



ENERGY STRATEGY 2050

MONITORING REPORT 2025

ABRIDGED VERSION¹

1 Based mainly on data up to 2024



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

CONTENTS

4 INTRODUCTION

▶ 8 TOPIC ENERGY CONSUMPTION AND PRODUCTION

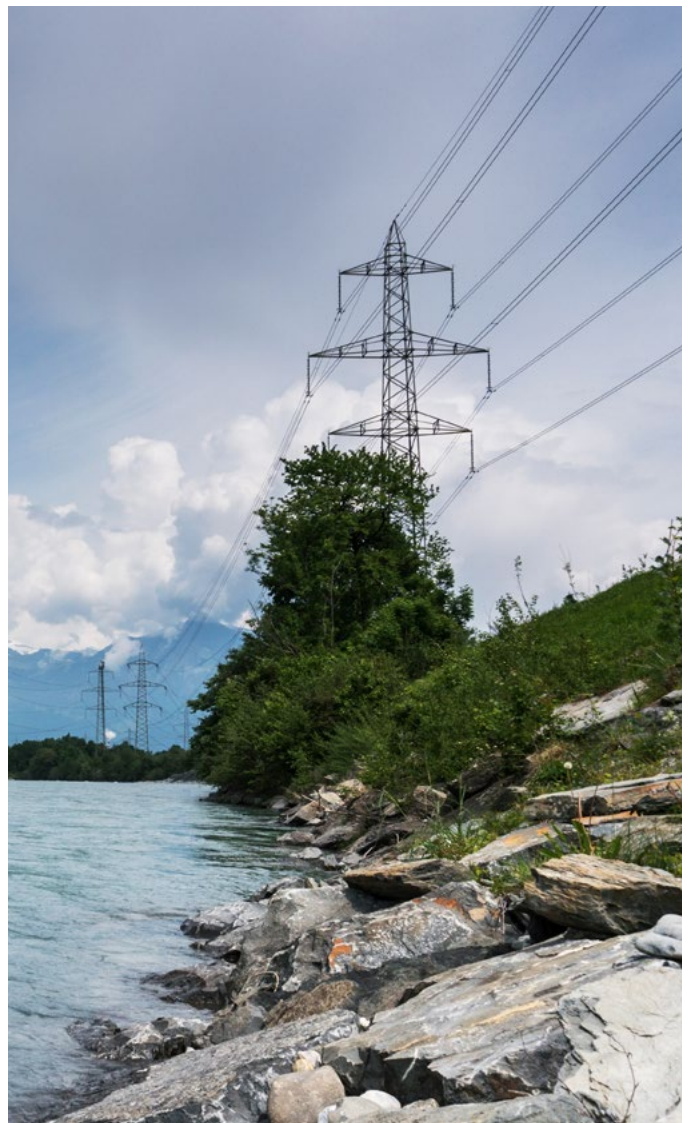
- 9 Final energy consumption per person and year
- 10 Electricity consumption per person and year
- 11 Electricity production from renewable energy (excluding hydropower)
- 12 Electricity production from hydropower plants

▶ 13 TOPIC GRID DEVELOPMENT

- 14 Status and duration of plans for the transmission grid
- 20 Brief description of the planning and realisation stages of individual grid projects
- 24 Underground cabling
- 26 Smart Meters

▶ 27 TOPIC SECURITY OF SUPPLY

- 28 Diversification of the energy supply
- 29 Dependency on imports
- 31 Electricity supply security: system adequacy and winter production capacity





CONTENTS

- ▶ **34 TOPIC**
EXPENDITURE AND PRICES
 - 35 Final consumer expenditure for energy
 - 37 Energy prices for industrial sectors: international comparison
 - 39 Energy prices for industrial sectors: international comparison

- ▶ **42 TOPIC**
CO₂-EMISSIONS
 - 43 Per capita energy-related CO₂ emissions
 - 44 Energy-related CO₂ emissions overall and by sector

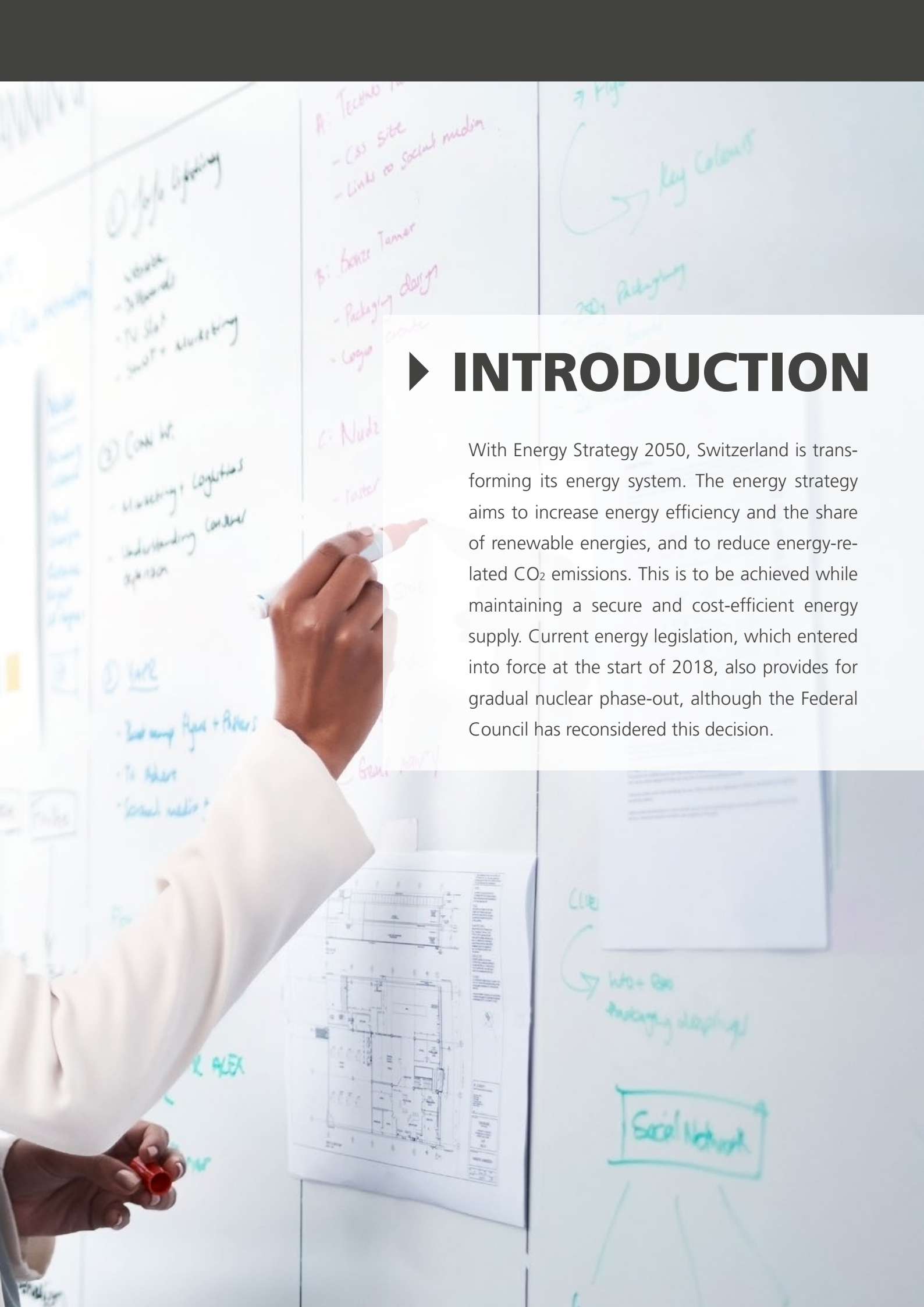
- ▶ **46 TOPIC**
RESEARCH AND TECHNOLOGY
 - 47 Public expenditure for energy research

- ▶ **49 TOPIC**
INTERNATIONAL ENVIRONMENT
 - 50 Development of global energy markets
 - 52 Developments in the EU
 - 54 International climate policy
 - 55 Switzerland's international cooperation in the energy sector

- 58 LITERATURE AND BIBLIOGRAPHY**

- 62 LIST OF FIGURES**





► INTRODUCTION

With Energy Strategy 2050, Switzerland is transforming its energy system. The energy strategy aims to increase energy efficiency and the share of renewable energies, and to reduce energy-related CO₂ emissions. This is to be achieved while maintaining a secure and cost-efficient energy supply. Current energy legislation, which entered into force at the start of 2018, also provides for gradual nuclear phase-out, although the Federal Council has reconsidered this decision.

In light of the 2050 climate target – which will require Switzerland to balance greenhouse gas emissions with natural and technical storage capacity from 2050 onwards – fossil fuels must be largely replaced by renewable electricity, particularly in transport and heating.

With the Federal Act on a Secure Electricity Supply from Renewable Energy Sources (Federal Gazette, 2023), the Federal Council and Parliament have taken a comprehensive step towards advancing Energy Strategy 2050. Swiss voters approved the legislative package on 9 June 2024, and the first part entered into force on 1 January 2025 (Federal Council, 2024n). The Act establishes measures to rapidly and systematically expand domestic renewable power generation, improve power system integration, and strengthen long-term supply security. To further accelerate renewable energy expansion, the Federal Council approved an amendment to the Energy Act – the acceleration bill – in June 2023 (Federal Council, 2023a). In the 2025 autumn session, the National Council and Council of States concluded their deliberations and approved the acceleration bill. This bill primarily aims to streamline licensing and appeals processes for large installations and simplify grid upgrade planning. It complements previously approved parliamentary bills expediting wind and solar energy projects.

As noted regarding the 2050 climate target, energy policy objectives closely align with climate policy, as approximately three quarters of Switzerland's greenhouse gas emissions come from fossil fuel use. The SFOE's Energy Perspectives 2050+ demonstrate that Switzerland can restructure its energy supply by 2050 to meet this target while maintaining supply security (Prognos/TEP/Infras/Ecoplan, 2020). Energy Perspectives 2050+ provided key foundations for the Federal Council's 2021 Long-term Climate Strategy for Switzerland, which detailed the net-zero target (Federal Council, 2021). The Federal Act on Climate Protection Goals, Innovation and Strengthening Energy Security (CIA), approved by Swiss voters on 18 June 2023, establishes the net-zero target as legally binding (Federal Gazette, 2022) and sets interim goals and guidance values for the buildings, transport and industry² sectors. Furthermore, the Act, which entered into force on 1 January 2025, includes time-limited support measures to advance fossil fuel replacement in buildings and industry. Switzerland has made an international commitment to reduce its greenhouse gas emissions by 50% compared to 1990 levels by 2030. The revised CO₂ Act, approved by Parliament in spring 2024 and effective from the start of 2025 (Federal Gazette, 2024), implements this target nationally, maintaining existing measures while introducing new targeted support measures and incentives for emissions reduction.

² In these three sectors, greenhouse gas emissions are to be gradually reduced compared to 1990 levels as follows: buildings: by 82% by 2040, and 100% by 2050; transport: by 57% by 2040, and 100% by 2050; industry: by 50% by 2040, and 90% by 2050.

The energy system transformation, with increased renewable energy use, enhanced efficiency, and growing decarbonisation and electrification, requires particular attention to supply security. Beyond long-term considerations, *which are given closer consideration in the chapter on supply security*, Russia's attack on Ukraine and rising tensions in the Middle East have highlighted short- and medium-term supply security concerns. Since February 2022, the Federal Council and Parliament have implemented various supply security measures. The Federal Act on a Secure Electricity Supply from Renewable Energy Sources mandates a hydropower reserve: reservoir operators retain energy for a fee from early February to mid-May for use when needed. The Act includes storage operators and large consumers with load reduction potential as additional electricity reserve components. The Winter Reserve Ordinance governs both hydropower reserve use and a supplementary thermal reserve comprising reserve power plants, emergency generators and CHP plants. This part of the electricity reserve has now been given a legal basis as part of an amendment to the Electricity Supply Act (Federal Council, 2024j). Parliament approved the bill in the 2025 spring session, and it is due to enter into force on 1 January 2027. The existing Winter Reserve Ordinance is to be extended until 2030 (it is currently valid until the end of 2026) so that the contracts for the existing reserve power plants can be extended until the new reserve power plants are available (Federal Council, 2025e). As part of the Switzerland–EU package, the Federal Council also approved the electricity agreement and submitted it for consultation on 13 June 2025. The electricity agreement between Switzerland and the EU is intended to facilitate Switzerland's access to the European electricity market and make an important contribution to overcoming challenges in terms of grid stability and security of supply (Federal Council, 2025a).

Given changed electricity market and energy policy conditions (climate targets, electricity demand, fossil gas-fired power plants as reserve only, geopolitical uncertainties), the Federal Council made a nuclear energy policy decision on 28 August 2024. It rejects the popular initiative 'Electricity for everyone at all times (Stop the blackout)' and has drawn up an indirect counter-proposal to the initiative, which provides for lifting the existing ban on the construction of new nuclear power plants in the interests of technological openness. The Federal Council approved the dispatch on this bill on 13 August 2025 and submitted it to Parliament. Parliamentary deliberations are scheduled to begin this year (Federal Council, 2024k + 2025c).

This monitoring report for 2025 (abridged version, majority of data as of 2024) deals with selected indicators and contains descriptive sections on the following seven topics:

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- **TOPIC** **ENERGY CONSUMPTION AND PRODUCTION**
 - **TOPIC** **NETWORK DEVELOPMENT**
 - **TOPIC** **SUPPLY SECURITY**
 - **TOPIC** **EXPENDITURE AND PRICES**
 - **TOPIC** **CO₂-EMISSIONS**
 - **TOPIC** **RESEARCH AND TECHNOLOGY**
 - **TOPIC** **INTERNATIONAL ENVIRONMENT**
-

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



- **Key figures on the current energy supply situation** are available on the SFOE's Energy Dashboard at www.energydashboard.ch





▶ **ENERGY CONSUMPTION AND PRODUCTION**

Enhancing efficiency to reduce energy and electricity consumption stands as a primary objective of Energy Strategy 2050 and a key pillar of energy legislation. Equally important is expanding renewable electricity production to partially offset declining nuclear power plant capacity. The monitoring of the Energy Strategy 2050 analyses these key issues in the gradual transformation of the Swiss energy system. This topic's indicators primarily comprise the targets for per-person energy and electricity consumption set down in the Federal Act on a Secure Electricity Supply from Renewable Energy Sources, alongside targets for expanding renewable electricity production and hydropower.

FINAL ENERGY CONSUMPTION PER PERSON AND YEAR

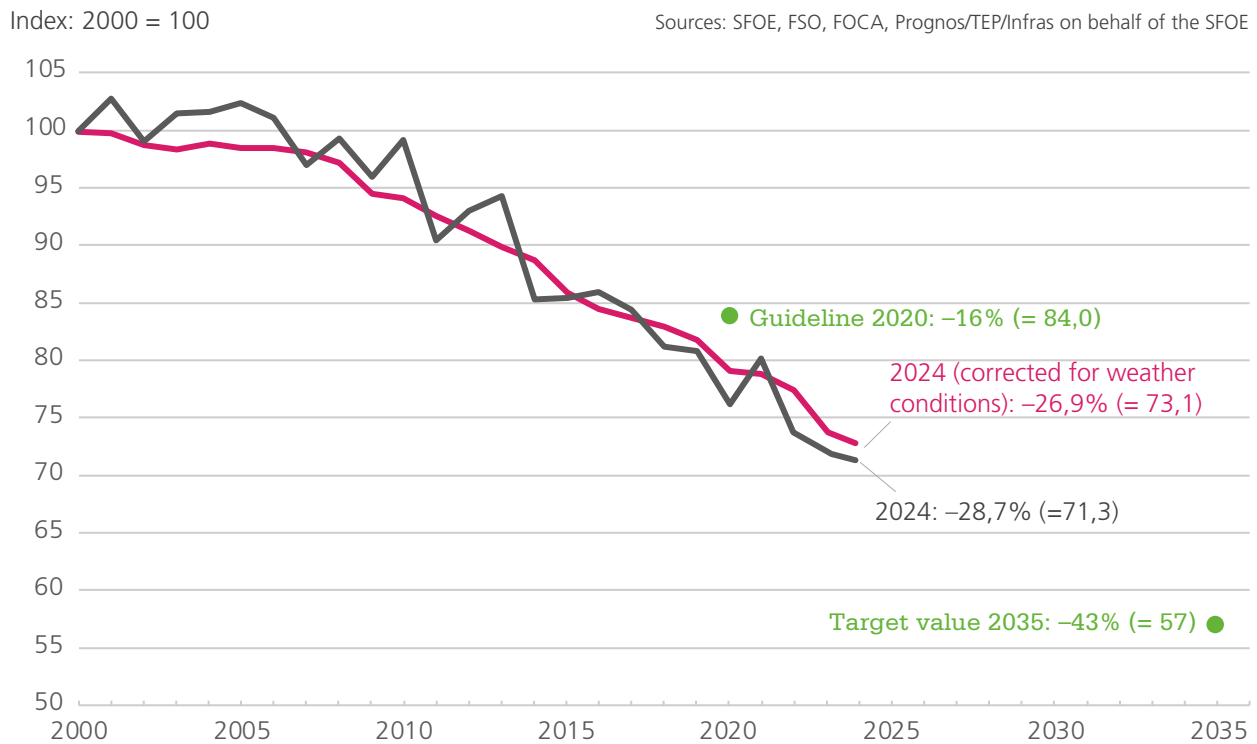


Figure 1: Final energy consumption³ per person per year since 2000 (indexed)

Final energy consumption per person has fallen since 2000, as **Figure 1** shows. The decrease reflects an 8.4% drop in absolute final energy consumption between 2000 and 2024 (-10.6% excluding international aviation), while population grew by 25.4% during this period. In accordance with the Federal Act on a Secure Electricity Supply from Renewable Energy Sources, which entered into force on 1 January 2025, by 2035 final energy consumption per person is to be reduced by 43% compared with the base year 2000. In 2024, final energy consumption per person was 77.8 gigajoules (21.6 MWh), 28.7% below 2000 levels. Weather-adjusted figures show a 26.9% decrease. To achieve the 2035 target, weather-adjusted final energy consumption per person must decline by 2.2% annually going forward. The past decade's average annual reduction was approximately 1.9%. In 2024, absolute final electricity consumption increased by 1% compared to 2023. The rise primarily reflects increased international air

traffic consumption and the slightly cooler weather. Absolute final energy consumption decreased over the entire period under review (from 2000 to 2024), as the consumption-reducing effects outweighed consumption-driving factors. Consumption was primarily driven by volume effects: all 'pure' growth effects were counted, such as the overall economic output (excluding structural effects), population, energy reference areas and the motor vehicle inventory. Such effects that tended to increase consumption were counteracted by policy measures and technological advances. Substitution effects from energy source changes also helped reduce consumption between 2000 and 2024. These include replacing heating oil with natural gas and increasingly with district heating, ambient heat, wood and electricity, as well as substituting petrol with diesel and, more recently, electricity (sources: SFOE, 2025a / FSO, 2025 / FOCA, 2025 / Federal Gazette, 2023 / Prognos/TEP/Infras 2025a+b).

