objective criteria on a case by case basis. In accordance with the Federal Act on the Expansion and Upgrading of the Electricity Networks (Electricity Networks Strategy), distribution network lines (network levels 3, 5 and 7) should be placed underground provided a specific cost factor is not exceeded (cost overrun factor). For this reason, the monitoring process primarily observes the development of the use of underground cabling at the distribution network level. This also provides information concerning the impact of the cost overrun factor.

More cables have been placed underground at all network levels in the distribution network to varying extents since 2010, as shown in **Figure 7**. Generally speaking, there is more underground cable in use at lower network levels; network level 7 in particular consists almost entirely of underground cable. At network level 5 too, cabling is widespread, especially in urban areas. In contrast, only a slight increase in the number of underground lines can be observed at network level 3, and to a lesser degree than at all other levels (cf. purple curve in the upper graph with differing scale). The trend towards underground cabling is not so pronounced at this level. In addition, between 2014 and 2015 and between 2017 and 2018, declines in underground cabling were observed, the reasons for which are not clear. However, in 2019 the degree of cabling increased relatively sharply compared with the previous year. The total length of the three transmission network levels (overhead transmission lines and cables, including domestic connections) is 203,589 kilometres, of which around 88 per cent consists of underground cables. To date, very few lines have been laid underground in the transmission network (network level 1), which has a total length of 6,700 kilometres. However, in the case of the 'Beznau-Birr' line *(see above)* with partial cabling at 'Gäbihübel' near Bözberg/Riniken, a longer section (around 1.3 kilometres) of a 380 kV ultra-high-voltage line was laid in the ground and put into operation. In addition, there is an underground cable project at the ultra-high-voltage level for the 'Bâtiaz-Le Vernay' network, where construction of a new 2 x 380 kV cable is planned as a replacement for the existing 220 kV overhead transmission line that crosses through the Rhône Valley over a distance of 1.3 kilometres. Swissgrid completed the installation of the underground structures, which cover a stretch of 1.2 kilometres, in summer 2021. The underground cable is scheduled to be put into operation in spring 2022. A further underground cable project involving a transmission line concerns the replacement of the existing 220 kV line over a length of 4.5 kilometres for the ASR project in the canton of Geneva. In addition, the 220 kV ultra-high-voltage line between Airolo and Mettlen is to be cabled in the Gotthard road tunnel between Airolo and Göschenen over a length of around 18 kilometres (sources: ElCom, 2021a / SFOE/Swissgrid, 2021).

SMART METERS

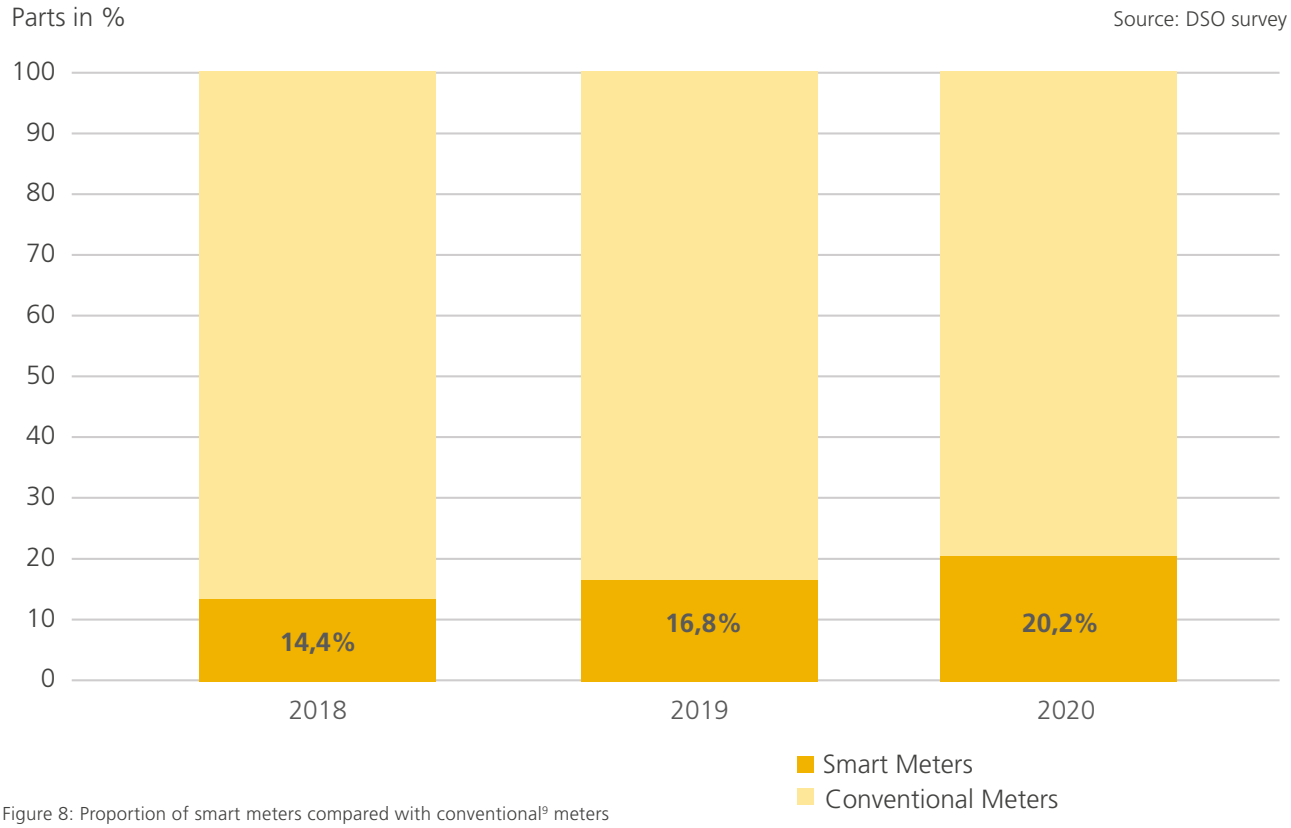


Figure 8: Proportion of smart meters compared with conventional[9] meters

The increasing proportion of electricity produced by decentralised providers is leading to many challenges for the electricity networks. In addition to renewal and expansion, the creation of a smart grid is an important priority of Energy Strategy 2050. Using information and communications technology, integrated data and electricity networks with innovative functions are to be developed. This means for example that intelligent control systems can balance out fluctuations in electricity production from renewable energy, as well as in electricity consumption. Smart grids guarantee secure, efficient and reliable system and network operation and make a contribution to minimising the extent of the required network expansion. At the same time, cyber security is becoming increasingly important.

Smart meters are a central component of intelligent networks. Their introduction is regarded as an important initial step towards creating smart networks. The Electricity Supply Ordinance therefore specifies the applicable minimum technical requirements and calls for the introduction of such systems. After an interim period of 10 years from the entry into force of the Electricity Supply Ordinance at the beginning of 2018 (i.e. by the end of 2027), 80 per cent of all metering systems in a network zone will have to comply with the corresponding requirements; the remaining 20 per cent may remain in use until they no longer function.

According to information from distribution system operators, in 2020 there were approximately 1,152,942 smart meters installed and in operation throughout Switzerland. This represents a proportion of around 20 per cent, as shown in **Figure 8**. The proportion has constantly increased during the past few years (source: DSO, 2021).

9 Data based on survey of distribution network operators (plausibility check only possible to a limited extent).

↗ For more detailed indicators regarding **NETWORK DEVELOPMENT**, see full version of the monitoring report

SUPPLY SECURITY

During the transformation of the energy system, with the increase in the use of renewable energy, enhanced energy efficiency and increasing decarbonisation and electrification, special attention has to be paid to the security of supply. One of the aims of Energy Strategy 2050 is to guarantee the currently high level of supply security over the long term. The issue of supply security is also anchored in the energy article in the Federal Constitution, as well as in the Energy Act. By categorising energy sources (diversification) and dependence on foreign supplies, the monitoring process observes indicators which characterise significant aspects of the development of supply security from the overall energy perspective. With the phasing out of nuclear power, the increase in the use of renewable energies, enhanced energy efficiency and the longer-term decarbonisation and electrification of the energy system, the electricity sector is also a centre of focus.

DIVERSIFICATION OF THE ENERGY SUPPLY

Figure 9 shows that oil products (combustibles and motor fuels, including aircraft fuel in international aviation) accounted for around 44 per cent of end energy consumption in 2020. Electricity accounts for around 25 per cent, and gas for approximately 15 per cent, of end energy consumption. The share of oil-based combustibles fell by 11 percentage points between 2000 and 2020 as a result of the replacement of oil-fired heating systems and efficiency increases in buildings. Due to the COVID-19 pandemic, the share of oil-based motor fuels fell by 5 per cent versus the previous year, whereas it had remained fairly constant prior to the pandemic. This reduction means that the proportions of all other energy sources have increased, even though their absolute consumption has decreased due to the pandemic: gas (+4.1%), electricity (+4.6%), wood and charcoal (+2.0%), other forms of renewable energy (+3.3%) and district heat (+1,3%). Overall, the energy supply is broadly diversified, which contributes towards the high degree of supply security in Switzerland (source: SFOE, 2021a).

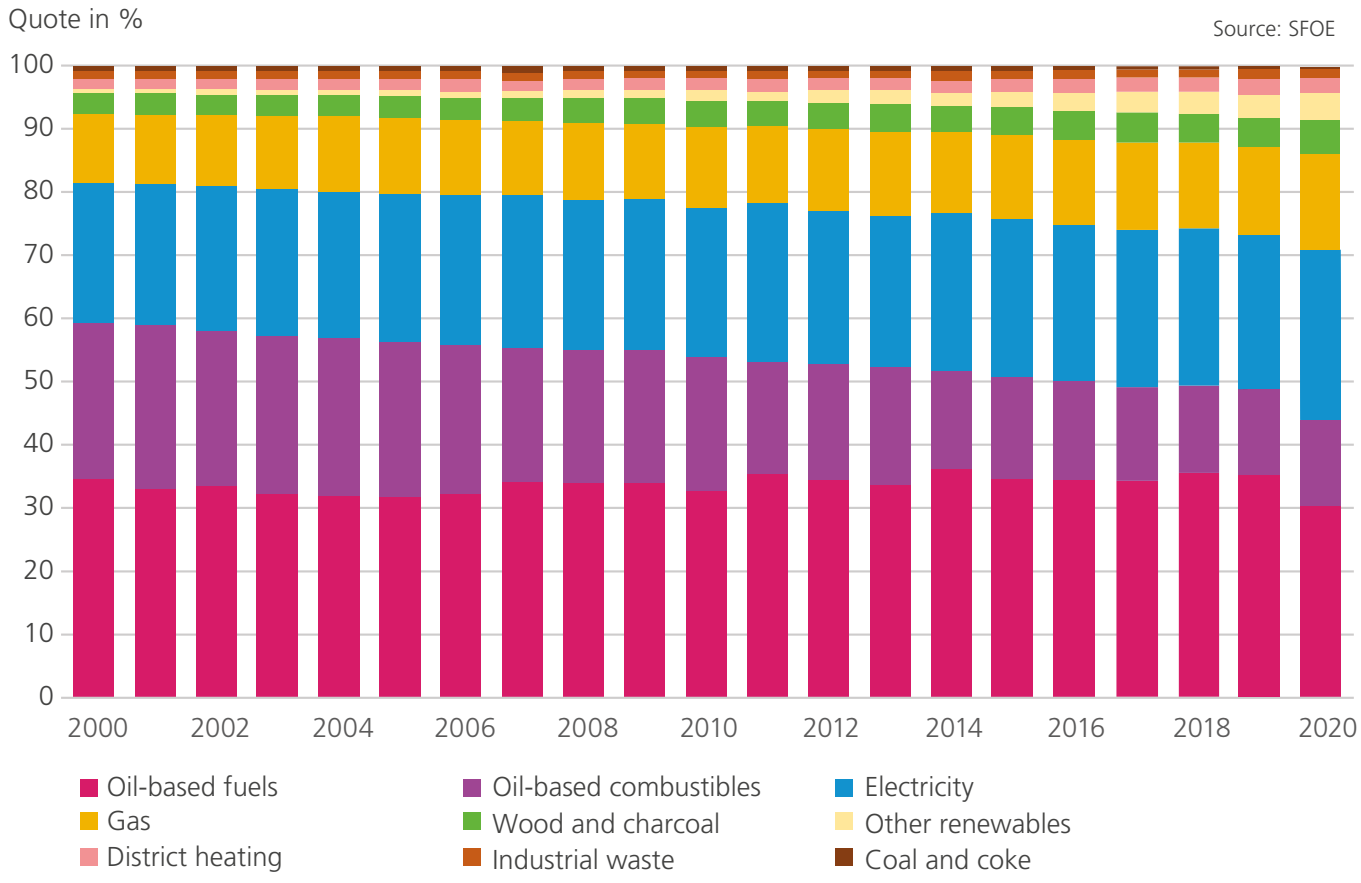


Figure 9: Diversification of the energy: proportion of energy sources to end energy consumption

DEPENDENCY ON IMPORTS

Figure 10 shows that the import surplus tended to rise between 2000 and 2006, after which it fell, though with occasional strong fluctuations. At the same time, domestic production has tended to increase since 2000. Gross imports were composed in the main of fossil energy carriers and nuclear fuels. As before, the most significant domestic energy source is hydropower, while the other renewable energy sources are indicating constant growth. As indicated by the grey curve in the graph, the proportion of imports to gross energy consumption (dependency on imports) grew from 2000 to 2006 and has declined since then, but it nonetheless remains at a high level: in 2020, the proportion of imports to gross energy consumption was 71.9 per cent (2019: 74.5 per cent; 2006: 81.6%). This ratio has to be interpreted with caution, because there are a number of different factors that influence it. In general it may be stated that energy efficiency measures that reduce consumption, and thus imports of fossil energy in particular, and the expansion of domestic energy production from renewable sources, lessen the dependency on imports and have a positive effect on supply security (sources: SFOE, 2021a / FSO/FOEN/ARE, 2021).

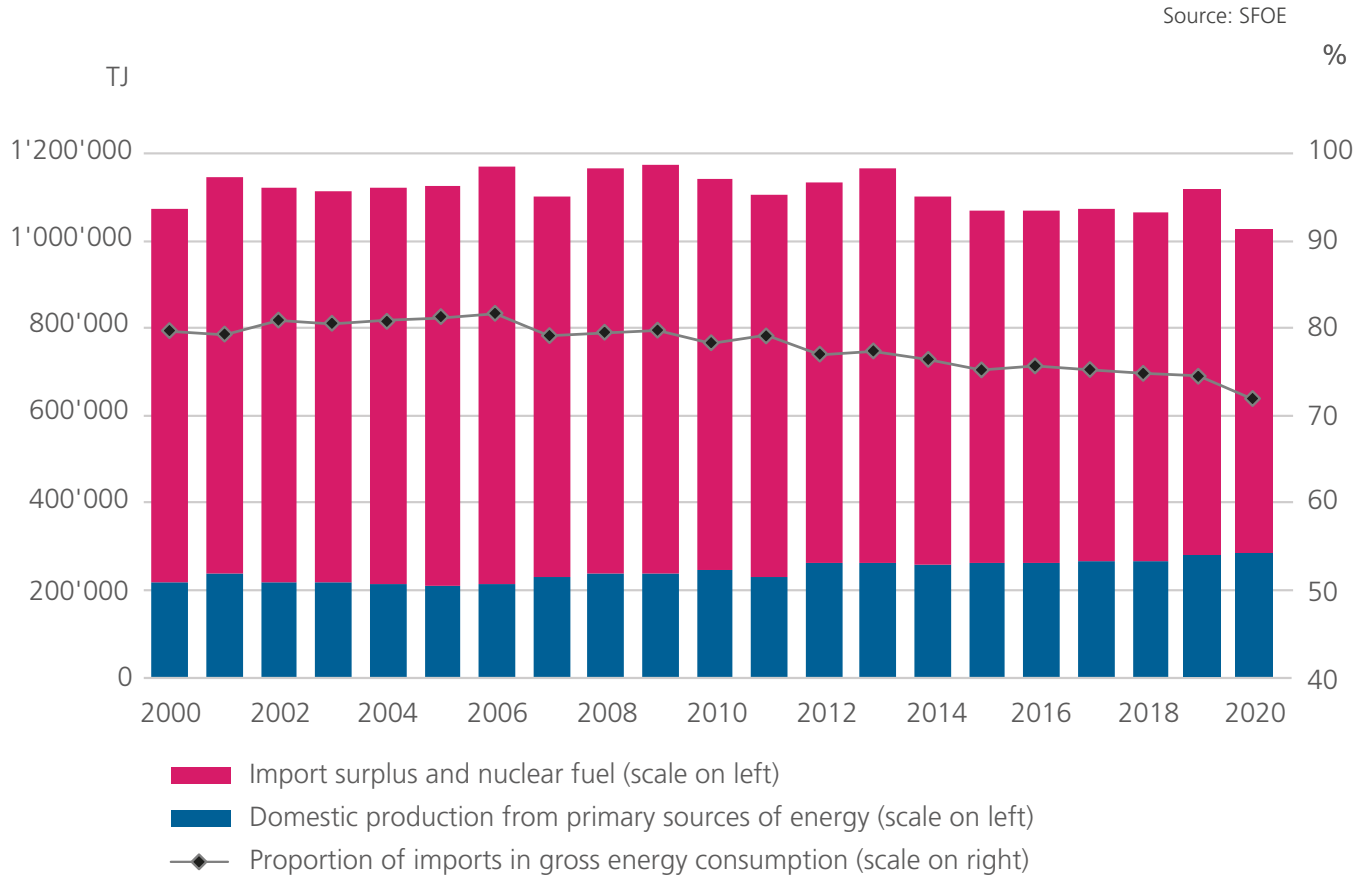


Figure 10: Import surplus and domestic production (in TJ) and proportion of energy imports to gross energy consumption (in %)

REPORTS ON SHORT- TO MEDIUM-TERM ELECTRICITY SUPPLY SECURITY

The phasing out of nuclear energy within the scope of Energy Strategy 2050 and the longer-term decarbonisation of the energy system represent major challenges for Switzerland's **electricity supply security**. On 18 June 2021, the Federal Council submitted its Dispatch to Parliament regarding a 'Federal Act on a Secure Electricity Supply with Renewable Energy', which envisages various measures to guarantee Switzerland's supply security over the long term. The measures include additional funding for the expansion of winter production (primary hydropower storage plants), the creation of an energy reserve and increased use of renewable energy (Federal Council, 2021b). Currently, the focus is on the short- to medium-term supply security, because in May 2021 the Federal Council terminated the negotiations on an institutional agreement with the EU and an electricity agreement is thus unlikely to be concluded in the foreseeable future. In October 2021, the Federal Department of the Environment, Transport, Energy and Communications (DETEC) informed the Federal Council about two corresponding reports, on the basis of which the Federal Council is to more thoroughly examine the measures for strengthening supply security and network stability, and where necessary issue the corresponding additional mandates. The Federal Council has already invited the Federal Electricity Commission (ElCom) to draw up a concept for the use of gas-fired power plants during peak load periods. In addition, DETEC is to submit an analysis of the potential for efficient electricity use by 2025 to the Federal Council (Federal Council, 2021h).