³ Excluding international air traffic

ELECTRICITY CONSUMPTION PER PERSON AND YEAR

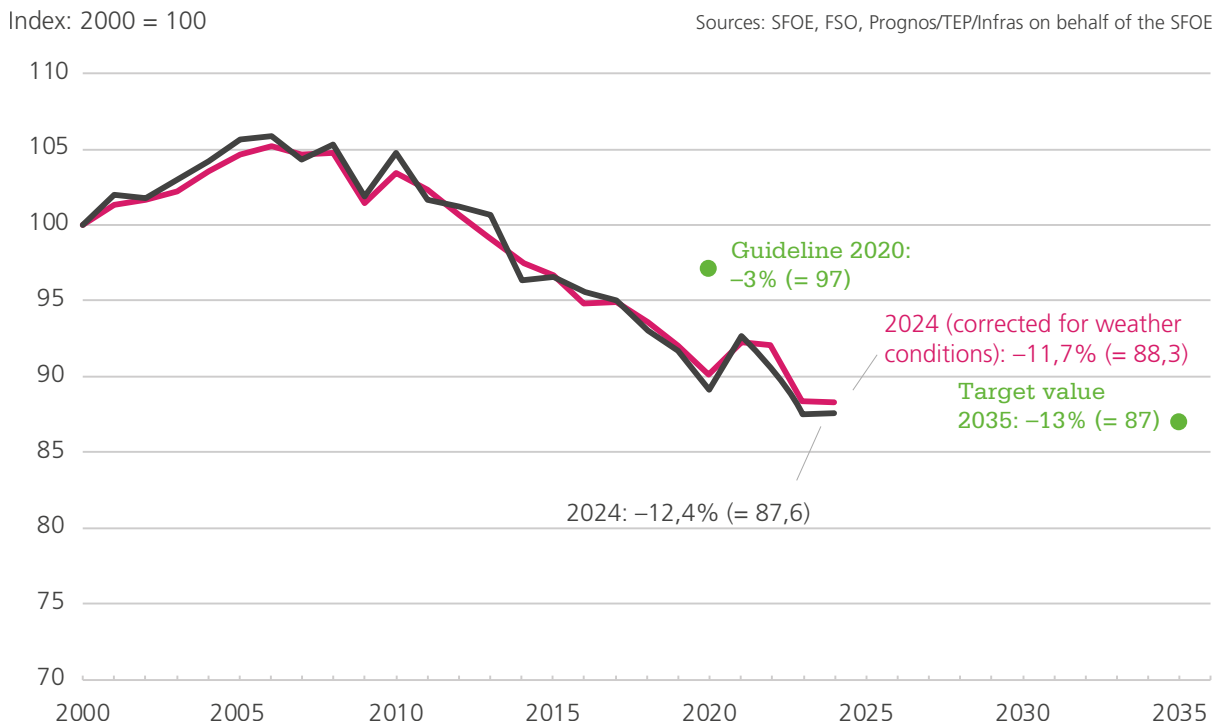


Figure 2: Electricity consumption per person per year since 2000 (indexed)

Per capita electricity consumption grew between 2000 and 2006 as absolute consumption increased by 10.3% while population rose only 4.2%. Since 2006, the trend has declined, as shown in **Figure 2**. Absolute electricity consumption fell by 3% between 2006 and 2023, while population increased by 18.8%. Sharp declines in per capita consumption in 2009 and 2020 reflect economic slowdown and COVID-19 impacts respectively. The current Energy Act targets a 13% reduction in per capita electricity consumption from 2000 levels by 2035. The Federal Act on a Secure Electricity Supply from Renewable Energy Sources will make this 2035 target legally binding. In 2023, per capita energy consumption reached 22.7 gigajoules (6,308 MWh), 13.5% below in 2000 levels. Weather-adjusted figures show a 12.6% decrease (*red curve*). The past decade's weather-adjusted average annual decline was approximately 1.3%. According to Energy Perspectives 2050+, meeting the net-zero emissions target by 2050 requires significant medium-term electricity demand increases, complicating target

achievement (electric mobility, (large-scale) heat pumps, hydrogen electrolyzers, long-term negative emission technologies and CO₂ capture and storage systems). The 2035 target (-13%) requires additional efforts. In 2023, absolute electricity consumption decreased 1.7% versus 2022. Over the entire period under review (2000–2023), electricity consumption rose 7.1%. Consumption was driven by volume effects and increasing substitution effects from energy system electrification (replacing fossil heating systems with heat pumps and conventional combustion engines with electric vehicles). These consumption-driving factors outweighed technological developments (structural measures for thermal insulation and the use of more efficient heating systems, electrical appliances, lighting, machines, etc.) and energy policy instruments (e.g. political requirements and the voluntary measures of SwissEnergy) (sources: SFOE, 2024a/FSO, 2024/Federal Gazette, 2023/Prognos/TEP/Infras 2024a+b/Prognos/TEP/Infras/Ecoplan, 2020).

ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY (EXCLUDING HYDROPOWER)

On the production side, the focus will be on using renewable energies for electricity production as nuclear power plant capacity is gradually phased out. In addition to increasing energy efficiency, Energy Strategy 2050 therefore provides for the expansion of new renewable energies while taking ecological requirements into account. The targets stipulated in absolute figures in the applicable legislation (Art. 2 para. 1 Energy Act) refer to domestic production, which corresponds to the sphere of influence of the legal instruments.

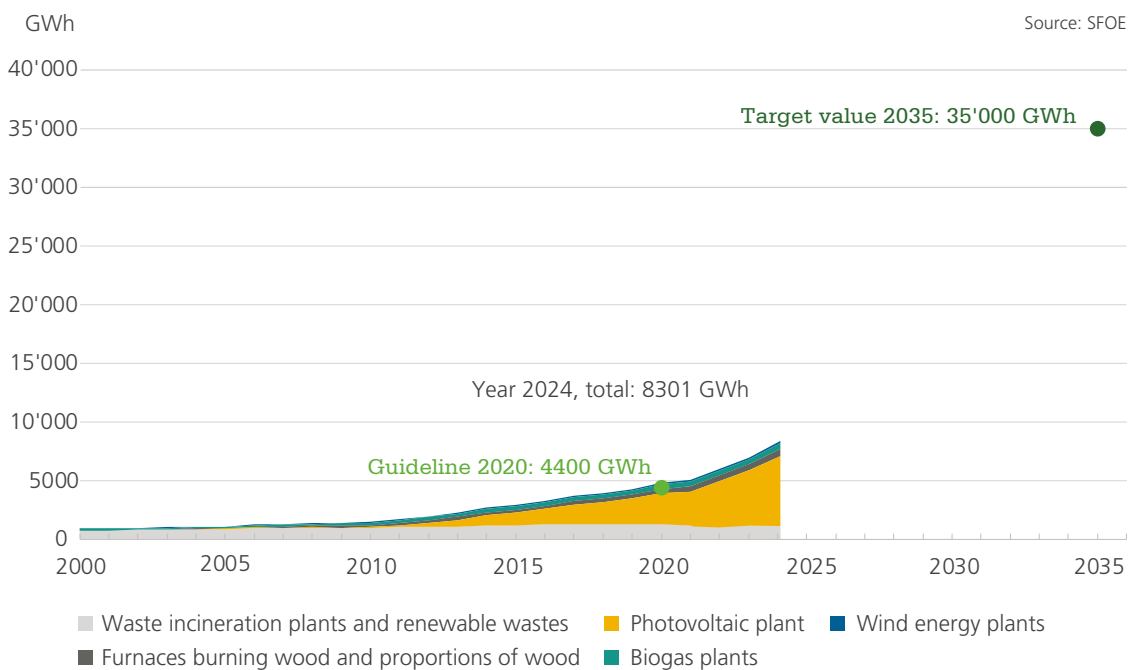


Figure 3: Electricity production from renewable energy (excluding hydropower) since 2000 (in GWh)

Renewable electricity production has increased since 2000, as **Figure 3** shows, accelerating from 2010. In 2024, it reached 8,301 gigawatt hours (GWh), which corresponds to 10.9% of the overall net electricity production (excluding consumption by storage pumps). In reference year 2010, electricity production from renewable energy was 1,402 GWh. In 2024, the net increase versus 2023 was 1,113 GWh; since 2011 it has averaged 492.7 GWh per year. The Federal Act on a Secure Electricity Supply from Renewable Energy Sources sets a 35,000 GWh target for 2035, requiring average annual net increases of 2,427 GWh. Technology breakdown

shows uneven expansion across renewable power generation types. Since 2010, photovoltaics (PV) have shown the strongest absolute growth, now representing about 71.8% of new renewable power generation (excluding hydropower). Other technologies show more modest growth: electricity from waste incineration plants and renewable waste (2024 share: 13.2%), furnaces burning wood and wood fuels (2024 share: 7.5%), biogas (2024 share: 5.4%), and wind energy plants (2024 share: 2.1%). Switzerland currently has no operational geothermal power plants (sources: SFOE, 2025a / Federal Gazette, 2023).

ELECTRICITY PRODUCTION FROM HYDROPOWER PLANTS

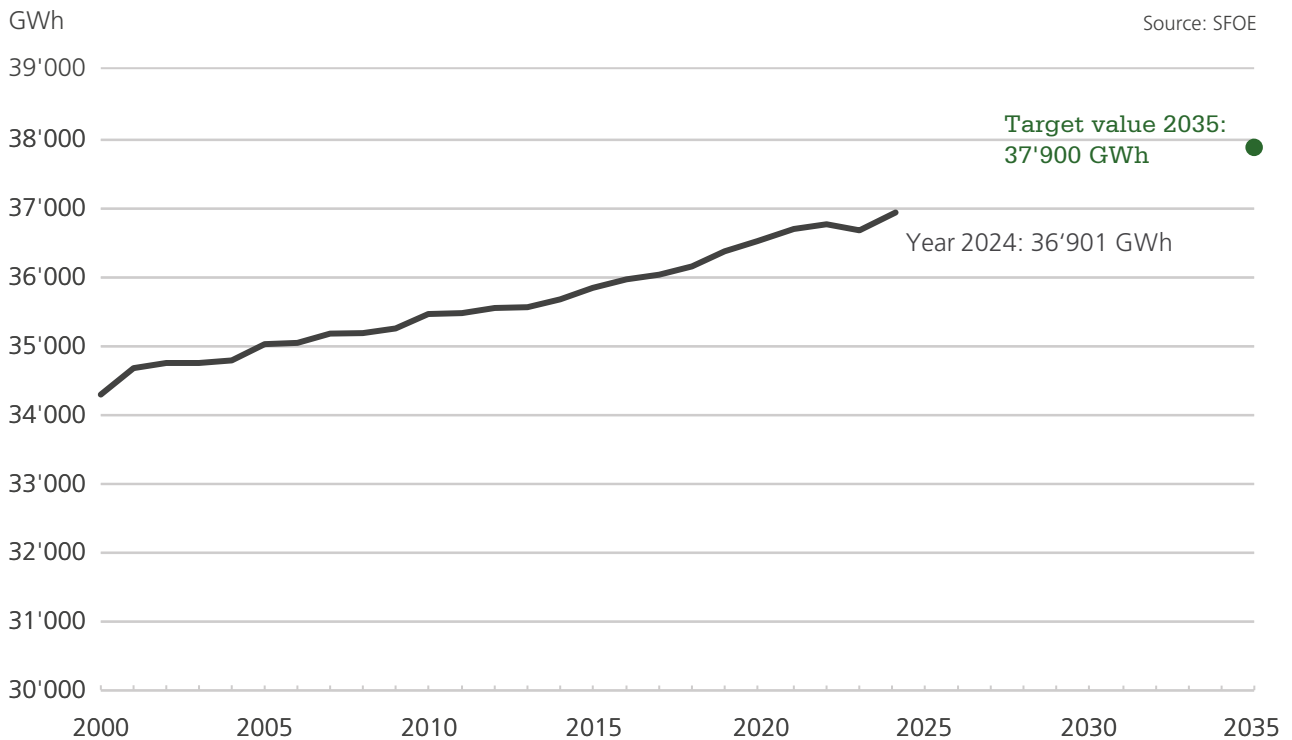
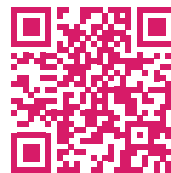


Figure 4: Anticipated average production of electricity from hydropower plants (in GWh) since 2000

Figure 4 demonstrates nearly continuous growth in hydropower plant electricity production since 2000, primarily through new installations and existing facility expansion and optimisation. In 2024 (as at 31 December 2024), the average production expectation was 36,901 GWh. In the base year 2011 (as at 31 December 2011), this figure was 35,488 GWh. To achieve the target set out in the Energy Act, a net increase of around 2,412 GWh will be required. By the year under review, 58.6% of this increase had been achieved. In 2024, anticipated average production rose by 193 GWh from the previous year. This was due in part to various data updates for power plant complexes and the high inflows in the previous year. Since 2012, the anticipated average production has increased by 109 GWh per year on

average. Achieving the 2035 target requires an average annual net increase of 91 GWh (source: SFOE, 2025b+d).