Report by ElCom and Swissgrid on measures in the networks sector: This report describes around 80 potential measures relating to networks, consumption and production. The various measures focus on different timeframes and priorities. However, their impacts and costs have only been roughly estimated. Many of the measures concern Swissgrid and are already either being implemented or are in the planning stage. ElCom regards six of these as currently of high priority. They include the planned conclusion of technical agreements under private law between Swissgrid and transmission system operators (TSOs) in the EU; the early replacement of coupling transformers between the 220 and 380 kV ultra-high-voltage levels in order to more efficiently control electricity flows; voltage increases in the transmission network in order to increase line capacities; better coordination between the transmission network and inter-regional networks; optimisation of maintenance operations; and modifications of the operating concept. An evaluation of the measures shows that the most important short-term measures have already been taken or are in the process of being implemented, the study concludes. The main objective is to accelerate these measures and, if possible, to implement them before 2025. However, it is also clear from analysis of the measures that the potential improvements that can be implemented by 2025 are limited for a variety of reasons. For this reason, ElCom recommends that the preparatory work for measures mentioned in Article 9 of the Electricity Supply Act (efficiency, gas reserve power plant, hydro reserve) be continued. (source: ElCom, 2021c).

Worst-case impacts of the lack of cooperation with the EU: The problems that could arise with respect to the new regulations in the EU legal framework form the subject of an external study mandated to consulting firm Frontier Economics by the SFOE and ElCom at the beginning of 2020 in view of the uncertainty regarding the conclusion of an electricity agreement. This study shows that the regulation of the European electricity market has undergone major developments since the initiation of negotiations on an electricity agreement in 2007. This situation also affects Switzerland, because its transmission network is closely linked to those of its neighbouring countries. A new set of regulations under the heading 'Clean Energy Package' entered into force in 2020, according to which, as of 2025, all European TSOs will be required to retain at least 70 per cent of their network capacity for the purpose of electricity trading within the EU. This EU regulation does not specify how cross-border capacities are to be taken into account for third countries

REPORTS ON SHORT- TO MEDIUM-TERM ELECTRICITY SUPPLY SECURITY

such as Switzerland. This means that Switzerland's import capacities could become significantly limited. In addition, the unplanned electricity flows caused by electricity trading in the neighbouring countries could increase further and thus threaten Switzerland's network stability. Based on three cooperation scenarios at differing levels, the study examines Switzerland's network stability and supply security in 2025, i.e. in the year in which the EU aims to have fully implemented its 70-per cent rule. All three scenarios are based on a 'worst case' assumption. A stress situation is assumed in which the cross-border capacities with the neighbouring countries are partially reduced by more than 70 per cent, and Beznau reactor blocks I and II and a third of France's nuclear power plants are not available:

- **In scenario 1 there is no cooperation:** Here, the neighbouring countries abide by the 70-per cent rule in that they limit the transmission capacity to and from Switzerland. Under normal circumstances, network stability and supply security are assured, but in the worst case defined for the study, the situation becomes critical towards the end of March: during a period of 47 hours, it would no longer be possible to meet the domestic electricity demand – there would be an energy shortage of 66 gigawatt hours per annum[10].

- **In scenario 2, Swissgrid concludes technical agreements with the European TSOs.** According to these agreements, with the implementation of the 70-per cent rule Switzerland is taken into account at its borders with northern Italy, France, Germany and Austria. In this scenario, it is possible to overcome the worst case. Switzerland always has enough energy at its disposal. However, it is unclear whether these agreements could be concluded in sufficient time.

- **In scenario 3, the electricity agreement is concluded and assures Switzerland's participation in the EU electricity market:** In this scenario the worst case can certainly be overcome.

A scenario in which there is no contractually secured technical cooperation is disadvantageous for Switzerland, the study concludes. Security of supply and also grid security would be undermined as a result. Contractually secured technical cooperation with the European transmission system operators would improve Switzerland's grid and supply security. In critical situations, sufficient transmission capacities would be available for electricity imports at Switzerland's borders with Germany, France, Austria and Italy. An electricity agreement between Switzerland and the EU would further improve Switzerland's grid and supply security (source: Frontier Economics, 2021).

10 The daily consumption on a typical winter day corresponds to about 180–200 GWh (source: Electricity Statistics 2020).

↗ For more detailed indicators regarding **SUPPLY SECURITY:**

- Full version of the monitoring report
- Reports on short- to medium-term electricity supply security
- SFOE reports on system adequacy
- ElCom reports on electricity supply security
- PENTA report on electricity supply security in the view of regional TSOs

EXPENDITURE AND PRICES

In addition to safety and environmental compatibility, a further significant dimension for a sustainable energy supply is economic viability. Energy Article 89 in the Federal Constitution and Article 1 of the Energy Act specify that a sufficient, diversified, safe, economic and environmentally compatible energy supply must be assured. The purpose of Energy Strategy 2050 is to successively reorganise Switzerland's energy system as a consequence of the phasing out of nuclear energy and other significant changes in the energy environment, without jeopardising the international competitiveness of Switzerland as a business location. The focus in this area is therefore on monitoring final consumer expenditure for energy and energy prices[11].

11 The indicators here encompass the development up to the end of 2020. The price increases on various energy markets (cf. 'International environment') observed in 2021, which also have impacts on Switzerland (especially oil, gas and electricity) are not yet depicted in the graphs below.

FINAL CONSUMER EXPENDITURE FOR ENERGY

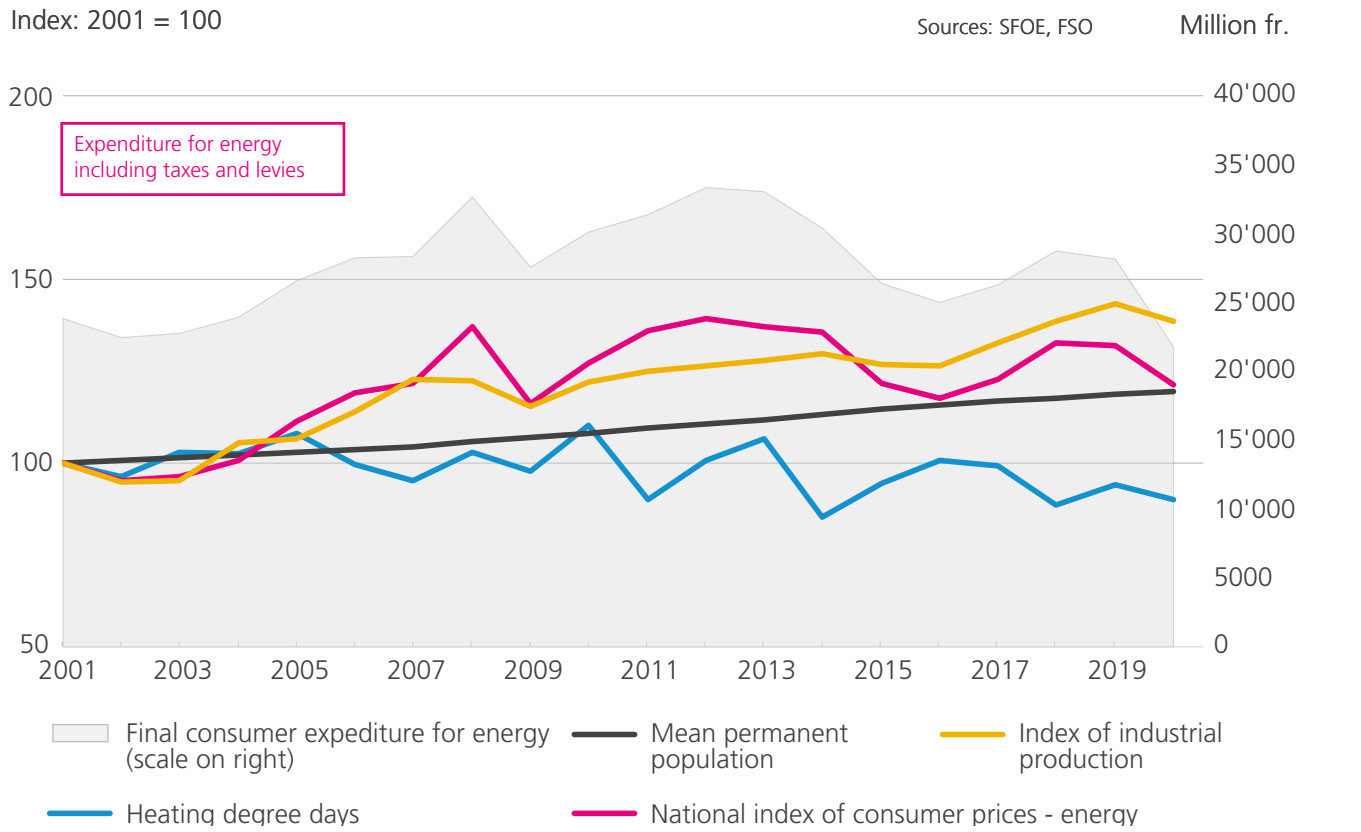


Figure 11: Final consumer expenditure for energy (estimates in million Swiss francs) and significant influencing factors (indexed)

Figure 11 shows the development of final consumer expenditure for energy in Switzerland, which amounts to around 21.7 billion Swiss francs in 2021. This is the lowest figure since 1999. As a consequence of the COVID-19 pandemic, the prices of energy sources have fallen and the consumption figures have declined. The decline in expenditure for fossil fuels and combustibles was especially pronounced[12]. These still account for around 40 per cent, which is slightly less than expenditure for electricity. Around 10 per cent is spent on gas, and the remainder on solid combustibles and district heat[13]. Between 2001 and 2019, expenditure for energy rose on average by 0.9 per cent per annum; by contrast, in the period up to 2020, due to the extraordinary situation, expenditure for energy was 23 per cent lower than in the previous year, and was thus below the figure recorded in 2001. During the same period, growth was reported in industrial production (1.6% per annum), the population (0.9% per annum) and the Swiss consumer price index for energy (1.0% per annum). What is noticeable here 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: this behaviour depends more on other existing and comparatively constant factors, such as the number of vehicles and dwellings. This constitutes an example of low, short-term price elasticity. Over the course of time, a significant increase in final consumer expenditure and energy prices is apparent in 2008, followed by a decline in 2009. 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 2020, expenditure fell more sharply than the prices. This trend is attributable to the fact that less energy, and especially less motor fuel, was consumed due to the pandemic. Improved energy efficiency measures can reduce energy consumption and therefore final consumer expenditure (sources: SFOE, 2021a / FSO, 2021).

12 In 2020, 3.7 per cent of consumed petrol and diesel were of biogenic origin, i.e. they are not oil products (SFOE press release dated 21 June 2021).

13 In addition to expenditure for energy and transport, all taxes and levies are included in energy expenditure (CO_2 levy, oil tax, value added tax, etc.). According to an estimate by the SFOE, taxes and levies for 2019 for oil-based fuels amounted to 5.03 billion Swiss francs, for oil-based combustibles 1.32 billion Swiss francs, for electricity (excluding network use remuneration) 2.03 billion Swiss francs, and for gas (excluding network use remuneration) 0.75 billion Swiss francs.

INTERNATIONAL COMPARISON OF ENERGY PRICES FOR INDUSTRY SECTORS

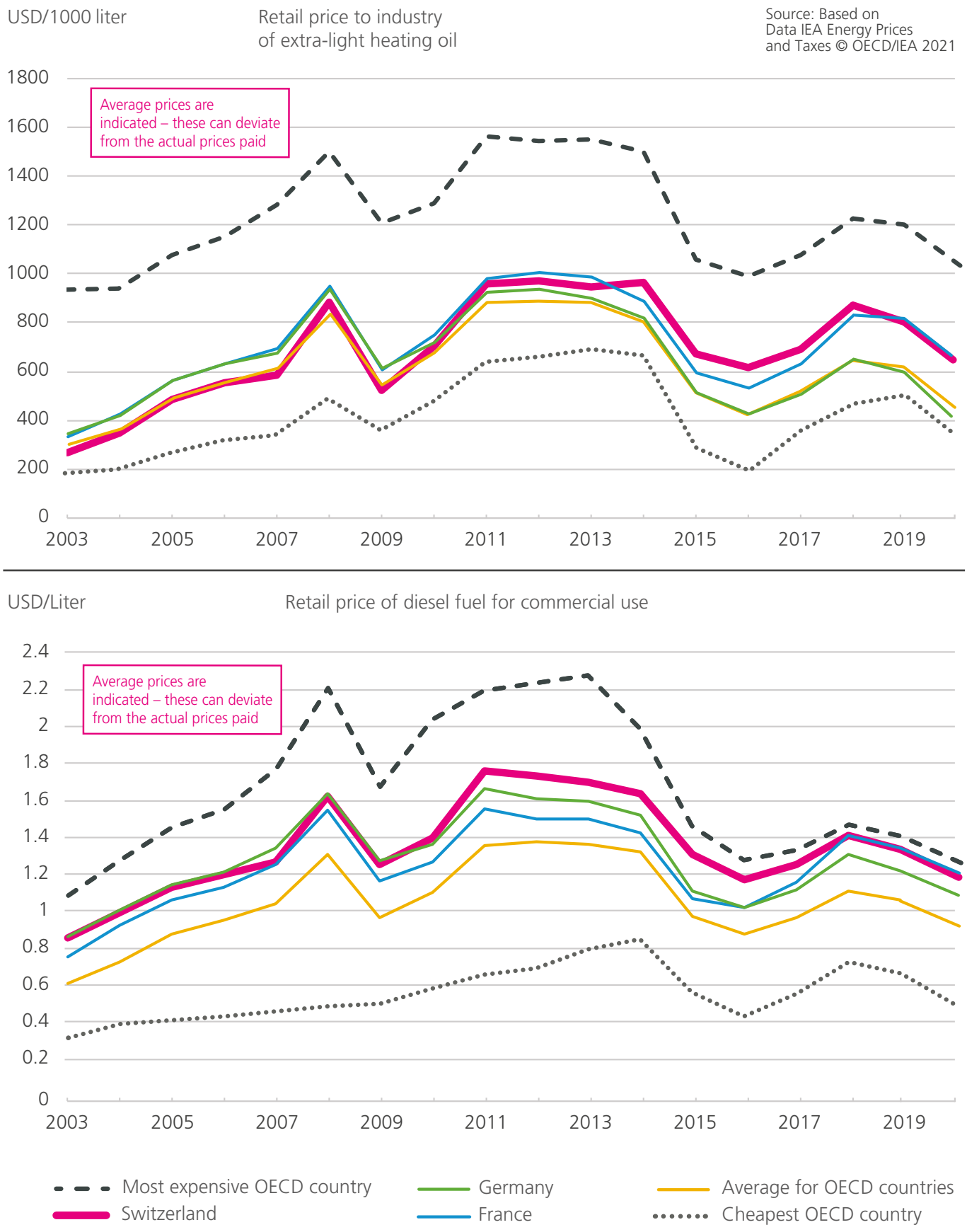


Figure 12: Average nominal end consumer prices of heating oil and diesel, including taxes for the industry sector (based on market exchange rates)

INTERNATIONAL COMPARISON OF ENERGY PRICES FOR INDUSTRY SECTORS

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 graph **(cf. Figure 12)**. In 2020, the price for Swiss heating oil was above the OECD average. The prices for oil-based products fell sharply in pandemic year 2020 versus the previous year, both globally and in Switzerland. One 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 96 Swiss francs per tonne of CO_2 in 2018; this increase was implemented because the interim biannual targets specified by the Federal Council for the reduction of emissions from fossil combustibles were not attained. The price level for diesel in Switzerland is higher than in Germany, or about average compared to OECD countries – the prices of this oil-based product also fell last year in all observed countries. The price in France has risen since 2018 to a level similar to that in Switzerland. The picture for petrol may differ because **diesel** is more heavily taxed than petrol in Switzerland than in other countries. Information about comparative international petrol prices is not monitored in the report because petrol is less significant for industry. The diesel price in Switzerland is closer to that in the most expensive rather than the cheapest OECD country (source: OECD/IEA, 2021a).

INTERNATIONAL COMPARISON OF ENERGY PRICES FOR INDUSTRY SECTORS

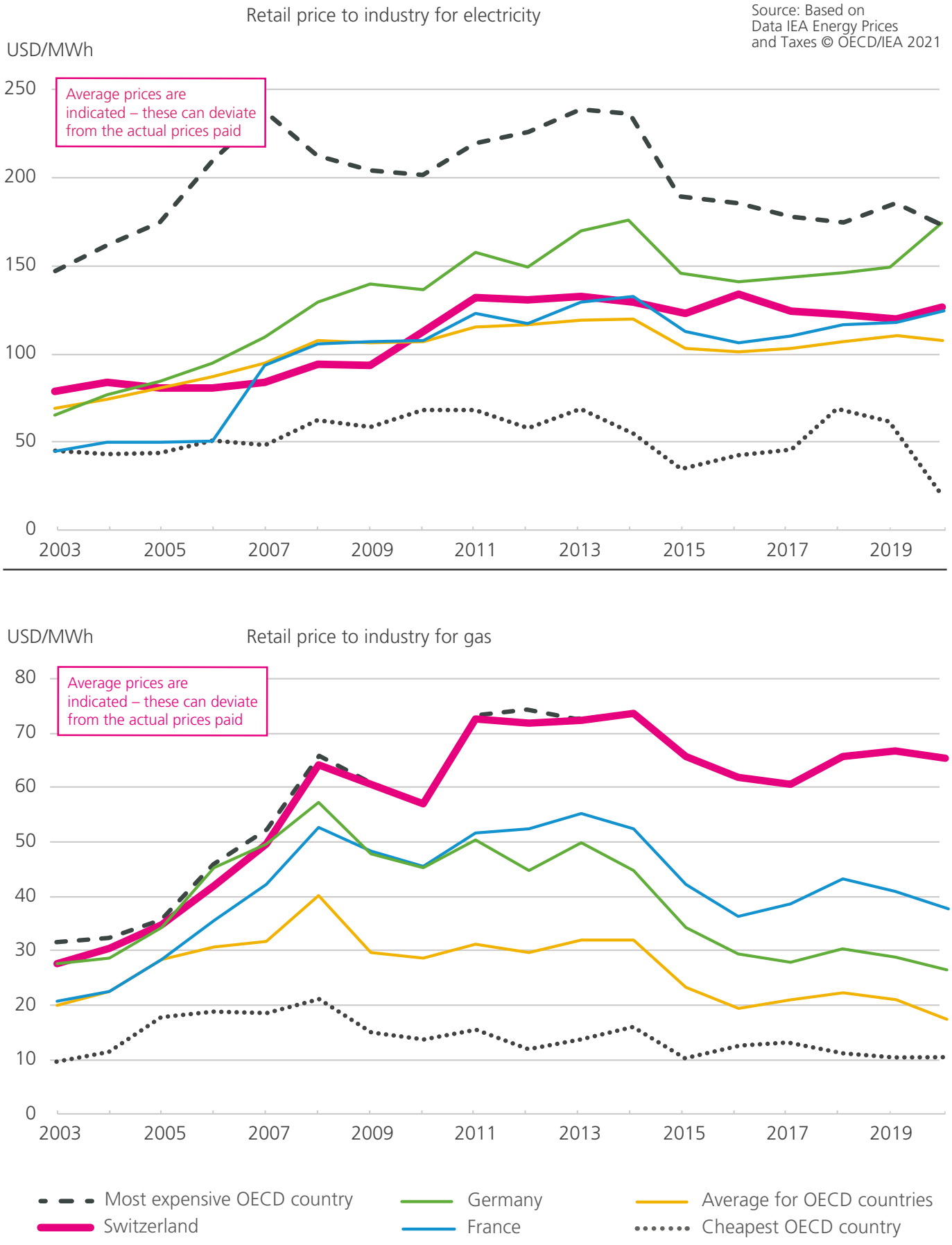


Figure 13: Average nominal end consumer prices of electricity and gas, including taxes for the industry sector, in US dollars (based on market exchange rates)