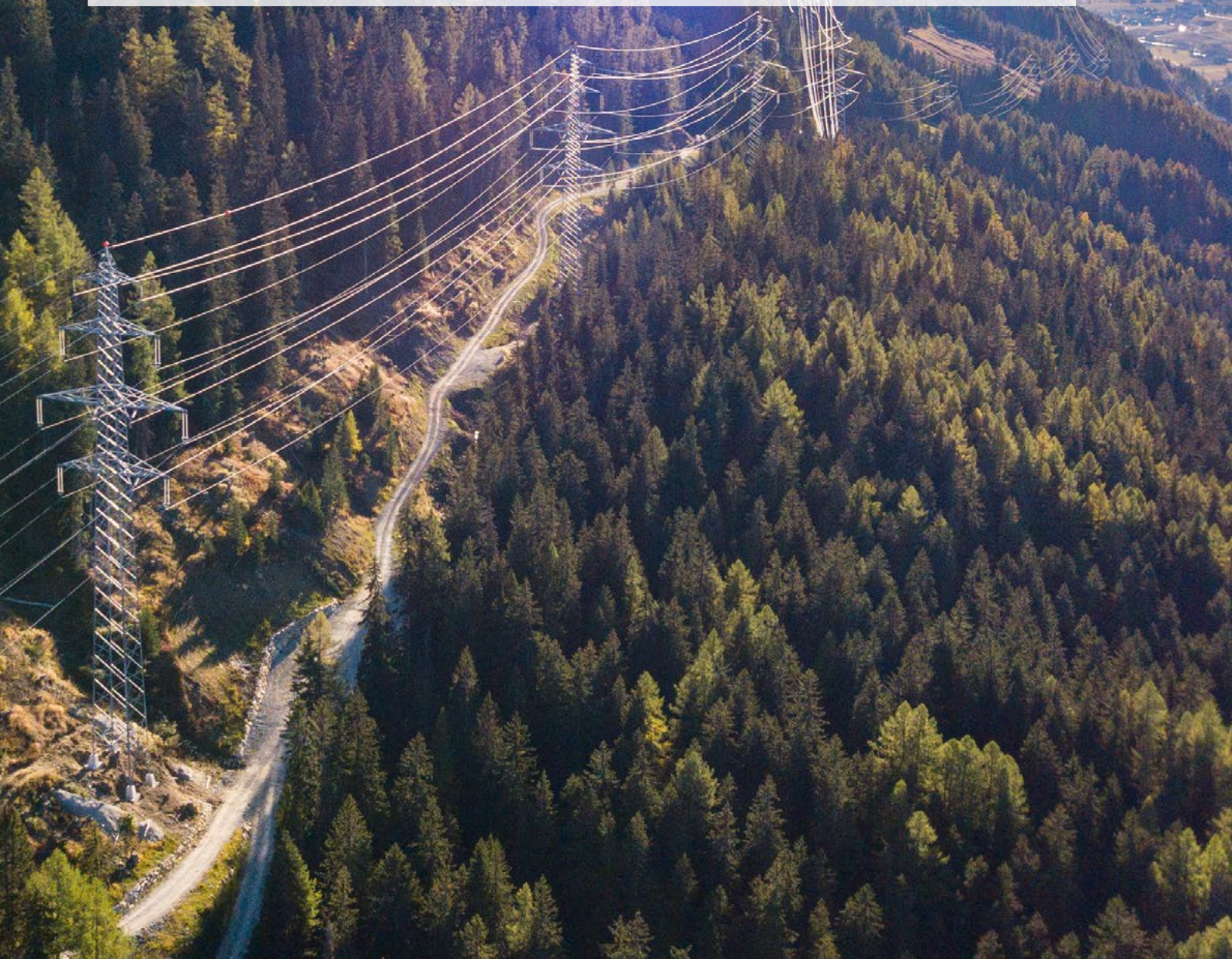
➤ For more detailed indicators regarding **ENERGY CONSUMPTION AND PRODUCTION** see the full monitoring report.



► GRID DEVELOPMENT

Along with digitalisation, the decarbonisation and decentralisation of the electricity supply are transforming the energy and electricity system in Switzerland and Europe. This process is placing new demands on energy networks. Electricity grid development is essential as these networks connect production and consumption; it is also the current focus of monitoring activities. As part of Energy Strategy 2050, the legal basis is provided by the Federal Act on the Conversion and Expansion of the Electricity Grid (Electricity Grid Strategy),⁴ which has been in force since 2019 and is currently being developed in order to further accelerate the procedures for the expansion and conversion of the electricity grids (Federal Gazette, 2025 / Federal Council, 2024d + 2025d).

⁴ See www.netzentwicklung.ch



STATUS AND DURATION OF PLANS FOR THE TRANSMISSION GRID

Monitoring of this indicator focuses on the status and duration of important line projects relating to the electricity transmission grid. These are projects that the national grid company Swissgrid has identified in its strategic grid planning for 2025 and 2040, and are either in a corresponding sectoral plan or planning approval procedure, in the implementation phase or already in operation. Some of these are also additional projects initiated by third parties. Projects that are still at the idea stage – i.e. are not yet in an actual preliminary or construction project and therefore still in a very early planning phase – will only be included once the associated plans have become more concrete.

Process and phases of a transmission network project

PRELIMINARY PROJECT: As the basis for the sectoral planning 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 with the initiation of the project, and enters the next phase when the application is submitted for the project to be incorporated in the Transmission Lines sectoral plan.

TRANSMISSION LINES SECTORAL PLAN: If a transmission line project will have a substantial impact on the area and the environment, a sectoral planning 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 planning 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 planning 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 in the planning approval procedure 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 constructed using the specified transmission technology and that the route lies within the defined

the specification of the planning corridor (at the end of the sectoral plan phase) and ends with submission of the Swissgrid planning approval application to the Swiss 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 (PAP):

Swissgrid now submits the detailed construction project to ESTI, together with the application for planning approval. This signals the start of the PAP. ESTI is responsible for examining the dossier and granting planning approval. In the PAP, 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 individ-

uals (property owners, local population). If ESTI 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 PAP 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 realisation phase starts on the date of the legally binding planning approval decision, and ends when the network project is put into operation.

The table below shows projects which have already reached a relatively concrete stage of planning, or are currently in a procedure and having their progress monitored by the federal government. This monitoring makes it possible to make statements about the duration of the various project phases, from preliminary project to commissioning. This should also enable conclusions to be drawn in the medium and long term regarding the effectiveness of the acceleration measures.

| NETWORK PROJECT | DESCRIPTION AND MAIN AIMS | CURRENT STATUS ⁵ | PLANNED DATE OF OPERATION ⁶ |
|--|---|---|--|
| Chamoson–Chippis | <ul style="list-style-type: none"> ▪ New 30km 380 kV overhead transmission line between Chamoson and Chippis ▪ Dismantling of almost 89km of power lines in Rhône plain ▪ Transfer of production from hydropower plants in Valais ▪ Improved connection between Valais and the Swiss and European extra-high-voltage networks ▪ Contribution towards network security in Switzerland | In operation | Concluded in 2022 and in operation |
| Bickigen–Chippis (Gemmi line) | <ul style="list-style-type: none"> ▪ Modernisation of Bickigen and Chippis substations and the existing 106km route by increasing the voltage 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 security of supply in Switzerland | FAC | 2029 |
| Pradella–La Punt | <ul style="list-style-type: none"> ▪ Increase of the level on the existing 50km 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 | In operation | Concluded in 2022 and in operation |
| Chippis–Lavorgo CL_1 Chippis–Mörel (Rhône Valley line) CL_2 Mörel–Ulrichen (Gommer line) CL_3 Chippis–Stalden CL_4 Airolo–Lavorgo | <ul style="list-style-type: none"> ▪ Increase in voltage to 380 kV on 124km Chippis–Mörel–Lavorgo axis (Chippis–Stalden remains at 220 kV) ▪ Dismantling of existing lines over 67km ▪ Supplements main supply axis for Ticino ▪ Elimination of a critical supply bottleneck | CL_1 SFOE PAP CL_2 Realisation (Mörel–Ernen) / in operation (Ernen–Ulrichen) CL_3 Realisation (Agarn–Stalden) / SFOE PAP (Chippis–Agarn) CL_4 SFOE PAP | 2032 |
| Beznau–Mettlen BM_1 Beznau–Birr BM_2 Birr–Niederwil BM_3 Niederwil–Obfelden BM_4 Mettlen–Obfelden | <ul style="list-style-type: none"> ▪ Optimisation of existing 40km route by increasing voltage to 380 kV and upgrading of 24km stretch ▪ Elimination of structural bottlenecks ▪ Creation of necessary conditions for combining the flexibility of domestic hydropower with fluctuating energy from wind and photovoltaic plants | BM_1 In operation BM_2 Construction project BM_3 Construction project BM_4 ESTI PAP | 2031 |
| Bassecourt–Mühleberg | <ul style="list-style-type: none"> ▪ Upgrading of the existing line over a length of 45km by increasing the voltage level to 380 kV because decommissioning Mühleberg nuclear power plant will lead to withdrawal of some feed-in at the 220 kV grid level ▪ Contribution to Swiss grid security and security of supply | In operation | Concluded in 2023 and in operation |

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2025)

⁵ Status: 15 October 2025

⁶ According to Swissgrid planning

| NETWORK PROJECT | DESCRIPTION AND MAIN AIMS | CURRENT STATUS | PLANNED DATE OF OPERATION |
|--|---|--|------------------------------------|
| Génissiat–Foretaille | <ul style="list-style-type: none"> Upgrading of (replacement of cable) the existing 220 kV twin lines over a length of 17km Eliminates frequent bottlenecks which occur for imports from France | In operation | Concluded in 2018 and in operation |
| Mettlen-Ulrichen MU_1 Mettlen–Innertkirchen MU_2 Innertkirchen–Ulrichen (Grimsel line) | <ul style="list-style-type: none"> Upgrade of the existing 220 kV line to accommodate a future increase of around 88km to 380 kV Important for the connection of new pumped-storage power plants to the 380 kV network and transfer of energy to the rest of Switzerland | MU_1 Sectoral planning procedure MU_2 Preliminary project / Construction project ⁷ | 2040 |
| All'Acqua-Vallemaggia–Magadino | <ul style="list-style-type: none"> 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 | Construction project | 2035 |
| Flumenthal–Froloo | <ul style="list-style-type: none"> Replacement of around 33km of existing 145 kV distribution network lines with a new 220 kV extra-high-voltage power line, as part of the strategic grid New line will improve security of supply in the Greater Basel area and throughout Switzerland The project is intended to relieve the burden on developed areas between Flumenthal and Therwil – the new line is planned as far away from settlements as possible After operation commences, the existing distribution network line will be completely dismantled | Sectoral planning procedure | 2036 |
| Nant de Drance connection NdD_1 Le Verney/Rosel–Bâtiaz NdD_2 Bâtiaz–Châtelard NdD_3 Châtelard–Nant de Drance | <ul style="list-style-type: none"> Connection of Nant de Drance pumped-storage power plant to the extra-high-voltage network Part of the strategic network in the initial Swiss-grid network Contribution towards integration of new renewable energy sources | NdD_1 In operation NdD_2 In operation NdD_3 In operation | Concluded in 2022 and in operation |
| ASR (Axe Stratégique Réseau) in the Geneva area | <ul style="list-style-type: none"> Underground cabling of existing 220 kV line from Foretaille–Verbois over a length of about 4.5km alongside Geneva airport | Realisation | 2025 |
| Bickigen–Mettlen | <ul style="list-style-type: none"> There are plans to replace the existing line with a new 220 kV line; the voltage will not be increased Planning and implementation are being carried out as part of a sectoral planning procedure (Transmission Lines sectoral plan) and also include examining the possibility of relocating the line | Sectoral planning procedure | 2034 |

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2025)

⁷ Project MU_2 Innertkirchen–Ulrichen (Grimsel line) will be treated as a 'preliminary project' by Swissgrid as long as there are several variants (with/without bundling of the Grimselbahn rail project). In the ES2050 monitoring, the project is referred to as a 'construction project' because the sectoral planning procedure corridor decision for the power line has been taken in principle.

| NETWORK PROJECT | DESCRIPTION AND MAIN AIMS | CURRENT STATUS | PLANNED DATE OF OPERATION |
|---|--|---|---------------------------|
| Obfelden–Samstagern OS_1 Schweikrüti (Mast 46)–Kilchberg OS_2 Kilchberg–Wollishofen (Frohalp) OS_3 Wollishofen (Frohalp)–Waldegg OS_4 Obfelden–Waldegg | <ul style="list-style-type: none"> 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 Construction project | 2033 |
| Grynau–Siebnen | <ul style="list-style-type: none"> 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 Zurich region/Linth plain and increase in import capacity from the north | SFOE PAP | 2028 |
| Amsteg–Mettlen AM_1 Lauerz section AM_2 Eyschachen bei Altdorf | <ul style="list-style-type: none"> AM_1: Swissgrid to place the line outside landslide area above Lauerz (SZ) AM_2: Swissgrid and Swiss Federal Railways to install high-voltage lines in the Uri valley floor. 2. This will relieve the burden on the settlement areas in Attinghausen and the Werkmatt developed area in Uri | AM_1 Construction project AM_2 In operation | 2040 |
| Airola–Mettlen | <ul style="list-style-type: none"> Bundling of infrastructure in the second tube of the Gotthard Road Tunnel Cabling of the existing 220 kV line from Airola–Mettlen in the Gotthard sector planned over a length of 18km Important element of the north–south connection for electricity supply in Switzerland and Europe Dismantling of existing overhead line over a 23km stretch with more than 70 masts that currently traverse the Gotthard Pass and run through the Schollenen Gorge in the canton of Uri | Construction project | 2030 |
| Marmorera–Tinzen | <ul style="list-style-type: none"> Extra-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 Swiss Plateau | Construction project | 2032 |
| Lavorgo–Magadino | <ul style="list-style-type: none"> Renovation and capacity increase of the 380 kV line between Lavorgo and Magadino Includes the replacement of the existing line and further measures in the existing and new substations | Sectoral planning procedure | 2033 |

Figure 5: Overview of network projects, status and proposed date of operation (status: 15 October 2025)

Sources: SFOE, Swissgrid

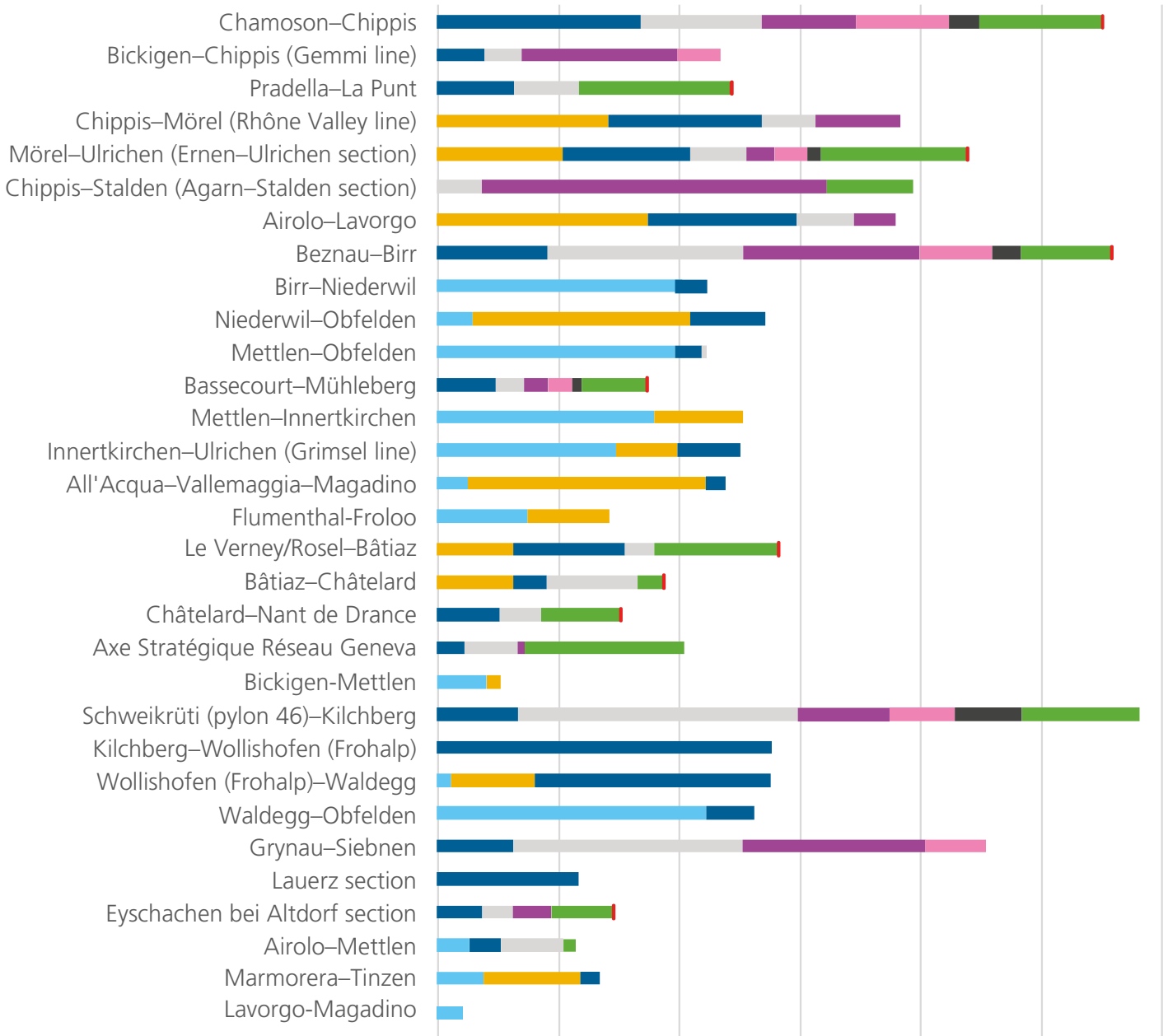


Figure 6: Accumulated duration of project phases of selected network plans in years at network level 1 as at 15 October 2025⁸

Figure 6 shows the duration of the individual project phases for the network projects listed above. 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.

⁸ Notes on methodology: a) for network projects with a longer history, the duration was calculated from the new launch of the project in question; b) for projects with a longer history, the preliminary project and construction project phases can no longer be determined in all cases, which is why they are sometimes missing from the chart; c) assumptions were made in consultation with Swissgrid for individual key dates that are no longer precisely known today; d) if the courts refer a PAP decision to the SFOE, half of the additional duration of the proceedings was allocated to the SFOE PAP phase and half to the construction project phase.

BRIEF DESCRIPTION OF THE PLANNING AND REALISATION STAGES OF EACH NETWORK PROJECT (STATUS: 15 OCTOBER 2024):

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 PAP. Swissgrid then proceeded with the realisation of the new overhead transmission line project. The actual building work got under way in 2018. After four years of construction, Swissgrid put the line into operation at the end of September 2022. In some cases, the dismantling of third-party lines which was ordered in connection with the project is still outstanding, but this has no impact on the Chamoson–Chippis line.

Bickigen–Chippis

The Transmission Lines sectoral planning 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 PAP commenced with an application to ESTI in mid-2015, and almost two years later the dossier was passed on to the SFOE. The SFOE granted planning approval in February 2022. However, various appeals were lodged against this decision with the Federal Administrative Court. The court partially upheld the appeals in mid-December 2023 and referred the planning approval dossier back to the SFOE for reassessment in line with its reasoning. The proceedings required further clarifications to be undertaken with regard to a possible reduction of corona noise (caused by tiny discharges under high-voltage lines) and with regard to non-ionising radiation. The SFOE subsequently granted planning permission in September 2025, but this was contested. Implementation of the project is expected to be delayed by a further two years until 2029 due to the appeal proceedings and the referral to the SFOE.

Pradella–La Punt

As part of the project to increase grid capacity, a second continuous 380 kV circuit will be added to the 50km line between Pradella and La Punt. This will substitute the transfer of energy on the existing 220 kV overhead transmission line between Zernez and Pradella from the Ova Spin power plant. The energy generated at Ova Spin power plant will be transported over a 110 kV valley cable. No sectoral planning procedure was necessary for the Pradella–La Punt project because of the minimal impact on the area. The construction project and PAP phases each lasted about three years. The implementation phase started in mid-2016 and Swissgrid put the line into operation in November 2022.

Chippis–Lavorgo

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

Chippis–Mörel (Rhône Valley line)

The project for construction of the new pipeline underwent a seven-year sectoral planning procedure and was under construction for almost six and a half years. The PAP was initiated by ESTI at the end of March 2019. In June 2021, ESTI passed on the procedure to the SFOE. Within the scope of the PAP, 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. Based on the insights gained from these issues, the SFOE had to request supplementary documents and studies from Swissgrid regarding a potential cabling of the line in the Chippis–Agarn segment (Pfyn forest).

Mörel–Ulrichen

Construction of the new line underwent planning and approval phases lasting several years. The section between Ernen and Ulrichen has been in operation since mid-October 2019. In the Mörel–Ernen section, the cabling study ordered by the Federal Supreme Court for the 'Binnegga–Binnachra–Hockmatta–Hofstatt' area (crossing the Binna) was submitted to the SFOE; the SFOE approved the overhead line version on 23 December 2016 and dismissed all objections. Appeals 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, and the planning approval is now legally binding. Construction of the line is in progress.

Chippis–Stalden

A planning approval procedure for the Agarn–Stalden segment took several years for the SFOE to process, and was concluded and became legally binding in the spring of 2022. This was under former legislation, which allowed procedures to be initiated without a sectoral plan entry. In 2012, it was determined in the sectoral planning 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 Pfyf 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 PAP for the Chippis–Agarn segment is currently in the hands of the SFOE.

Airolo–Lavorgo

The project for the construction of the new line underwent a sectoral planning 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 approval dossier to ESTI, which transferred it to the SFOE in mid-September 2022. The SFOE suspended the ongoing planning approval procedure temporarily because various documents had to be revised. The project was suspended again from mid-March 2024 until mid-January 2025. Swissgrid delivered some of the required documents in December 2024 and January 2025. The SFOE has set a new deadline for supplementing and completing the documents, which has been extended several times. The SFOE will then decide whether the project needs to be put out for public consultation again.

Beznau–Mettlen

Operation of the overall Beznau–Mettlen project is planned for 2033. It comprises several sub-projects, the current status of which is described below:

Beznau–Birr

The line with partial underground cabling of 'Gäbihubel' at Riniken was initiated before the Transmission Lines sectoral plan was developed, and went through planning and approval phases lasting many years. A key milestone was reached in 2016: the SFOE's planning approval became final and the realisation got under way. 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 extra-high-voltage line was placed underground.

Birr–Niederwil

The preliminary project for the section of the line was completed in September 2022. The project is currently in the construction phase; a sectoral planning procedure was not required.

Niederwil–Obfelden

The voltage increase was subject to a preliminary project phase lasting around 18 months and underwent a sectoral planning procedure lasting several years. A significant interim stage was reached in 2016 with the

definition of the planning zone. In late August 2022, the Federal Council defined the planning corridor. ESTI is currently conducting a preliminary examination of the PAP.

Mettlen–Obfelden

This section was in the preliminary project phase for a number of years. This was temporarily suspended to await the Federal Council's decision on the planning corridor and on the transmission technology (see 5.3). In June 2024, the SFOE decided that a Transmission Lines sectoral planning procedure can be dispensed with, as the project to increase the operating voltage from 220 to 380 kV has no significant impact on space and the environment. Swissgrid submitted the dossier for planning approval to ESTI at the end of July 2025.

Bassecourt–Mühleberg

The Bassecourt–Mühleberg extra-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 planning 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 PAP 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 planning approval was granted on 22 August 2019. A number of objectors lodged appeals against this decision with the Federal Administrative Court. In its ruling of September 2020, the latter dismissed the objections it examined. The ruling was referred to the Federal Supreme Court. In its ruling dated 23 March 2021, the court dismissed the objections, and implementation was initiated; the line went into operation with a voltage of 380 kV on 21 November 2023.

Génissiat–Foretaille

Swissgrid has reduced the scope of the project 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.

Mettlen–Ulrichen

Operation of the overall project is currently planned for 2040. It comprises two sub-projects, the current status of which is described below:

Mettlen–Innertkirchen

This section of line 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 planning 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 planning procedure for the complete stretch. The sectoral planning procedure for the complete stretch started in late June 2021. The SFOE announced the planning zone in mid-November 2022. In May 2023, Swissgrid submitted the documents for the second phase of the sectoral planning procedure to the SFOE. This phase, which has been ongoing since then, involves defining the planning corridor.

Innertkirchen–Ulrichen (Grimsel line)

Upgrading of the existing 220 kV line between Innertkirchen and Ulrichen (Grimsel line) is a key element in Network Strategy 2025. Swissgrid applied for a sectoral planning procedure for this line at the beginning of July 2020. The Federal Council determined two potential planning corridors in February 2022: if funding for the Grimselbahn project is secured in time, the line will be bundled with the rail project and mounted in a cable tunnel running parallel to the railway tunnel; alternatively, the line will be laid in a cable tunnel between Innertkirchen and Oberwald. In both cases the line between Oberwald and Ulrichen will be an overhead line.

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 high-voltage and extra-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 planning procedure was initiated in 2015. In 2016, a significant stage in the project was attained when the planning zone was defined. In view of its length, the project was divided into three segments for the implementation of the sectoral planning procedure so that it could be carried out in manageable stages. On 20 December 2024, the Federal Council defined the planning corridor for the entire line project; this enabled Swissgrid to initiate the construction project, which specifies the exact route of the line. Operation of the new 220 kV line is planned for 2035.

Flumenthal–Froloo

The preliminary project for the new 220 kV transmission line between Flumenthal (SO) and Froloo (in the commune of Therwil, BL) was launched in 2018. In early April 2022 Swissgrid submitted an application to the SFOE to start the sectoral planning procedure. Operation is planned for the end of 2036.

(Sources: SFOE / Swissgrid, 2025 / Swissgrid 2015 + 2025b)

➤ Description of other selected projects:

[full version of the monitoring report.](#)



UNDERGROUND CABLING

Source: ElCom

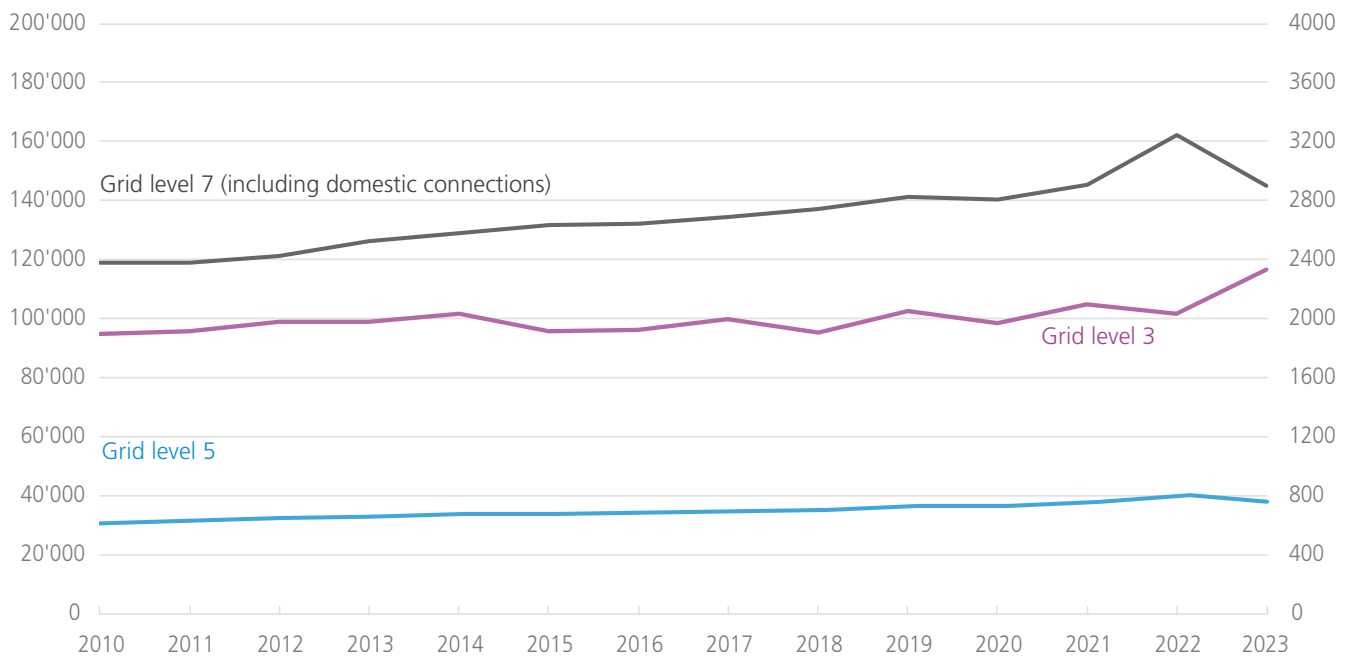


Figure 7: Inventory of underground cabling in the distribution network (in kilometres)

Laying 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 criteria⁹ on a case-by-case basis. As mentioned above, the Federal Council wants to further speed up the conversion and expansion of the electricity grid. To this end, it adopted the dispatch on a revision of the Electricity Act for the attention of Parliament on 21 May 2025. In accordance with the Federal Act on the Conversion and Expansion of the Electricity Grid (Electricity Grid 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. The reasons for the sharp increase in 2022 and subsequent decline in 2023 are unclear.¹⁰ Cabling has also progressed at grid level 5, particularly 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 (see purple curve in the upper graph with differing scale).

⁹ See SFOE transmission lines evaluation model: [Overhead lines versus underground cables \(admin.ch\)](#).

¹⁰ The information on the installations on the Swiss electricity grid is based on self-declarations that grid operators have made to ElCom. Discrepancies between the years may be due to errors in declarations or in measurement units.

The trend towards underground cabling is not so pronounced at this level. In addition, repeated declines in underground cabling were observed (most recently between 2021 and 2022), the reasons for which are not clear. The total length of the three transmission network levels (overhead transmission lines and cables, including domestic connections) is 207,425 kilometres, of which around 90% consists of underground cables. To date, very few lines have been laid underground in the transmission network (grid level 1), which has a total length of 6,700 kilometres. However, in the case of the Beznau–Birr line with partial cabling at Gäbihubel near Bözberg/Riniken, a longer section (around 1.3 kilometres) of a 380 kV extra-high-voltage line was laid in the ground and put into operation. As part of the connection

of Nant de Drance pumped-storage power plant, the Bâtiaz–Le Vernay section was also laid underground. The new 2 x 380 kV cable replaced the existing 220 kV overhead line that crossed the Rhône Valley over a distance of 1.2 kilometres. This section has been in operation since the beginning of April 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 extra-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, 2025a / SFOE / Swissgrid, 2025).

SMART METERS

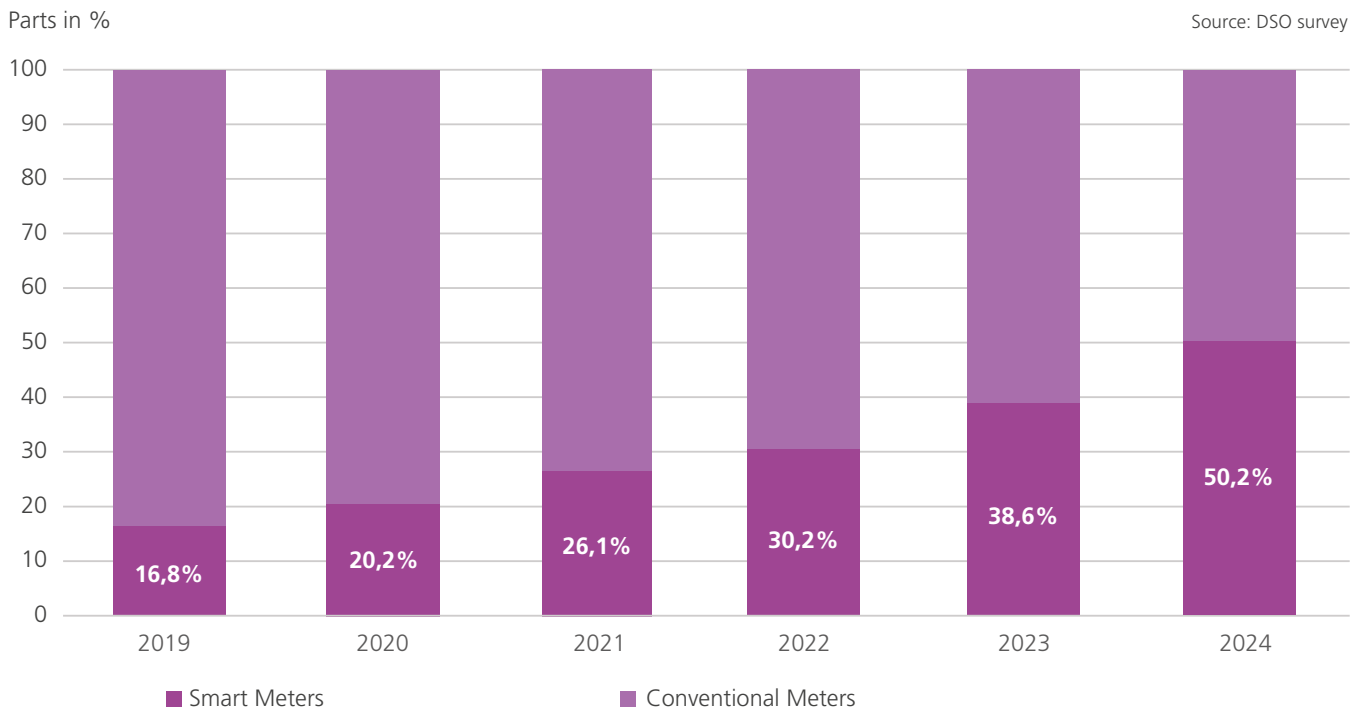


Figure 8: Share of smart meters compared with conventional meters¹¹

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% of all metering systems in a network zone will have to comply with the corresponding requirements; the remaining 20% may remain in use until they no longer function. According to information from distribution network operators, in 2024

there were 2,940,000 smart meters installed and in operation throughout Switzerland. This represents a proportion of over 50%, as shown in **Figure 8**. The proportion has constantly increased during the past few years (source: DSO, 2025).

➤ For more detailed indicators regarding **GRID DEVELOPMENT** see the full monitoring report.



¹¹ Data based on survey of distribution network operators (plausibility check only possible to a limited extent).

A background image showing a wooden frame structure, likely for a building or a large piece of furniture, with vertical and horizontal beams creating a grid pattern. The wood is light-colored and shows natural grain and knots.

▶ SECURITY OF SUPPLY

Diversification of the energy supply plays an important role with regard to security of supply. It reduces dependence on individual energy sources and thus reduces the vulnerability of the overall system in the event of complete or partial interruptions in the supply of an energy source. The monitoring programme therefore tracks developments in the diversification of Switzerland's energy supply. Two sub-indicators are observed. On the consumption side, it is the breakdown of final energy consumption by energy source. On the production side, the electricity sector is examined in more detail with electricity production by type of electricity production. Weather and the economic situation may also drive annual fluctuations.