The **electricity price** depends on many factors, including the technology used in production, the production and transport costs, capacity of the networks, market structures and levies. The same tendency as noted in France and the average OECD country can be observed in the development of electricity prices in Switzerland, where prices tended to move laterally **(cf. Figure 13)**. The price level in Switzerland is close to the OECD average and to that in France, while it is lower than that in Germany, which in 2020 became the country in the OECD with the highest price. The differences in price levels should be interpreted cautiously because companies that consume large quantities of electricity can be exempted from paying levies contained in prices, and the dataset is incomplete. In fact, the prices in Switzerland for those industrial customers who cover their needs on the open market are not recorded. The share of these industrial customers has risen steadily since the market was partially opened. Today, around two-thirds of all eligible customers have switched to the free market; these purchase four-fifths of the corresponding energy volumes[14]. Domestic prices for **gas** are much higher than in Germany and France, and about average for OECD countries. In 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 particular in contrast to Canada, the country with the lowest prices in 2020. There are a number of possible explanations for the difference in prices: as noted above, the CO_2 levy 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 levy 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 are able to apply for a refund of the levy. The CO_2 levy is only a partial explanation for the relatively high prices and is no explanation for the figures prior to 2008. Other potential explanations include the higher network costs (arising because there are only a low number of connections per kilometre), and the intensity of competition. For example, the gas markets in the countries to which Switzerland is being compared were all fully opened up. In Switzerland, gas sales conditions in 2012 were regulated for major industrial customers on the basis of an association agreement, according to which a few hundred end users can choose their gas supplier. At the end of October 2019, in the course of the consultation procedure on the Gas Supply Act, the Federal Council proposed that the market should be partially opened up, a measure which would give significantly more customers (about 40,000 consumption sites) free access to the market. The Competition Commission also fully opened up the market for gas in the Lucerne area with a decision taken in June 2020. The commission anticipates that this decision will have a signal effect on the whole of Switzerland (sources: OECD/IEA, 2021a / Federal Council, 2019b / COMCO, 2020).

14 Source: 2020 Report on the Activities of ElCom, p. 35.

↗ For more detailed indicators regarding
EXPENDITURE AND PRICES
see the full monitoring report

CO_2 EMISSIONS

Energy and climate policy are closely linked, as around three-quarters of Switzerland's greenhouse gas emissions are attributable to the use of fossil fuels. Energy Strategy 2050 is intended to contribute to lowering the consumption of fossil energy, and thus the level of energy-related greenhouse gas emissions. It supports the achievement of the climate policy objectives up to 2030 and the long-term objective of net zero greenhouse gas emissions by 2050 declared by the Federal Council in 2019. These objectives were also specified in the corresponding long-term climate strategy (Federal Council, 2019a+2021a). The most significant greenhouse gas in terms of volume is carbon dioxide (CO_2), which is mainly produced when fossil combustibles and fuels are burnt (heating oil, gas, petrol, diesel). The annual monitoring process traces the development of CO_2 emissions per capita, in total and in the individual sectors, as well in relation to other variables. The main 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 UN Framework Convention on Climate Change.

PER CAPITA ENERGY-RELATED CO_2 EMISSIONS

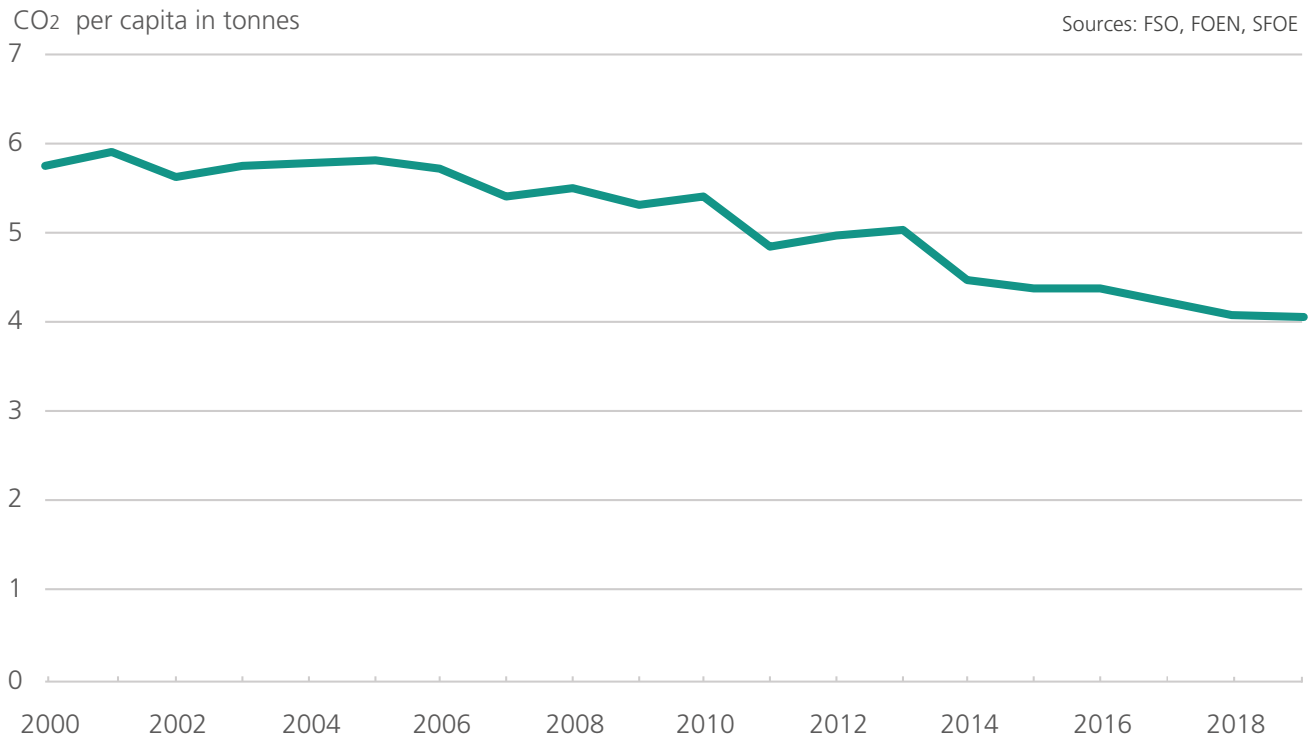


Figure 14: Per capita energy-related CO_2 emissions (in tonnes of CO_2 per capita)[15]

'Energy Perspectives 2050+' describes how Switzerland can restructure its energy supply by 2050 in line with the Federal Council's net zero target (Prognos/TEP/Infas/Ecoplan, 2020). Energy-related CO_2 emissions must also pursue this target. This means that the previous long-term strategic goal in accordance with the 2013 Dispatch to Parliament on an initial package of measures for Energy Strategy 2050, which called for energy-related CO_2 emissions to be reduced to 1 to 1.5 tonnes per capita by 2050, has been superseded. In a net-zero world, in which all avoidable emissions have to be eliminated by 2050, in accordance with 'Energy Perspectives 2050+' around 0.4 tonnes of energy-related greenhouse gas are still emitted per capita. **Figure 14** shows that per capita energy-related CO_2 emissions in Switzerland have been continually falling. While CO_2 emissions from energy sources have fallen slightly since 2000, the population of the country has constantly increased during the same period. There thus appears to be an increasing separation of the factors of population growth and CO_2 emissions. In 2019, domestic per capita emissions amounted to around 4.0 tonnes and were thus almost 30 per cent lower than the level recorded in 2000 (5.8 tonnes)[16]. When compared internationally, this is a relatively low figure resulting from the fact that Switzerland's electricity production is largely CO_2-free and the services sector contributes a major share of the added value. So that the climate objective of net zero greenhouse gas emissions by 2050 can be realised, the energy-related CO_2 emissions per capita will have to be reduced to a greater extent than in the past (sources: FOEN, 2021 / FSO, 2021 / SFOE, 2021a).

15 Differentiation according to the CO_2 Act (excluding international aviation, inclusive statistical difference). Not adjusted for climate influences.

16 By way of comparison, per capita emissions of all greenhouse gases amounted to around 5.4 tonnes in 2019. This is equivalent to a reduction by almost 23 per cent versus the figure for 2000 (7.4 tonnes). Thus in terms of percentage, per capita energy-related CO_2 emissions have fallen to a slightly higher extent than overall greenhouse gas emissions.

ENERGY-RELATED CO_2 EMISSIONS OVERALL AND BY SECTOR

Overall CO_2 emissions from energy sources **(cf. Figure 15)** amounted to 34.6 million tonnes in 2019, and were therefore 17 per cent lower than in 2000. The **transport sector** accounts for the highest proportion (2019: 43 per cent, excluding international aviation), in which motorised road vehicles are responsible for a large share of the emissions[17]. Between 2000 and 2019, CO_2 emissions in the transport sector fell by around 1 million tonnes. International aviation is playing an increasingly important role: after a decrease at the beginning of the millennium, its emissions have been constantly increasing since 2005 and reached 5.7 million tonnes in 2019[18]. In the **industry sector** (proportion in 2019: 23%), energy-related CO_2 emissions primarily result from the production of goods, and to a lesser extent from the heating of buildings. A slight decline has been reported since 2000, illustrating the effectiveness of the implemented measures, as well as increases in energy efficiency and a decoupling of CO_2 output and industrial production. The fluctuations over the course of time are primarily attributable to the state of the economy and climatic conditions. In the **households sector** (proportion in 2019: 22%), the emissions are largely attributable to heating and hot water production. Since 2000, the emissions have fallen, although the volume of space to be heated has increased. This also shows there has been an increase in efficiency and a tendency to use technology creating lower CO_2 emissions. Because there are still numerous fossil-based heating systems in use, the annual emissions depend to a large extent on the weather conditions. Emissions are higher in years with relatively cold winters, and lower in years with warmer winters.