DIVERSIFICATION OF THE ENERGY SUPPLY

Figure 9 shows that oil products (combustibles and motor fuels, including aviation fuel in international air traffic) accounted for almost 46% of final energy consumption in 2024. Electricity accounted for approximately 27% of overall final energy consumption and gas around 12%. After a decline as a result of the COVID-19 pandemic, the share of petroleum fuels has stabilised and is at roughly the same level as in 2000. Despite slightly cooler weather, the share of oil fuels has fallen (−0.7 percentage points year-on-year), while the share of gas has remained the same. Substitution effects are likely to have played a role here. In the longer term (between 2000 and 2024), the proportion of oil-based combustibles has fallen by 13 percentage points as a result of the replacement of oil-fired heating systems and efficiency increases in buildings. For this reason, the proportions of all other energy sources (except coal) have increased: gas (+ 1.3 percentage points), electricity (+ 4.4 percentage points), wood and charcoal (+ 2.1 percentage points), and other forms of renewable energy (+ 4.2 percentage points) and district heat (+ 1.6 percentage points). Overall, the energy supply is broadly diversified, which contributes towards the high degree of supply security in Switzerland (source: SFOE, 2025a).

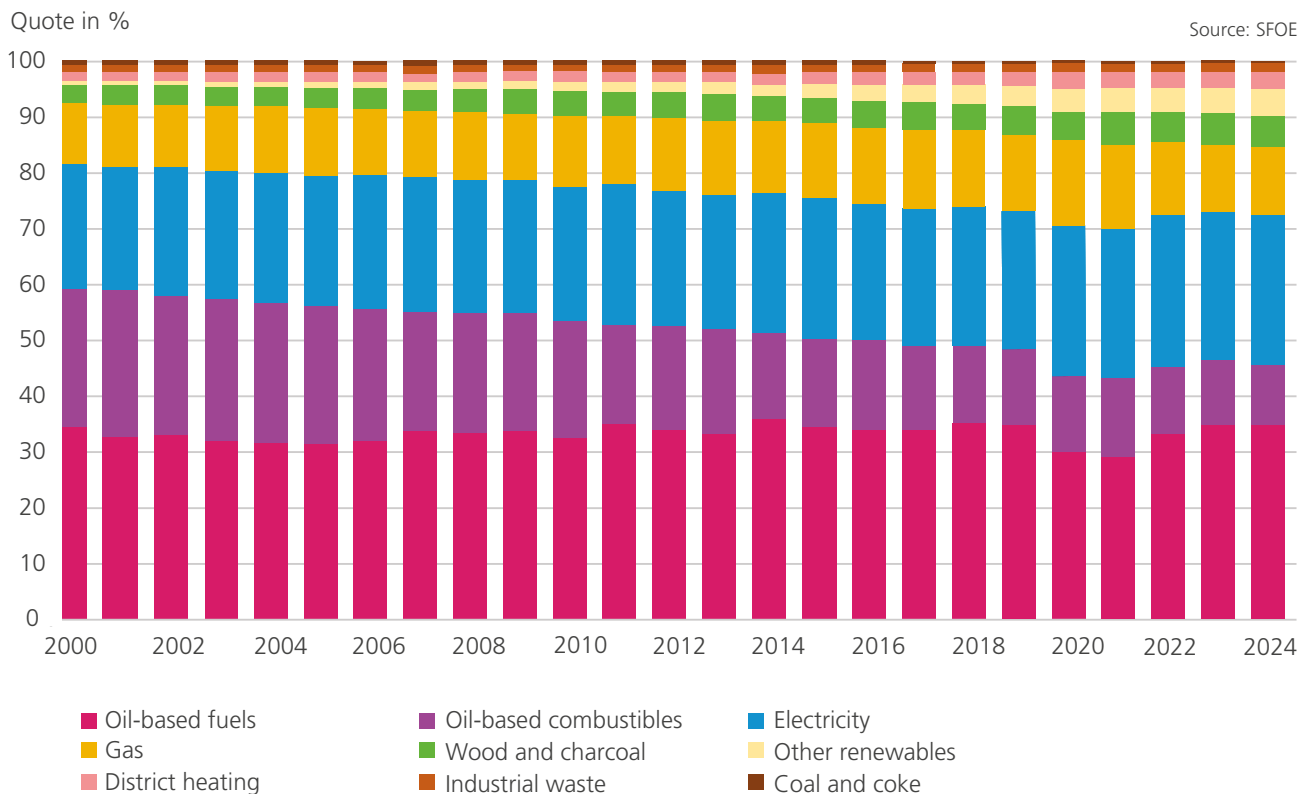


Figure 9: Diversification of the energy supply: proportion of energy sources to final energy consumption

DEPENDENCY ON IMPORTS

Switzerland's energy supply is characterised by a high degree of dependency on imports. This dependency can be reduced by expanding domestic renewable energies and improving energy efficiency. However, Switzerland remains part of the global energy market and is not aiming for energy self-sufficiency. Energy Strategy 2050 nevertheless aims to reduce the current high level of dependency overall. To analyse dependency on imports, monitoring

is based on the MONET indicator system for sustainable development, looking at the development of gross energy imports (import surplus of energy sources and nuclear fuels¹²) and at the same time how much energy is produced domestically. This indicator shows the ratio between domestically produced and imported energy and thus Switzerland's dependency on energy imports.

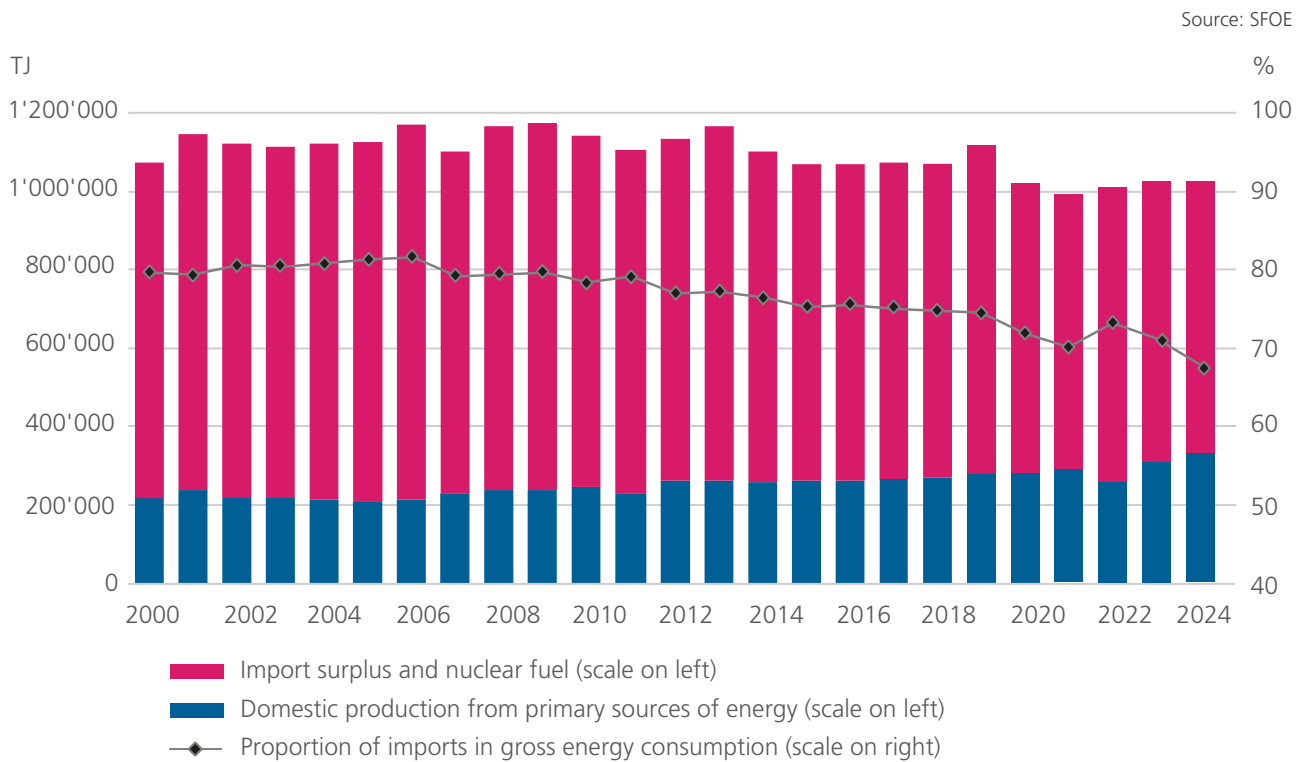


Figure 10: Import surplus and domestic production (in TJ) and proportion of energy imports to gross energy consumption (in %)

Figure 10 indicates that the import surplus showed an upward trend between 2000 and 2006, after which it fell, though with occasional strong fluctuations. At the same time, domestic production has shown an overall increase since 2000. Following the prolonged drought in 2022, which led to a

sharp decline in hydropower production, domestic generation began increasing again in 2023 and in 2024 reached a level not seen since 2000. While hydropower remains the primary domestic energy source, other renewable energy sources continue to show steady growth. Gross imports were mainly

¹² In the case of nuclear fuels, the thermal energy produced – not the electricity produced – is included in accordance with international conventions with an efficiency of 33%.

composed of fossil fuels and nuclear fuels. As indicated by the black curve on the graph, the ratio of imports to gross energy consumption (dependency on imports) increased from 2000 to 2006 and then declined until 2021. Import dependency rose again in 2022, primarily due to reduced domestic production and a sharp increase in aviation fuel imports. It has been falling again since 2023, but nevertheless remains high: the proportion of imports to gross en-

ergy consumption was 67.6% (compared to 71.1% in 2023, 73.6% in 2022 and 81.6% in 2006). This ratio should be interpreted cautiously as several factors influence it. Generally speaking, energy efficiency measures that reduce consumption – particularly of fossil fuel imports – and the expansion of domestic renewable energy production help reduce import dependency and strengthen supply security (sources: SFOE, 2025a / FSO / FOEN / ARE, 2025).

ELECTRICITY SUPPLY SECURITY: SYSTEM ADEQUACY AND WINTER PRODUCTION CAPACITY

The phase-out of nuclear energy under Energy Strategy 2050 and the longer-term decarbonisation of the energy system present major challenges for Switzerland's supply security. The Federal Act on a Secure Electricity Supply from Renewable Energy Sources, which entered into force on 1 January 2025, establishes various measures to improve long-term supply security. These measures include additional funding for expanded winter production (mainly hydropower storage plants), the creation of an energy reserve, and increased use of renewable energy. Against this backdrop, ElCom 2025 has updated its system adequacy analyses and the report on winter production capability, which are among the references used for the monitoring report.

Electricity supply security relies on the interplay between power plant capacity and the electricity grid that enables energy transmission and distribution. The cross-border electrical transmission grid supplements domestic power plant capacity with imports and is equally crucial for supply security. Switzerland's high level of interconnection means it is increasingly affected by conditions in neighbouring countries. As circumstances can change over time due to strategic shifts in other countries (particularly within the EU), regular comprehensive analyses of system adequacy are essential to assess the supply security situation accurately. System adequacy analyses are based on detailed supply situation modelling that reflects strategic approaches to production and consumption, while accounting for international exchange. Like all simulations, the modelling methods used in system adequacy studies have their limitations and require simplified assumptions. The underlying data assumptions about European and Swiss system developments – and their uncertainties, especially long-term – are particularly significant. Therefore, the resulting simulations should be viewed not as predictions but as indicators of developments considered critical from a system-wide perspective.

Study on short-term system adequacy (winter 2022/23): Due to the strained supply situation fol-

lowing Russia's military attack on Ukraine, a system adequacy study was conducted for winter 2022/23, commissioned by the SFOE in cooperation with ElCom and the Federal Office for National Economic Supply (FONES). The study concluded that while Switzerland's electricity supply was not at immediate risk, shortages could not be ruled out in extreme circumstances. This assessment remains broadly applicable to the following winters, provided no new risk factors emerge from current developments.

The study examined and simulated various scenarios with different availabilities of gas and nuclear power plants. Combinations of meteorological conditions and power plant outages were also run through and the probability of bottlenecks calculated. It was possible to fully cover electricity consumption at all times, except in scenarios with gas shortages or a combination of limited gas availability across Europe and the unavailability of Swiss nuclear power plants. In the most likely scenarios, energy consumption can be covered by the measures listed below. A hydropower reserve will secure energy supply at the critical stage towards the end of winter. The provision of a temporary reserve power plant in Birr (canton of Aargau) and other reserve power plants and emergency generators can plug any gaps in power supply independently of the market. The other measures, such as increasing capacities in the transmission grid, the backstop for system-critical power companies, and the temporary reduction in the residual flow in hydropower plants, will further strengthen winter supply. Voluntary efforts by businesses and individuals to use less energy also play an important part (source: SFOE / ElCom / FONES, 2022).

Towards the end of 2022, the SFOE published an SA study with a **timeframe up to 2040**. Based on Energy Perspectives 2050+, which includes the 2050 net-zero climate target, this study assessed medium- and long-term electricity supply security. While it considered factors such as the absence of an electricity agreement, time constraints meant potential gas shortages were not included (see above: *short-term SA study*). The study identified three crit-

ical factors for Switzerland's supply security: hydropower, import capacity and broader European developments. With effective coordination between hydropower and imports, even significant shortages in Switzerland or Europe would remain manageable. Other key findings showed that:

- With the expansion of renewable energy, the European electricity supply system will become increasingly dependent on weather conditions. From a purely physical perspective and based on the assumed scenarios, dependence on weather conditions could lead to a maximum of 250 GWh of unmet electricity demand in Switzerland by 2040. From a market perspective, however, there are no problems for Switzerland as long as it is well integrated into the overall European system.
- Without European cooperation, Switzerland risks supply shortages from 2030 during certain weather patterns if current framework conditions (as of 2019) are not adapted for expansion of renewable energy. This analysis does not account for the impact of either the Federal Act on a Secure Electricity Supply from Renewable Energy Sources or the Federal Act on Urgent Measures for the Short-Term Provision of a Secure Electricity Supply in Winter.
- However, if the expansion of renewable energies is effectively sped up, there will be no supply bottlenecks even without cooperation – except in the case of very strong electrification in specific unfavourable weather conditions.
- If limited exchange capacities (due to lack of cooperation) coincide with major incidents in Switzerland or neighbouring countries (such as power plant outages), this would significantly impact Switzerland. In such situations, any additional domestic energy helps, with the flexibility of Swiss hydropower being particularly crucial, as additional energy can be optimally integrated into the system through pump usage or modified power plant schedules (source: University of Basel/ETH Zurich/Consentec, 2022).

Additionally, the European association ENTSO-E publishes the annual European Resource Adequacy Assessment (ERAA). The 2024 analyses show no significant supply bottlenecks for Switzerland through to 2035, although safety margins will remain low in coming years. As supply security has transnational implications, Switzerland's continued integration into the European system remains vital. The report also concludes that reduced exchange capacities between Switzerland and neighbouring countries negatively impacts both Switzerland and surrounding nations. To prevent such reductions, Swissgrid has established a technical agreement with the Italy North¹³ capacity calculation region and is working toward an agreement with the CORE¹⁴ region. However, these agreements must be renewed annually and therefore offer no long-term security. In addition, talks are currently under way on merging the Italy North and CORE calculation regions. If these talks are successful, negotiations will have to be restarted on a technical agreement between Switzerland and this new zone. The ERAA was published in April 2025 (source: ENTSO-E, 2024).

ElCom updated its analyses of medium- and long-term electricity supply security in 2025. It has commissioned Swissgrid to recalculate an SA study for the years **2028, 2030 and 2035** with adjusted scenarios, while also updating its calculations on **winter production capacity** through 2035 with new projections for nuclear power plant operating lives, electricity demand, and renewable energy expansion.

In the SA study for 2028, 2030 and 2035, stress scenarios were modified from the 2023 analysis to reflect recent experiences related to Russia's attack on Ukraine, the extremely low availability of French nuclear power plants and uncertainty regarding exchange capacities at the borders. The assumptions regarding the availability of domestic electricity production were also adjusted. In particular, the targets for electricity production from renewable energies set out in the Federal Act on a Secure Electricity

¹³ Italy, France, Austria and Slovenia

¹⁴ Austria, Belgium, Croatia, Czech Republic, France, Germany, Hungary, Luxembourg, the Netherlands, Poland, Romania, Slovakia and Slovenia

Supply from Renewable Energy Sources and the operation of Beznau 1 and 2 beyond 2030 were taken into account.