ENERGY-RELATED CO_2 EMISSIONS OVERALL AND BY SECTOR

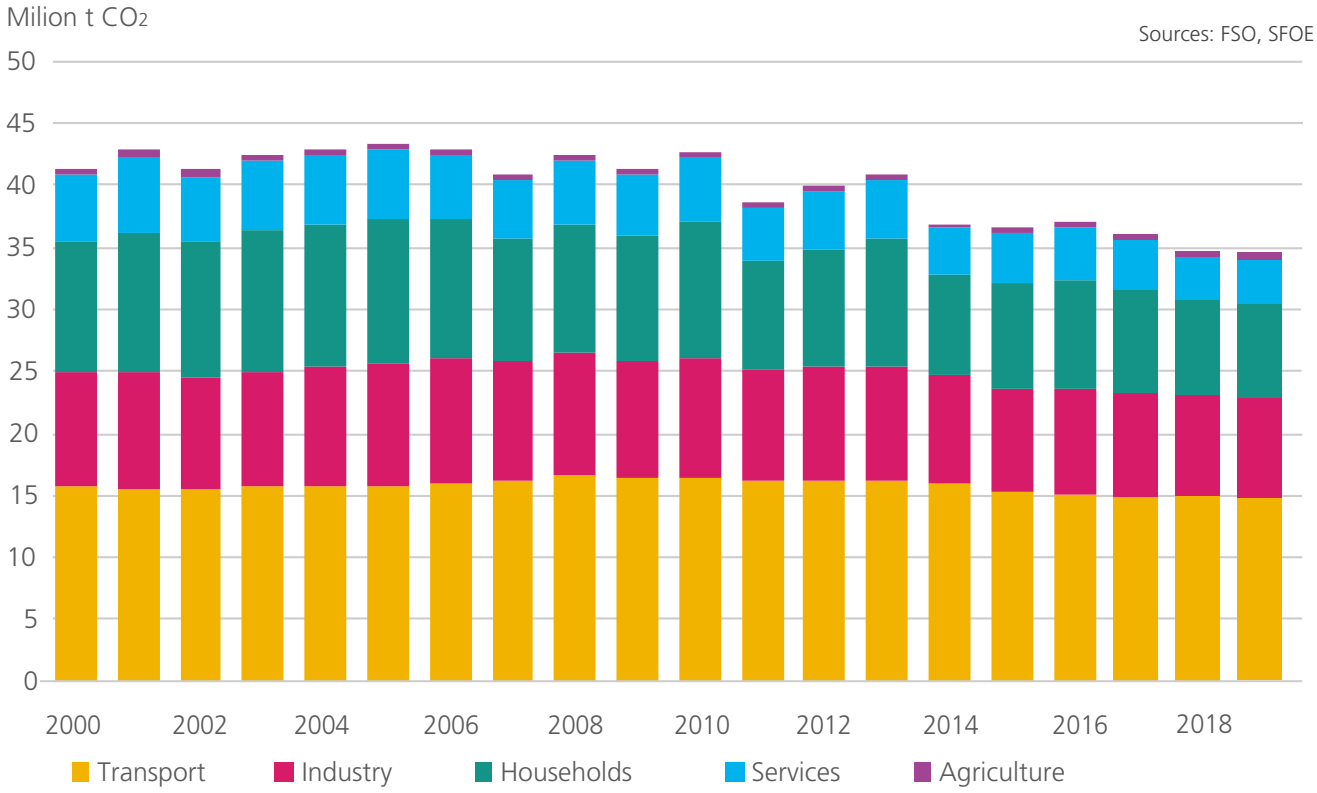


Figure 15: CO_2 emissions from energy sources in total and by sector (in million tonnes CO_2 excluding international air traffic)

The same applies to the **services sector** (proportion in 2019: 10%). Here, too, CO_2 emissions from energy sources have been declining slightly since 2000, but the levels fluctuate according to the weather conditions. In the **agriculture sector**, CO_2 emissions from energy sources have similarly decreased slightly since 2000, while the overall share is very low (2019: 2%). In the agriculture sector, it is not energy-related CO_2 emissions that are of significance, but rather above all methane and nitrogen dioxide. Overall, each sector's share of energy-related CO_2 emissions has only changed to a minor extent since 2000. Emissions from the transport and industry sectors have increased (from 38 to 43% and 22 to 23% respectively), while the households and services sectors contributed slightly less (sources: FOEN, 2021+2018 / SFOE, 2021a / Ecoplan, 2017 / Ecoplan/ EPFL/FHNW, 2015).

17 In certain publications, the SFOE shows the proportion of transport to total greenhouse gas emissions, which is currently around one-third (32%).

18 International aviation is not included in international balances, so no results flow into the evaluation of attainment of climate policy targets. If air traffic were included, its proportion to overall CO_2 emissions would be around 14 per cent. If this segment is allocated to the overall transport sector, the share would be 27%.

↗ For more detailed indicators regarding **CO_2 EMISSIONS** see the full monitoring report

RESEARCH AND TECHNOLOGY

To achieve the long-term objectives, new developments in the technology sector will be required. To stimulate further development, Switzerland has allocated significantly more resources to energy research. Progress in research and technology cannot generally be measured directly with indicators. For this reason the annual monitoring process focuses on public expenditure for energy research as an indicator for efforts being made in this regard.

PUBLIC EXPENDITURE FOR ENERGY RESEARCH

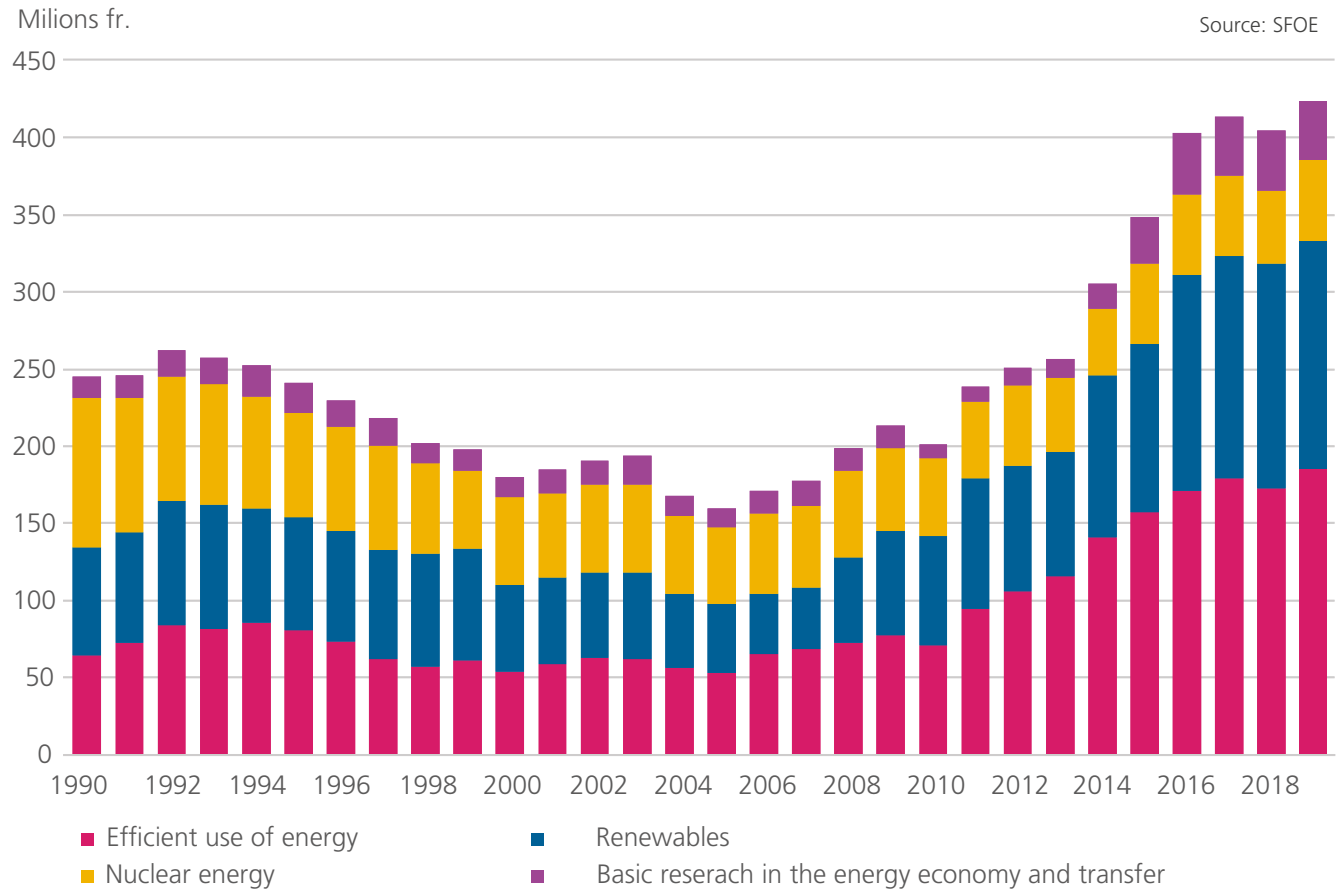


Figure 16: Public expenditure for energy research by field of research (in million Swiss francs [real figures])[19]

Since 2005, public funding for energy research has increased continuously, as shown in **Figure 16**. Above all, a significant increase in expenditure has been noted since 2014 within the framework of Energy Strategy 2050 and the 'Coordinated Energy Research in Switzerland' action plan. A major contribution has been made through the development and creation of the Swiss Competence Centres for Energy Research (SCCERs) by Innosuisse, the new National Research Programmes in the energy sector (NRP 70 and NRP 71) by the Swiss National Science Foundation (SNSF), and the targeted expansion of pilot, demonstration and flagship projects by the SFOE. In 2019, public expenditure in the sector amounted to 427 million Swiss francs (in real terms), compared with close to 406 million in 2018. In accordance with the priorities of Energy Strategy 2050, the largest amounts of funding flow into the fields of *energy efficiency* (share in 2019: 43.6%) and *renewable energy* (share: 2019: 35.1%). Absolute expenditure for *nuclear energy research* (nuclear fusion and nuclear fission) has been stable since 2004, but its proportion to total expenditure has fallen and amounted to 12.1 per cent in 2019. The share of expenditure for *basic energy research* was 9.1 per cent (source: SFOE, 2021c).

19 Expenditure includes a share in overheads (indirect research costs) of the research institutions.

↗ For detailed indicators regarding **RESEARCH AND TECHNOLOGY** see full monitoring report

INTERNATIONAL ENVIRONMENT

The international environment is important for Switzerland because our country is closely integrated into the international energy markets and is dependent on energy imports. Developments in Europe at the regulatory level are of central importance for Switzerland. International efforts to combat climate change also play a major role. The annual monitoring process focuses on a descriptive overview of substantial developments.

DEVELOPMENT OF GLOBAL ENERGY MARKETS

Europe and other regions of the world are currently being confronted with rising energy prices, and this is also having an impact on Switzerland (especially with respect to electricity, oil and gas). The main cause for this development is the global increase in energy demand because economies are beginning to recover now that the COVID-19 pandemic has peaked, but energy production is unable to increase at the same pace. Furthermore, the European CO_2 price has risen sharply in 2021. On 13 October 2021, the European Commission presented a range of instruments that the EU and its member states can use in order to overcome the immediate impacts of the current price increase and strengthen their resilience against future price shocks. At the meeting of the European Council on 21 October 2021 the heads of state and government also discussed the high energy prices (sources: COM (2021) 660 final / European Council, 2021).

Oil: In its medium-term forecast, the International Energy Agency (IEA) anticipates that global demand for oil will reach around 104.1 million barrels per day in 2026. This is equivalent to an increase by 4.4 million barrels per day versus 2019. On the supply side, by 2026 the IEA forecasts growth in production capacities by 3.7 million barrels per day to 104.2 million versus 2019.

In 2020, demand amounted to 91.0 million barrels per day (9 million barrels per day less than in 2019, i.e. prior to the COVID-19 pandemic). For 2021, the IEA expects demand to recover to 96.5 million barrels per day. In 2019, supply totalled 100.5 million barrels per day, and this figure fell in 2020 to 93.9 million.

In July 2021, OPEC+ (i.e. OPEC, plus other countries under Russia's leadership) resolved to increase production after it had been suppressed in the past few years. Despite this increase in production, the price of oil reached a new high in October 2021 of over 80 dollars per barrel (source: OECD/IEA, 2021b).

Gas: In its medium-term forecast, the IEA anticipates annual growth in the demand for gas by 1.7 per cent up to 2024 – slightly lower than the 1.8 per cent growth prior to the pandemic – which means that global demand will reach around 4,300 billion cubic metres in 2024. Global gas production in 2024 is expected to be around 6 per cent higher than before the pandemic in 2019 and amount to 4,328 billion cubic metres.

The gas markets underwent a sharp recovery at the beginning of 2021 as a result of stronger economic growth and periods of cold weather. In the view of the IEA, the increasing demand in 2021 should offset the decline that was recorded in 2020. For 2020, the IEA originally anticipated a fall in demand by 4 per cent, but in fact demand fell by only 1.9 per cent to 3,926 billion cubic metres. Gas production totalled 3,960 billion cubic metres, which was 3 per cent less than in 2019.

Following a paradigm-related fall in summer 2020, the price on the US market (Henry Hub) rose in the third quarter of 2021 year-on-year to above 5 US dollars per British thermal unit (mmbtu), which was still well below the prices on the European and Asian markets. In Europe (TTF spot), the high global demand, together with the lower inflows of liquefied natural gas and the fact that the pipeline through Ukraine operated by Russia remained largely unused, prompted a sharp increase in TTF prices, which in October 2021 rose temporarily to over 100 Euro per MWh, with futures for next April they were below 50 Euro again (sources: OECD/IEA, 2021c / EU, 2021 / Argus Gas Connections[20]).

DEVELOPMENT OF GLOBAL ENERGY MARKETS

CO_2 in European emission trading: In June 2020, the price for CO_2 emission rights rose to 23.5 euros per tonne, i.e. back at the level prior to the COVID-19 pandemic. Following the announcement by the European Commission of its 'Fit for 55' climate package (see below) and the relatively high prices of gas and coal, the CO_2 price reached 60 euros per tonne in September 2021, and has since remained at this record high level. The price for futures, too, is at the level of 60 euros per tonne for 2022 to 2024 (sources: EU, 2021 / EEX[21]).

Electricity: After falling by around 1 per cent in 2020 to 26,800 TWh, in 2021 the global electricity demand according to figures from the IEA is expected to rise by almost 5 per cent to around 28,100 TWh, and by 4 per cent to approximately 29,200 TWh in 2022. The Asia-Pacific region will account for the greatest share of this increase. More than half the global growth in 2022 is expected to occur in China – the world's largest electricity consumer. India, which is the world's third-largest consumer, will account for 9 per cent of the growth in global demand.

The European Power Benchmark (the index for the average wholesale electricity price on the European market) rose in the first quarter of 2021 to 53 euros per MWh (79 per cent higher than in the first quarter of 2020) due to the high fuel prices. In June, the electricity prices reached a record level on the majority of markets (e.g. in Germany and France). The price for the front year base-load contract for Switzerland (Swissix) followed this trend, exceeded the level of 150 euros per MWh in September and has since dropped to 130 euros (sources: OECD / IEA, 2021d / EU, 2021 / ElCom, 2021b).

20 www.argusmedia.com

21 www.eex.com

DEVELOPMENTS IN THE EU: THE 'EUROPEAN GREEN DEAL' AND THE 'FIT FOR 55' CLIMATE PACKAGE

In July 2021, the European Commission presented a comprehensive package of legislation under the name **'Fit for 55'**. This package aims to support the implementation of the **'European Green Deal'**, as well as to facilitate the achievement of the targets specified in the European Climate Law, according to which net greenhouse gas emissions must be reduced by 55 per cent by 2030 versus the 1990 level, and thus to bring the EU onto the path to climate neutrality in 2050. The package contains 13 interlinked legislative proposals in a number of different areas (source: COM(2021) 550 final):

- **EU emission trading scheme (EU-ETS):** The Commission wants to further reduce the limit levels for all emissions in the EU-ETS and increase the annual reduction. Its goal is a reduction of CO_2 in the EU-ETS by 61 per cent versus 2005. It also proposes to discontinue the free emission certificate for air transport on a step-by-step basis, and implement the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). In addition, shipping emissions are to be incorporated in the EU-ETS for the first time. The Commission is also proposing to top up the innovation fund and the modernisation fund, both of which are financed with the proceeds from emission rights auctions.

- **New ETS in the road transport and buildings sectors:** In order to address the lack of emission reductions in road transport and buildings, two new emission trading schemes for fuel and combustible supply are to be introduced in these sectors. The aim is to merge these at a later date if the cross-sector emission reduction costs prove to be similar.

- **CO_2 border adjustment system:** The aim of this new instrument is to introduce a CO_2 price for the import of certain products into the EU. The goal here is to ensure that European emission reductions contribute towards a decline in global emissions, to prevent the exit of CO_2-intensive industrial production from Europe. In addition, according to the Commission the new system is intended to motivate industrial companies in third countries, as well as international partners of the EU, to take steps in the same direction. The Commission's proposal calls for the new system to fully replace the existing free allocation of emission rights.

- **Emission regulations for vehicles:** More stringent CO_2 emission regulations for cars and light duty vehicles are intended to speed up the transition to emission-free mobility. The Commission's proposal calls for average annual emissions from new cars and delivery vehicles to be reduced by 55 per cent from 2030, and by 100 per cent from 2035 versus the 2021 level. In effect, this means that all newly registered cars and delivery vehicles must be emission-free as of 2035.

- **Energy taxation:** The proposed revision of the energy tax directive calls for the taxation of energy products to be harmonised with EU energy and climate policy. Here, minimum tax rates are to be increased, energy taxation is to be harmonised and outdated tax exemptions or reductions are to be abolished in favour of fossil energy sources. The EU's agreements do not include competency for these fiscal issues. This means that, contrary to other legislative proposals, the approval of this directive requires unanimous acceptance by all member states.

- **Renewable energy:** The revision of the renewable energy directive envisages the binding objective at the EU level for the proportion of renewable energy to total energy consumption to be increased to above 40 per cent. In addition, the revision proposes specific targets for the use of renewable energy in the transport, heating and refrigeration, buildings and industry sectors. It also aims to enhance the sustainability criteria for the use of biomass. Furthermore, the member states must structure their support schemes for biomass so that the principle of cascaded use is secured for wood biomass.

DEVELOPMENTS IN THE EU: THE 'EUROPEAN GREEN DEAL' AND THE 'FIT FOR 55' CLIMATE PACKAGE

- **Energy efficiency:** In order to reduce overall energy consumption, cut emissions and combat energy poverty, the revision of the energy efficiency directive envisages a more ambitious binding annual target at the EU level for the reduction of energy consumption throughout the EU[22]. The directive serves as a guiding principle for specifying the indicative national contributions towards the EU-wide efficiency target. The annual obligation to reduce end energy consumption is to be almost doubled to 1.5 per cent. Each year, the public sector must renovate 3 per cent of its building inventory.

- **Reduction of CO_2 emissions outside the emission trading scheme:** A revision of the EU carbon offsetting regulation adjusts the binding national CO_2 reduction targets outside the ETS to the more stringent EU-wide target of 40 per cent by 2030 versus 2005. For the distribution of loads, the starting level of the individual member states and their economic capacity are to be taken into account.