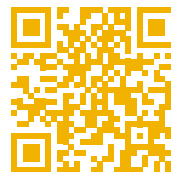
This study shows that the exchange capacities at the borders play an important role in the security of supply. If the EU and Switzerland cooperate in accordance with the technical agreements currently being negotiated, no critical supply problems are expected to arise up to 2035, even in case of a combination of internal (unavailability of half of the Swiss nuclear power plant fleet between January and April) and external (15% reduction in gas availability in Europe and unavailability of half of the French nuclear power plants) stress factors, although the situation would remain tense. Without cooperation with Europe, or with only limited cooperation, security of supply will become problematic. The average energy shortfall (energy not served, ENS) is high, depending on the scenario, and could reach more than 7 TWh in 2035 in the worst-case scenario, in which all stress factors come together. However, these results must be understood in context: Switzerland is often an exporter when such supply problems occur, which shows that it plays a stabilising role in Europe and that the supply problems are not attributable to the Swiss system, but to those of its European neighbours.

For the longer-term outlook to 2030 and 2035, ElCom has updated its winter production analysis. The analysis serves as a basis for determining the need for reserve power plants to ensure security of supply in Switzerland. It focuses on domestic power generation and demand, while excluding foreign developments and import opportunities. The analysis thus provides simplified parameters for Switzerland's longer-term supply resilience, using two indicators. As in ElCom's previous white paper on winter production, one indicator measures Switzerland's winter import requirement. The other counts the number of days Switzerland could maintain self-sufficiency towards winter's end when seasonal storage facilities are largely depleted, assuming temporary import unavailability due to European supply constraints.

ElCom develops scenarios based on various projections from established institutions and policy objectives. The minimum resilience benchmarks assumed are the winter import limit defined by Parliament (5 TWh in the winter half-year) and at least 22 days of self-sufficiency (approximate current value). Both indicators show considerable uncertainty in supply resilience trends: to meet targets (assuming 60-year nuclear power plant operation), continuous output capacity reserves of between 0 and 800 MW would be needed by 2030, and between 0 and 1,900 MW by 2035, depending on the scenario.

Based on these studies, ElCom recommends continuous output capacity reserves of at least 500 megawatts (MW) for 2030, and 700 to 1,400 MW from 2035. Given the high uncertainty, a gradual approach is logical to allow reserve expansion if needed. The Electricity Supply Act regulates this reserve, which comprises the mandatory hydropower reserve, the storage reserve and the demand-side reserve. With the decision of Parliament on 20 June 2025, the supplementary thermal reserve consisting of reserve power plants, emergency backup power generators and combined heat and power plants will also be enshrined in the Electricity Supply Act (sources: ElCom, 2025b + c).

➤ For more detailed indicators regarding **SECURITY OF SUPPLY** see the full monitoring report.





► EXPENDITURE AND PRICES

Economic viability represents another crucial dimension for a sustainable energy supply, alongside safety and environmental compatibility. Article 89 of the Federal Constitution and Article 1 of the Energy Act stipulate that energy supply must be sufficient, diverse, safe, economical and environmentally compatible. Energy Strategy 2050 aims to gradually restructure the Swiss energy system without jeopardising Switzerland's international competitiveness as a business location. The focus in this area is therefore on monitoring final consumer expenditure for energy and on energy prices.

FINAL CONSUMER EXPENDITURE FOR ENERGY

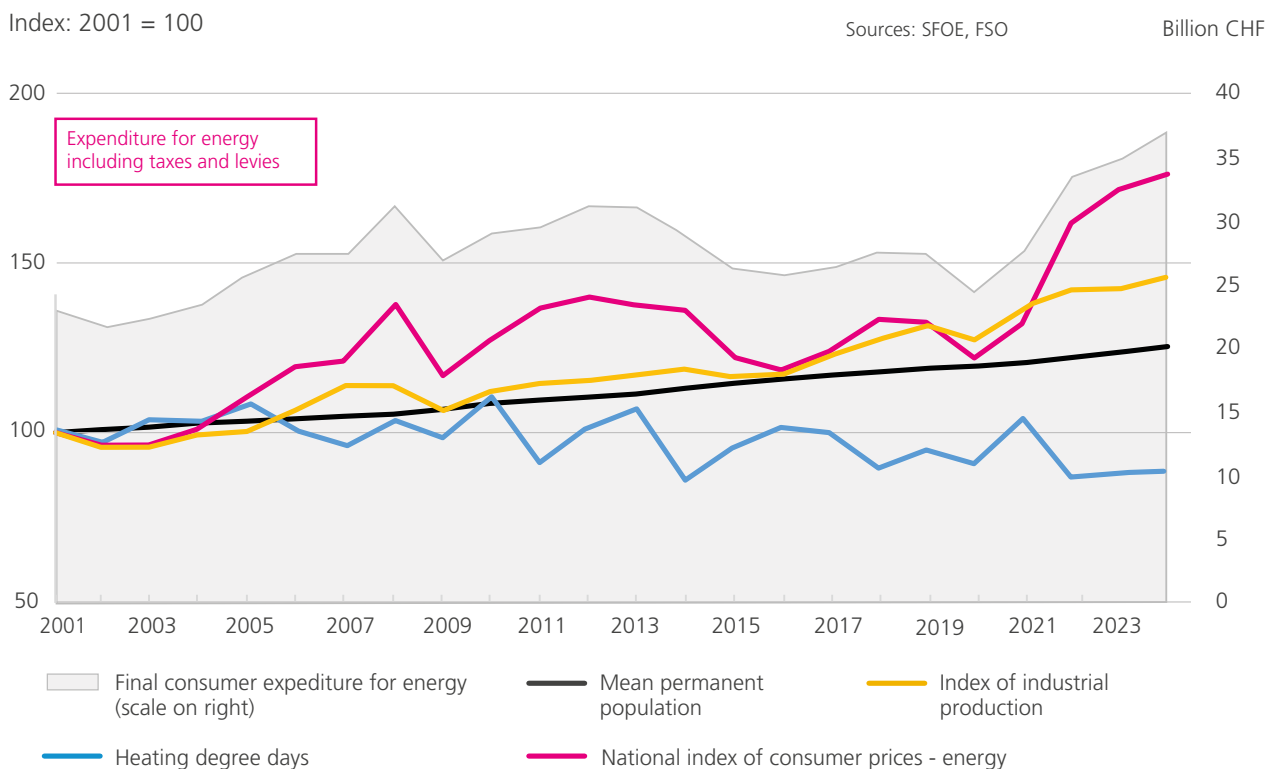


Figure 11: Final consumer expenditure for energy (estimates in million Swiss francs) and significant influencing factors (indexed)

Figure 11 shows the evolution of final consumer expenditure for energy in Switzerland, which reached approximately CHF 36.7 billion in 2024. This figure stood at CHF 24.1 billion in 2020, its lowest point since 2004. Expenditure then rose sharply: by 13% in 2021 (to around CHF 27.3 billion), by 22% in 2022 (to CHF 33.4 billion), by 4% in 2023 (to CHF 34.6 billion) and by 6% in 2024. Rising energy prices drove this increase. For example, the energy sub-index of the national consumer price index has risen by around 34% since 2021. Between 2021 and 2024, expenditure increases were particularly marked for electricity (75%) and gas (26%).

At CHF 17.3 billion, fossil combustibles and fuels (oil-based combustibles, motor fuels, gas, coal)¹⁵ ac-

counted for just less than half of total expenditure for energy in 2024 – the lowest proportion since 1980. Electricity costs amounted to CHF 18.4 billion, with wood and district heat accounting for the remaining CHF 1.1 billion.¹⁶ Between 2001 and 2020, energy expenditure increased by an average of 0.3% annually. Expenditure rose sharply from 2021 to 2024 – with a particularly notable spike during the crisis year of 2022 – resulting in 52% or CHF 12.6 billion more being spent on energy last year than in 2020. As a result, the annual growth rate of energy expenditure from 2001 to 2024 is 2%. The increase in industrial production (1.6% annually) and the population (0.9% annually) contributed to this. The parallel movement between final consumer expenditure and the energy price index is notable.

¹⁵ In 2024, 4.8% of consumed petrol and diesel were of biogenic origin, i.e. they are not oil products (Overall Swiss energy statistics 2024, p. 1). The share of domestic biogas fed into the grid accounted for 1.7% of gas imports in 2024 (Overall Swiss energy statistics 2024, Table 23).

¹⁶ In addition to expenditure for energy and transport, all taxes and levies are included in energy expenditure (CO₂ levy, oil tax, value added tax, etc.).

This occurs partly because energy prices have limited short-term impact on consumer behaviour, which is more influenced by relatively stable factors such as vehicle and housing numbers – an example of low short-term price elasticity of demand. The COVID-19 pandemic led to reduced energy consumption in 2020, particularly of motor fuel, resulting in exceptionally low energy expenditure when combined with low prices. In 2021, consumption and expenditure rose again and the years 2022 to 2024 were characterised by rising prices and the resulting high-

er expenditure. Gas and electricity consumption fell in 2022 and 2023, mainly due to the mild weather (low number of heating degree days), but rose again slightly for both energy sources in 2024, although heating degree days remained low or only slightly higher than in 2023. Fuel consumption has been rising steadily since the sharp drop in 2020, but has not yet returned to 2019 levels. Energy efficiency improvements can reduce both consumption and final consumer expenditure (sources: SFOE, 2025a / FSO, 2025).

ENERGY PRICES FOR INDUSTRIAL SECTORS: INTERNATIONAL COMPARISON

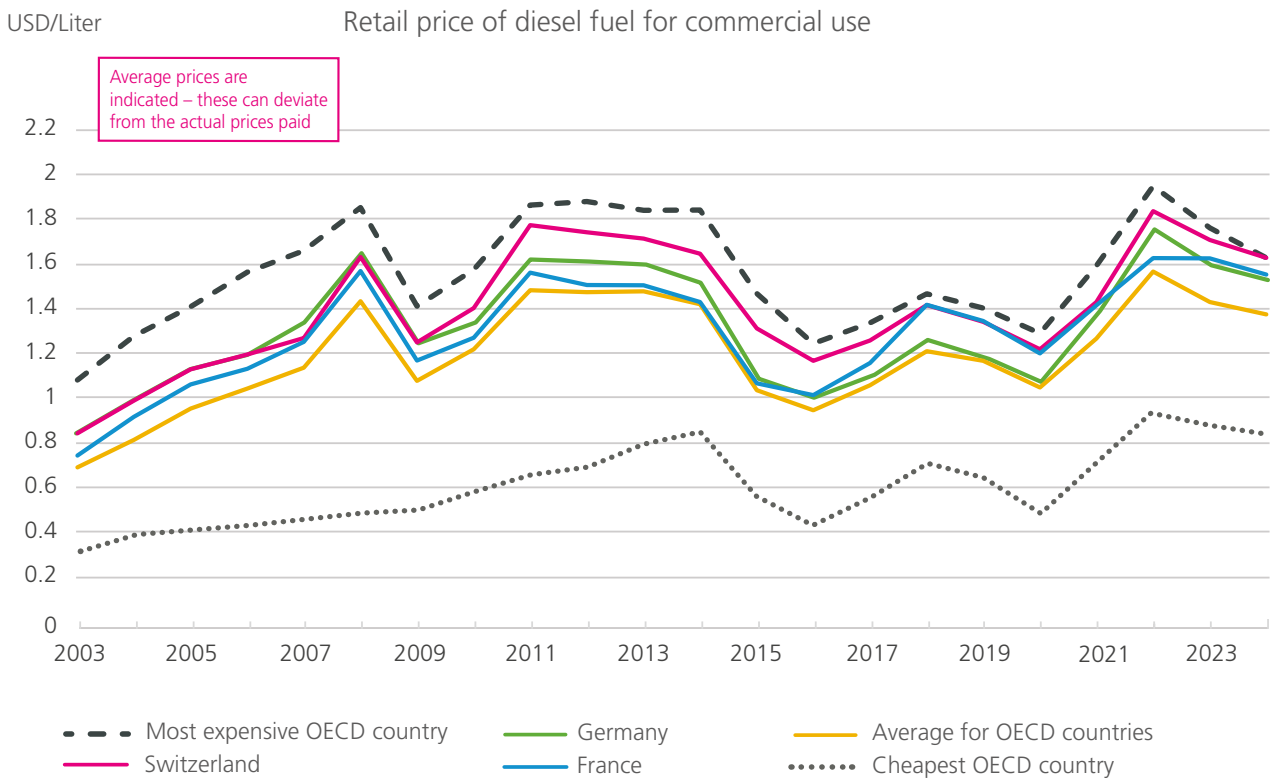
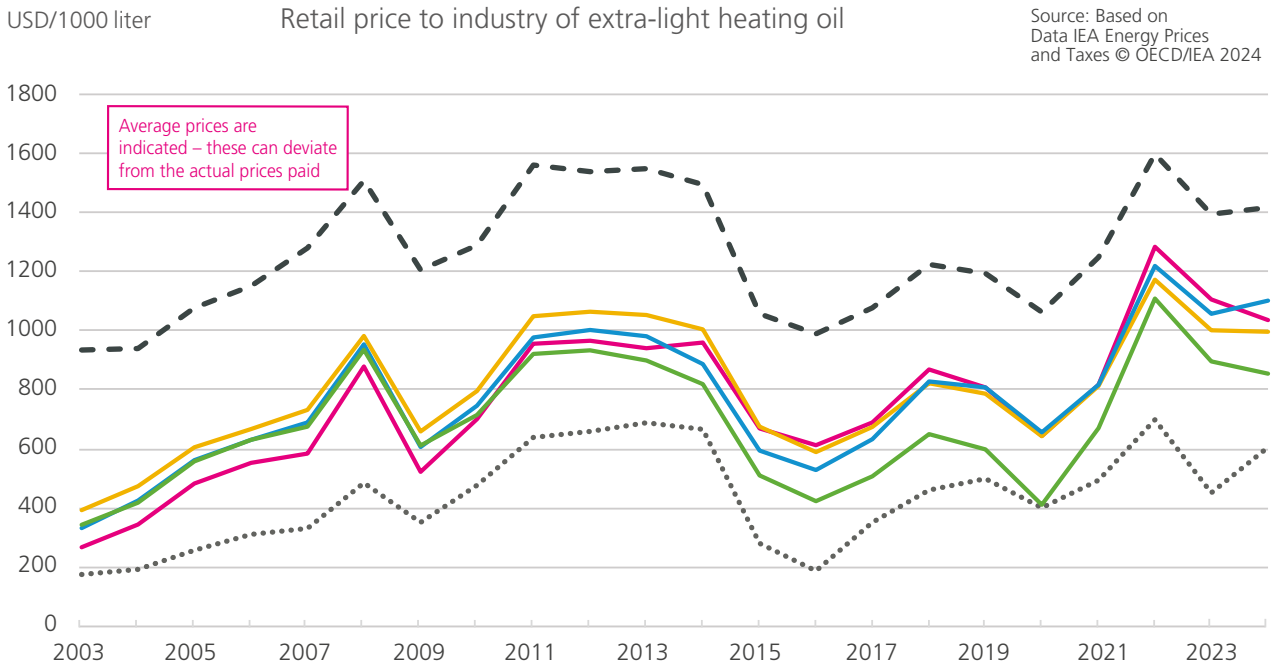


Figure 12: Average nominal final consumer prices for heating oil and diesel (including taxes) for industry, in USD (based on market exchange rates)

Oil and its refined products, such as heating oil and diesel, are traded globally, which explains the similar price trends across most countries shown in the graph (*Figure 12*). Swiss **heating oil** prices remained above the OECD average in 2024. Prices fell worldwide in 2023 and 2024 compared to the peak¹⁷ in 2022. The fall in prices was similar in Switzerland and Germany, while prices in France were slightly higher than those in Switzerland in 2024. However, longer-term analysis shows slightly steeper price increases in Switzerland compared to other countries. This may partly reflect the gradual increase in the CO₂ levy since its 2008 introduction, from CHF 12 to CHF 120¹⁸ per tonne of CO₂. These increases were implemented because interim emissions reduction targets for fossil

fuels set by the Federal Council every two years were not met. Nevertheless, heating oil prices in Switzerland in 2024 will only be slightly higher than the average for OECD countries. The price level for **diesel** in Switzerland was also slightly higher than in France and Germany in 2024, and was once again the highest among OECD countries; in previous years, diesel had been more expensive in Finland. Prices for this oil product fell last year in all the countries analysed and on average in the OECD countries. In France, the 2022 diesel tax relief expired last year, and since then prices have been roughly the same as in Germany (*blue curve in Figure 12*). The report does not track international petrol price comparisons as petrol is less relevant for industry (source: OECD/IEA, 2025a).

¹⁷ Note that these prices are not inflation-adjusted.

¹⁸ This rate has applied since 2022.

ENERGY PRICES FOR INDUSTRIAL SECTORS: INTERNATIONAL COMPARISON

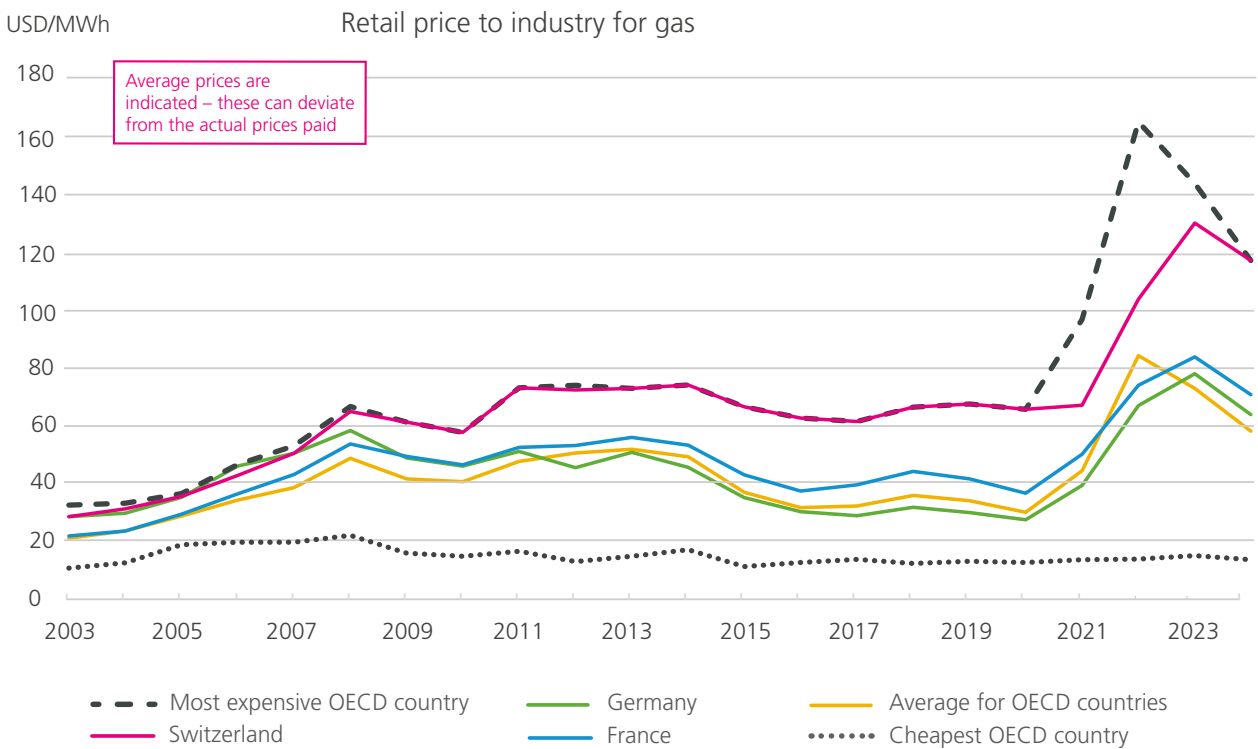
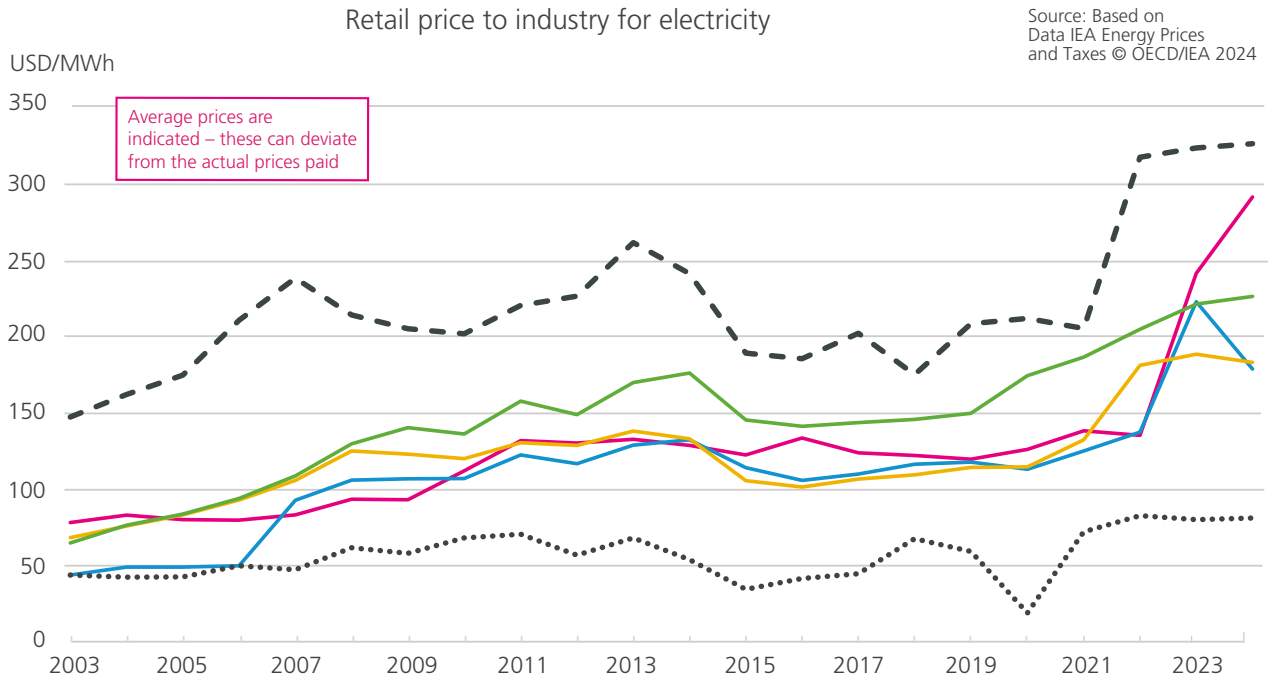


Figure 13: Average nominal final consumer prices of electricity¹⁹ and gas (including taxes) for industry, in USD (based on market exchange rates in each case)

¹⁹ For Switzerland, the chart shows final consumer prices for the 10–20 GWh consumption category.

Many factors influence the **electricity price** for industrial customers, including the technologies used for production, the amount of electricity demanded and its flexibility in terms of time, and the market structure. All of these factors are shaped by energy policy and influence European wholesale electricity market prices, which in turn significantly affects Swiss wholesale prices. End customers pay for grid usage and taxes as well as for the energy itself. Swiss electricity prices remained relatively stable compared to the OECD average until 2020 (*Figure 13*). In 2021 and particularly 2022, OECD countries, including Germany, experienced higher price increases than Switzerland. For data collection reasons, the sharp price increases on the European markets are not reflected in Swiss prices until 2023.²⁰ They rose again in Switzerland in 2024, while falling in some comparable countries (France, OECD). Prices were thus significantly higher than in Germany and France and also above the OECD average. There are various reasons for this development. In 2023, higher prices could largely be traced back to the increased market prices for electricity on the European wholesale markets in 2022 and 2023. As a result, tariffs for industrial customers in the basic supply also rose in 2024. However, many industrial customers operate in the free market rather than basic supply, similar to their European competitors. Due to the staggered procurement of most companies over the years, the increased price level on the wholesale market is also reflected over time in the final consumer prices paid by these companies and shown in the graph. For this reason, the actual price paid for electricity can also vary greatly around the average price shown, with exposure to price fluctuations depending on procurement strategy. The recent slight fall in wholesale prices will therefore be reflected in the coming reporting years. The figures do not take into account the fact that electricity-intensive companies

can receive a full or partial refund of the grid surcharge (2.3 centimes/kWh) paid to promote electricity from renewable energies.²¹ The increase in industrial electricity prices is also likely due in part to the surcharge to finance the electricity reserve (hydropower, reserve power plants), which was levied for the first time in 2024 and amounted to 1.2 centimes/kWh, and the increase in grid utilisation tariffs in 2024. The differences in level between countries should be interpreted with caution, however. This is partly because electricity-intensive businesses may be exempt from certain levies included in the price.

Swiss **gas** prices exceed those in Germany and France, sitting around the OECD average. Switzerland was the OECD's most expensive country from 2010–2020, with the exception of 2012. Sweden overtook this position in 2021, partly due to its rising CO₂ levy (EUR 120/tonne in 2024²²). In 2024, Switzerland was once again the most expensive OECD country, although the industrial price of natural gas in Sweden was not yet available in the IEA database when this report was completed. Switzerland, France and Germany saw significant price increases in 2022 and 2023, while prices fell slightly in 2024. The price increases were mainly due to higher European wholesale prices following Russia's military attack on Ukraine. The fact that Europe must import more liquefied natural gas (LNG) means that Europe and Asia are competing for LNG supplies. As a result, European gas prices are now more closely aligned with gas prices in Asia, which in the past were generally higher than those in Europe. The price gap with other OECD countries is substantial, particularly compared to Canada, the lowest-priced OECD country in 2024. This difference reflects several factors: Wholesale prices for natural gas in North America are significantly lower than in Asia or Europe due to high domestic production. In order

²⁰ Given that the Federal Statistical Office has collected the producer and import price index for electricity quarterly rather than annually since 2023, the price increases in 2022 and 2023 are reflected cumulatively in the figures for 2023. This means it is not apparent that the actual increase in electricity prices for end customers was spread over both years.

²¹ In accordance with Article 39 EnA, end consumers whose electricity costs account for at least 5% but less than 10% of gross value added will, upon request, receive a partial refund of the grid surcharge they have paid; for those whose electricity costs comprise 10% or more of gross value added, they will be reimbursed in full. In 2022 (the last year for which figures are available), refunds were made to 254 end consumers, 149 of whom received a full refund.

²² [CO₂ Tax | Climate Policy Database](#).

for natural gas to be brought to Europe from North America, southern Africa or the Arabian Peninsula, it must be liquefied and transported by LNG ships. Liquefying natural gas is particularly energy-intensive and therefore also expensive. As mentioned above, Switzerland increased the CO₂ levy on combustibles, which is reflected in the figures. Some companies²³ can receive exemptions if they make emissions reduction commitments, but this is not shown in the current figures. In fact, such companies pay the end-user price but can apply for a refund of the levy. The CO₂ 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 grid costs (due to low connection density 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 freely choose their gas supplier. On 19 September 2025, the Federal Council submitted the revised draft of the Gas

Supply Act for further consultation after the original draft from autumn 2024 had undergone extensive changes following the consultation. Among other things, the law provides for free market access for all end consumers, regulates the obligation to store gas for the winter and closes institutional gaps by providing for a market area manager to coordinate the transport network and creating a regulatory authority. The Lucerne area has had a fully open gas market since June 2020 following a Competition Commission decision (sources: OECD/IEA, 2025a / Federal Council, 2025f / COMCO, 2020).

➤ For more detailed indicators regarding **EXPENDITURE AND PRICES** see the full monitoring report.



²³ Until 2024, the year which forms the basis for the figures, this included companies in certain sectors that have a high tax burden in relation to their value added and whose international competitiveness would be greatly undermined as a result; see CO₂ Ordinance, Annex 7 (activities that qualify for exemption from levy with reduction obligations). These companies can apply to have the CO₂ levy refunded. Large CO₂-intensive companies participate in the emissions trading system and are (also) exempt from the CO₂ levy.



CO₂ EMISSIONS

Energy and climate policy are closely linked, as around three quarters of Switzerland's greenhouse gas emissions stem from fossil fuel use. Energy Strategy 2050 helps reduce fossil energy consumption and thus energy-related greenhouse gas emissions. This supports climate policy targets set out in the Federal Act on the Reduction of CO₂ Emissions (CO₂ Act) and the Federal Act on Climate Protection Goals, Innovation and Strengthening Energy Security (CIA) (Federal Council, 2019b + 2021 + 2022 / Federal Gazette, 2022 + 2024). Carbon dioxide (CO₂) is the most significant greenhouse gas by volume, primarily produced by burning fossil combustibles and fuels (heating oil, gas, petrol, diesel). The annual monitoring process tracks CO₂ emissions per person, both overall and by sector, as well as in relation to other variables. The main source for indicators is Switzerland's greenhouse gas inventory, compiled annually by the Federal Office for the Environment (FOEN) according to UN Framework Convention on Climate Change requirements. The greenhouse gas inventory is updated each spring with data from the year before last. The figures in the following charts thus cover the period up to and including 2023.

PER CAPITA ENERGY-RELATED CO₂ EMISSIONS

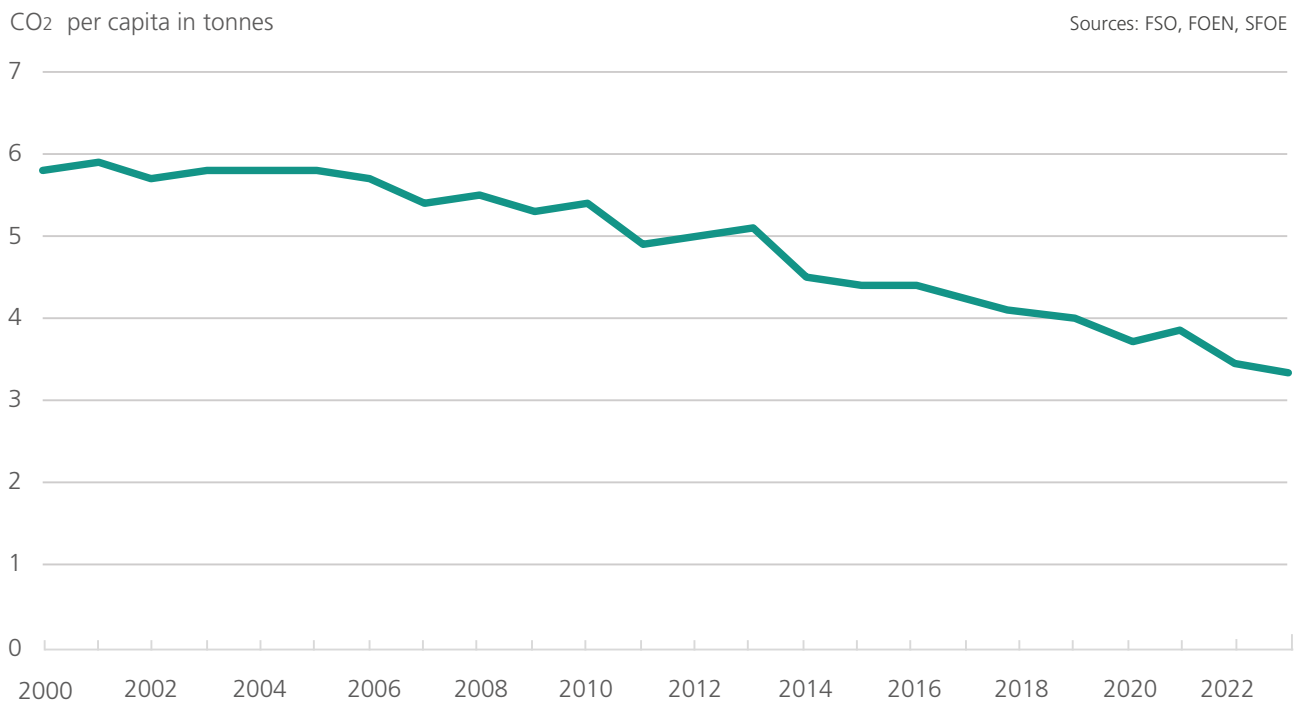


Figure 14: Energy-related CO₂ emissions per person per year (in tonnes of CO₂ per person)²⁴

Energy Perspectives 2050+ outlines how Switzerland can restructure its energy supply by 2050 to meet the Federal Council's net-zero target (Prognos/TEP/Infras/Ecoplan, 2020). Energy-related CO₂ emissions must align with this target. In a net-zero world, where all avoidable emissions must be eliminated by 2050, Energy Perspectives 2050+ indicates around 0.4 tonnes of energy-related CO₂ will still be emitted per person.

Energy-related CO₂ emissions per person in Switzerland have steadily decreased since 2000, as shown in **Figure 14**. While CO₂ emissions from energy sources have fallen slightly since 2000 (see *Figure 15 below*), the country's population has grown continuously during this period. This suggests increasing separation between population growth and en-

ergy-related CO₂ emissions. In 2023, domestic per capita emissions were around 3.4 tonnes, almost 41% lower than in 2000 (5.8 tonnes).²⁵ This is relatively low by international standards, reflecting Switzerland's largely CO₂-free electricity production and significant service sector contribution to added value. However, achieving the net-zero climate target by 2050 requires faster reduction of energy-related CO₂ emissions per person than previously achieved (sources: FOEN, 2025 / FSO, 2025 / SFOE, 2025a).

²⁴ Differentiation according to the CO₂ Act (excluding international aviation, including statistical difference). Not weather-adjusted.

²⁵ For comparison: Total domestic greenhouse gas emissions per capita were approximately 4.6 tonnes in 2023, representing a reduction of almost 39% from 2000 levels (7.6 tonnes). Thus, in terms of percentage, energy-related CO₂ emissions per person have fallen to a slightly higher extent than overall greenhouse gas emissions.