- **Land use, forestry:** A revision of the land use regulation is intended to ensure that by 2030 land use gives rise to a removal of 310 million tonnes of CO_2 from the atmosphere.

- **Regulation for infrastructure for alternative fuels:** With the proposed legislation, the previous directive is to be formulated as a Regulation. In the view of the Commission, only a Regulation can meet the urgent need of the booming market for infrastructure (upon their entry into force, EU Regulations automatically apply throughout the entire union). The legislation contains detailed stipulations for the member states concerning the development of charging infrastructure for electric vehicles including ships, and for hydrogen and liquid natural gas filling stations, as well as criteria governing billing, pricing and data delivery for operators of recharging and refuelling infrastructure.

The Commission presented the **'European Green Deal'** on 11 December 2019. The centrepiece of this comprehensive strategy is the objective of the EU to become the first climate-neutral continent by 2050. The European Council adopted the target of climate neutrality by 2050 in December 2019 (sources: COM(2019) 640 final) / European Council, 2019).

The **European Climate Law** specifies the climate neutrality obligation of the EU and the interim target of reducing net greenhouse gas emissions by 2030 by at least 55 per cent versus the 1990 level, in legally binding form. It entered into force in July 2021[23].

The developments in the EU in the framework of the 'Green Deal' are also of interest for Switzerland. They clearly confirm the strategic direction of European energy and climate policies for the next few decades, which will also influence Switzerland's energy and climate policies. Many aspects of the Green Deal, especially those relating to financing, apply to the EU only. At the same time, it is important to closely monitor further developments and identify any potential challenges for Switzerland at an early stage. Various aspects of the 'Fit for 55' package also affect Switzerland, including the revision of the EU-ETS, which has been linked to the Swiss emission trading system since the beginning of 2020. In accordance with the Commission's proposed regulation, Switzerland is excluded from the CO_2 border adjustment system due to the linking of the emission trading systems. This means that the border adjustment levy will not be collected when Swiss products are exported to the EU. Potential impacts of the new CO_2 border adjustment system on the entire supply chain of Switzerland's manufacturers need to be closely observed. It will also be necessary to examine how Switzerland will deal with the new emission regulations for vehicles from 2025.

22 A reduction by 9 per cent versus an updated reference scenario for 2020 corresponds to an absolute level of end energy consumption by 2030 of 787 million tonnes of crude-oil equivalents (mtoe) and a primary energy consumption of 1,023 mtoe.

23 Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law).

INTERNATIONAL CLIMATE POLICY

With respect to the further implementation of the **Paris Climate Change Agreement**, the signatory states met in November 2021 for the 26th UN Climate Change Conference in Glasgow (COP26). At the conference, countries were called upon to boost their climate targets for the period up to 2030 by the end of 2022. In the adopted text, countries also affirm for the first time their intention to phase out coal energy, whose emissions are not captured using technological means, as well as inefficient subsidies for fossil fuels such as oil and gas. Switzerland welcomes this course of action, as DETEC wrote in a 14 Nov. 2021, press release. However, at the conference, it had advocated the complete removal of any kind of subsidies for these energy sources and an end to any kind of coal use. A solution was found on the issue of emission reductions generated abroad. At COP26, rules were adopted that prevent double counting between countries. Moreover, emission reductions between states and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) cannot be counted twice. In addition, private stakeholders may also participate in this market through voluntary carbon reduction projects without double-counting. However, these reductions may not be counted towards the climate targets set by individual countries. This was a success for Switzerland, which campaigned against double counting at the conference and was able to demonstrate on the basis of its bilateral climate protection agreements that it is possible to introduce such a rule. Switzerland will continue to advocate for robust climate change rules, as it has done in several bilateral climate change agreements signed with partner countries since 2020. At COP26, Switzerland signed two such agreements with Vanuatu and Dominica. Similar agreements already exist s with Peru, Ghana, Senegal and Georgia. After years of negotiation on the part of the international community, the Paris Agreement entered into force on 4 November 2016. It followed up on the second commitment period of the Kyoto Protocol and obliges all countries to adopt measures to reduce greenhouse gas emissions, with the common objective of limiting the increase in the global average temperature to well below 2° C above the pre-industrial level, while at the same time striving to limit the temperature increase to 1.5° C. The further aims of the Agreement include 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. All 197 parties to the United Nations Framework Convention on Climate Change (UNFCCC) have adopted the Convention and 189 countries, as well as the EU, have ratified it. After he assumed office in January 2021, US President Joe Biden announced that the USA is re-adopting the Paris Agreement, thus reversing his predecessor's decision in 2017 to pull the USA out of it.

Switzerland signed the Paris Agreement in 2015 and ratified it in autumn 2017. Switzerland's target calls for a halving of the total greenhouse gas emissions by 2030 versus the 1990 level. For the implementation of the Agreement by 2030, the Federal Council and Parliament resolved to revise the existing CO_2 Act, but the electorate rejected the proposed revision in a referendum that was held in June 2021. Nonetheless, the internationally declared target remains unchanged despite the rejection of the revised CO_2 Act. By the end of 2021, the Federal Council aims to submit a new version of the draft legislation for consultation, which takes account of the result of the referendum and is intended to create as broad a basis as possible for Switzerland's future climate policy. Following the ratification of the Paris Agreement, Switzerland is also legally obliged to implement measures to combat climate change. As before, it is required to submit a Biennial Report to the Secretariat of the UN Framework Convention on Climate Change concerning the development of greenhouse gas emissions, planned measures to reduce emissions and adapt to climate change, and the contributions made towards the financing of international climate policy.

INTERNATIONAL CLIMATE POLICY

At the beginning of August 2021, the Intergovernmental Panel on Climate Change (IPCC) published its 6th status report on the scientific principles of climate change. This latest report confirms the findings of previous IPCC reports, notably the contribution of greenhouse gases resulting from human activities towards climate warming, and the correlation between climate change and the increasingly frequent occurrences of extreme weather events such as heat waves, heavy rainfall and periods of drought. In 2018, the IPCC highlighted in a special report the consequences of global warming by 1.5° C and compared these consequences with those of global warming by 2° C. The report emphasised that serious changes in the ecological system would have to be anticipated with global warming by1.5° C, and that the changes would be even more severe with additional warming by 2°. To restrict global warming to 1.5°, a CO_2 balance of net zero would have to be reached by the middle of the century. In view of these findings, the Federal Council resolved that Switzerland is to not emit any more greenhouse gases by 2050 than can be collected through natural and technical storage, i.e. net zero emissions by 2050. This climate objective ensures that Switzerland will make its own contribution towards limiting global climate warming to a maximum of 1.5° C. In January 2021, the Federal Council adopted the corresponding long-term climate strategy. In August, in its Dispatch concerning its direct counterproposal to the Glacier Initiative it also proposed that the previously indicative net zero target should be adopted into the Federal Constitution.

(Sources: Federal Council, 2021a+c+f+g+2020+2019a / DETEC, 2021 / IPCC, 2018+2021).

SWITZERLAND'S INTERNATIONAL COOPERATION IN THE ENERGY SECTOR

Switzerland initiated negotiations with the EU on a **bilateral electricity agreement** in 2007. These negotiations came to a halt in the middle of 2018 because the EU insisted that their continuation must be tied to the institutional agreement between Switzerland and the EU. In May 2021, the Federal Council resolved to terminate the negotiations on the draft institutional agreement. This means that an electricity agreement between Switzerland and the EU is unlikely to be concluded in the foreseeable future.

With respect to **regional cooperation**, Switzerland has participated as a permanent and active ob- server of the Pentalateral Energy Forum since February 2011. The energy ministries of the following countries all participate voluntarily in this forum: Germany, France, Belgium, the Netherlands, Luxembourg, Austria and Switzerland. The forum focuses on electricity market coupling, electricity supply security, flexibility in the electricity market, and hydrogen. In autumn 2021, it published a joint position paper regarding a future regulation of the hydrogen market. In early December, Federal Councillor Simonetta Sommaruga took part in an online ministerial meeting of the Pentalateral Energy Forum; on this occasion, member countries jointly signed a Memorandum of Understanding on risk preparedness in the electricity sector; this MoU paves the way for member countries to work together more extensively on electricity crisis preparedness and to develop solidarity measures that can be deployed regionally in the event of a crisis. These measures would be based on a corresponding EU regulation to be issued in 2019. How member countries will cooperate in this regard, in particular with Switzerland, has yet to be negotiated.

The numerous interdependencies with neighbouring countries in the energy sector call for an intensification of **bilateral relations** in the areas of energy and climate. In her preparation for the 26th UN Climate Conference in Glasgow, Federal Councillor Simonetta Sommaruga attended a range of meetings and held talks with important negotiation partners in 2021. In April, she also participated in the round table discussions organised by US special presidential envoy for climate, John Kerry. A virtual working visit 'conveyed' the head of DETEC to California in June, during which climate, energy and transport issues were on the agenda. In September, she signed the climate agreement between Senegal and Switzerland that was adopted by the Federal Council, and in Ghana together with the relevant ministers, she expedited the implementation of the agreement signed between the two countries. In October, a climate agreement was signed in Bern between Switzerland and Georgia.

In the field of **multilateral cooperation**, Switzerland is active within the multilateral energy institutions, including the International Energy Agency (IEA). Since March 2021, Federal Councillor Sommaruga has held a seat in the IEA's new 'Global Commission on People-Centred Clean Energy Transitions'. This Commission aims to contribute towards a global energy system in which the centre of focus is on the social compatibility of the transition towards a clean energy system. In January 2020, as in 2019, Switzerland organised a workshop on hydropower on the periphery of the annual meeting of the International Renewable Energy Agency (IRENA). Switzerland held a seat in the IRENA Council in 2019 and 2020, and also plans to do so in 2021 and 2022.

(Sources: Federal Council, 2020+2021c+g / DETEC, 2021).

↗ For more detailed indicators regarding **INTERNATIONAL ENVIRONMENT** see full monitoring report

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