ENERGY-RELATED CO₂ EMISSIONS OVERALL AND BY SECTOR

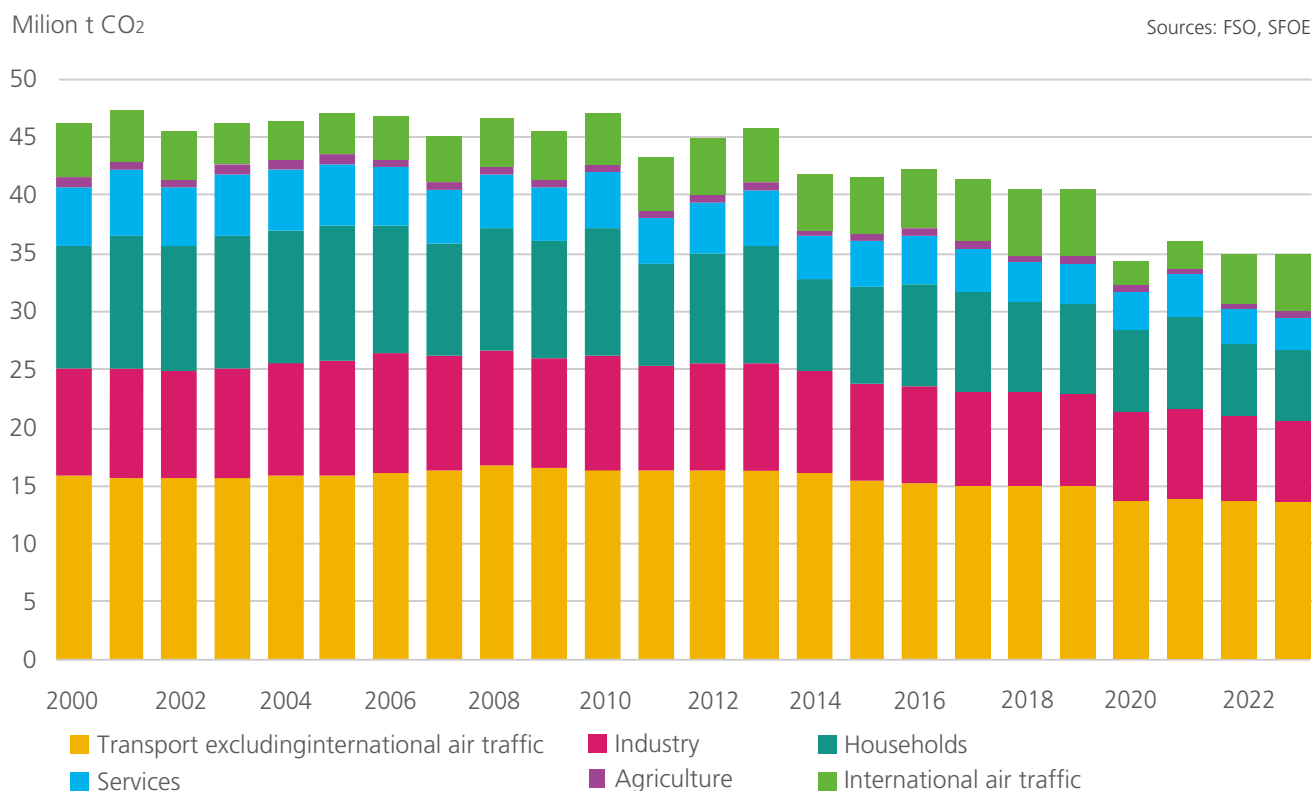


Figure 15: Total energy-related CO₂ emissions and by sector (in million tonnes of CO₂)

Total energy-related CO₂ emissions (see Figure 15; including international aviation) reached 35.1 million tonnes of CO₂ in 2023, a reduction of almost 24% compared with 2000 levels.

- **Transport:** The transport sector represents the largest share (39% in 2023, excluding international air traffic), with motorised road vehicles accounting for most of these emissions.²⁶ Between 2000 and 2023, CO₂ emissions in the transport sector fell by almost 2 million tonnes. After a decrease at the beginning of the millennium, emissions from international air traffic have been constantly increasing since 2005 and in 2019 reached 5.7 million tonnes of CO₂. Owing to the COVID-19 pandemic, these emissions declined sharply in 2020, and were still below previous levels in 2022 at 4.2 million tonnes and in 2023 at 5 million tonnes of CO₂ (share of 14%).²⁷

- **Industry:** In industry (2023 share: 20%), energy-related CO₂ emissions arise primarily from goods production and, to a lesser extent, from building heating. A modest decline since 2000 demonstrates the effectiveness of implemented measures, improved energy efficiency, and the separation of CO₂ output from industrial production. Variations over time mainly reflect economic conditions and climate patterns.

- **Households:** In the households sector (2023 share: 17%), emissions largely stem from heating and hot water production. Emissions have decreased since 2000, despite increased heating space requirements. This indicates improved efficiency and adoption of lower-CO₂ technologies. With numerous fossil-based heating systems still in use, annu-

²⁶ In certain publications, the SFOE shows the proportion of transport to total greenhouse gas emissions, which is currently around one third (33%).

²⁷ International air traffic is not included in national balances, so no results flow into the evaluation of climate policy targets. If air traffic were included, its proportion of overall energy-related CO₂ emissions would be 12%. Within the transport sector, the share of flight-related emissions would be 37.6%.

al emissions remain heavily dependent on weather conditions, with higher emissions during colder winters and lower emissions during milder ones.

- **Services:** Similar patterns apply to the services sector (2023 share: 8%). Here, too, CO₂ emissions from energy sources have shown a slight decline since 2000, though levels fluctuate with weather conditions.
- **Agriculture:** In agriculture, energy-related CO₂ emissions have decreased slightly since 2000, with the sector's overall share of CO₂ emissions remaining very low (2023: 2%). For agriculture, energy-related CO₂ emissions are less significant than methane and nitrogen dioxide emissions.

Overall, sectoral shares of energy-related CO₂ emissions have changed minimally since 2000. The contribution of the transport sector (excluding international aviation) has increased (from 34% to 39%), while the contribution of households has fallen (from 23% to 17%) (sources: FOEN, 2025 / SFOE, 2025a).

➤ For more detailed indicators regarding [CO₂-EMISSIONS](#) see the full monitoring report.



► RESEARCH AND TECHNOLOGY

To achieve the long-term objectives of Energy Strategy 2050, technological advances are essential. Switzerland is allocating resources to energy research to provide targeted support. Since progress in research and technology cannot typically be measured directly through indicators, the annual monitoring process uses public expenditure on energy research as a measure of ongoing efforts. The report also references current research activities and programmes.

PUBLIC EXPENDITURE FOR ENERGY RESEARCH

The SFOE has been collecting data on public expenditure on energy research since 1977. The survey is based on projects that are funded in whole or in part by the public sector (federal government and cantons), the Swiss National Science Foundation (SNSF), the Swiss Innovation Agency (Innosuisse) or the European Commission. The following figure shows the development of total public expenditure

on energy research since 1990, broken down into the four research areas that form the main structure of Swiss energy research statistics. Recipients of these funds include the ETH Domain, universities and universities of applied sciences, research facilities of national importance, non-commercial research centres outside the university sector and the private sector.

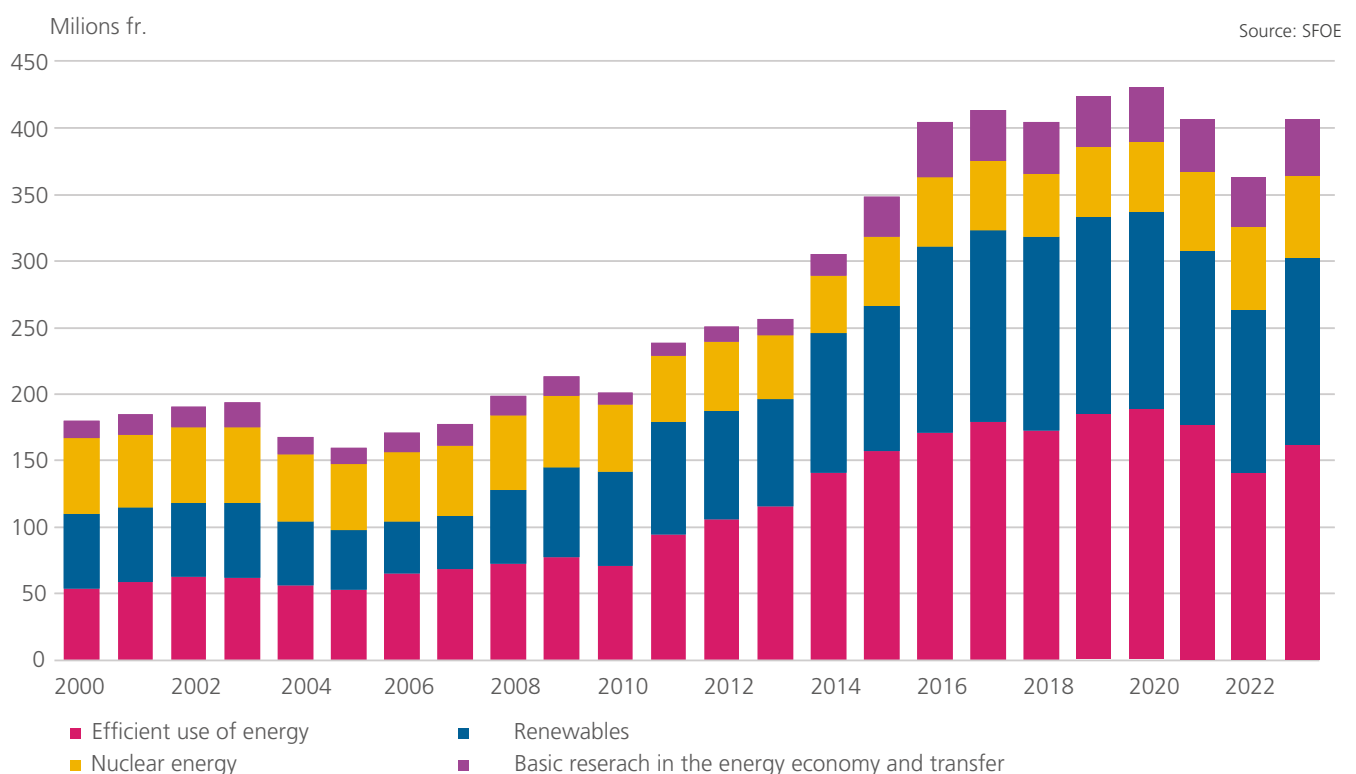


Figure 16: Public expenditure for energy research by field of research (in CHF million, real figures)²⁸

As shown in **Figure 16**, public funding for energy research increased steadily between 2005 and 2020. A marked increase in expenditure has occurred since 2014 under Energy Strategy 2050 and the Coordinated Energy Research in Switzerland action plan. Key contributors include the development and establishment of Swiss Competence Centres for Energy Research (SCCERs) by Innosuisse, the National Research Programmes in the energy sector (NRP 70 and NRP 71²⁹) by the Swiss National Science Foundation (SNSF), and the expanded pilot, demonstration

and flagship projects by the SFOE. In 2023, public sector expenditure reached CHF 406 million in real terms (2022: CHF 365 million). The 2022 reduction reflects the conclusion of the SCCER energy funding programme in late 2020. The 2021 level was reached again in 2023. There are various reasons for this, such as fluctuations in participation in the EU framework programmes; calls for proposals for the Innosuisse Flagship initiative, which also included energy-related topics in 2021 and 2023; and the increase in funds paid out under the SWEET funding programme.

²⁸ Expenditure includes a share in overheads (indirect research costs) of the research institutions.

²⁹ Programmes | National Research Programme Energy

In line with Energy Strategy 2050 priorities, the largest funding allocations are directed towards **energy efficiency** (2023 share: 39.9%) and **renewable energy** (2023 share: 34.3%). Expenditure on **nuclear energy research** (nuclear fusion and nuclear fission) has remained constant since 2004, while its proportion of total spending fell slightly from the previous year to 15.4% in 2023 (2022: 16.6%). **Basic energy research** accounted for 10.2% of expenditure (source: SFOE, 2024 + 2025c).

➤ For more detailed indicators regarding **RESEARCH AND TECHNOLOGY** see the 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, particularly in the fossil fuel sector. 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

Crude oil: Global oil production continued to rise in 2024. According to the US Energy Information Administration (EIA), it averaged 102.62 million barrels per day worldwide. A further increase to 104.66 million barrels per day is forecast for 2025. This increase is due in particular to rising production outside the OPEC+ countries,³⁰ with the US making a significant contribution and reaching a new record level of over 13.4 million barrels per day in 2024. A further slight increase in US production is expected for 2025. Other non-OPEC+ countries, such as Brazil and Norway, also recorded rising production volumes. The production cuts that OPEC+ extended in 2023 were partially maintained in 2024. However, it is set to expand production in 2025, especially if oil prices remain low. Overall, stronger production growth, particularly in non-OPEC+ countries, will lead to a supply surplus on the oil market in 2025, as global demand growth will be weaker than in the recovery years following the COVID-19 pandemic. Global demand in 2024 was higher than ever before. Various factors determined demand in 2024. Global economic growth remained moderate, which had a dampening effect on the oil price, as did the increased supply due to higher production volumes in non-OPEC countries. Non-OECD countries continue to drive demand. According to the EIA, India will contribute significantly to the increase in global demand and will be responsible for around a quarter of global demand growth in 2024/25. India in particular will need more fuel, while in established markets (including China, the EU and Japan) the increasing share of electric vehicles and energy efficiency measures will limit oil consumption. The resulting decline in demand there will partially offset the growth in emerging markets.

Natural gas: Global natural gas production was largely stable in 2024. Production declined in the US for the first time since 2020, in particular due to reduced drilling activities in the wake of low gas prices. Natural gas prices have declined globally in the last two years after reaching an all-time high in 2022. The international natural gas market never-

theless remains volatile, mainly due to geopolitical uncertainties. However, this did not trigger a general global surge or a slump in production in 2024 or 2025. According to preliminary data from the IEA, global demand for natural gas increased by 2.8% in 2024. Asia, particularly China and India, accounted for 40% of the additional gas demand. Demand for natural gas rose only slightly in the US and Europe.

Coal: Global coal production rose to a peak of over 9 billion tonnes in 2024. The main drivers of this growth were China, which continues to produce just over half of the world's coal, and India, where production also rose sharply. In industrialised countries such as the US and Europe, on the other hand, both production and consumption fell significantly. Demand for coal continues to be driven by high demand for electricity in emerging countries – despite higher CO₂ prices – and fluctuating electricity generation from renewable sources. For 2025, the IEA expects coal production to stagnate at the high level of 2024 (sources: OECD / IEA 2025b + c + d).

CO₂ in European emission trading: Contracts up to 2028 range between EUR 70 and 80 per tonne of CO₂. In 2024, CO₂ prices varied between EUR 50 and EUR 75 per tonne. Due to the lower CO₂ prices at the beginning of 2024, electricity generation from gas was slightly cheaper, but was somewhat displaced by coal-fired power generation in the second half of the year due to rising gas prices, which increased demand for CO₂ certificates.

Electricity: The IEA projects global electricity demand growth of 4% annually from 2025 to 2027, compared to 4.3% in 2024 and global demand of around 29,000 TWh. This growth primarily reflects stronger demand in Asia and the United States, along with increasing power consumption from artificial intelligence (AI) server applications. China's gross electricity demand approached the 10,000 TWh mark at the end of 2024. Since 2023, China has accounted for more than one third of global electricity consumption. Despite economic growth

30 OPEC (Organisation of Petroleum Exporting Countries) is an international organisation currently comprising 12 oil-exporting countries. It was founded in 1960 and is based in Vienna. The term OPEC+ refers to other producing countries (e.g. Russia, Kazakhstan) that are not members of OPEC but cooperate on production decisions.

slowing by around 5%, electricity consumption rose by around 7% in both 2023 and 2024 compared to the previous year. In the US, the world's second-largest electricity consumer after China, demand rose by 2% in 2024 to reach a new high. Demand had previously fallen by 1.8% in 2023 due to mild weather conditions and weaker production activity. In India, electricity demand rose by 5.8% year-on-year in 2024 amid strong economic growth, but demand growth was nevertheless lower than in 2023 due to the milder summer.

The share of renewable energies in the global electricity supply rose to over 30% in 2024 and is expected to exceed the share of coal for the first time in 2025. Estimated renewable generation for 2024 is 9,848 TWh (2023: 8,958 TWh). The IEA expects coal-fired power generation to decline slightly for the first time in 2025, after rising by 0.8% in 2024. While coal-fired generation decline should be pronounced in the United States and Europe, increases in Asia will likely largely offset this. Fossil fuels remain the primary energy sources for electricity gen-

eration in the US,³¹ with natural gas leading at 43% in 2024, followed by renewable energy at 24%, and nuclear energy and coal at approximately 18% and 15%, respectively. In 1990, renewable energy constituted only about 12% of electricity generation. Since 2008, natural gas has progressively replaced coal, with the natural gas share now almost triple that of coal.

Electricity consumption in the EU rose slightly in 2024, by 1%, following two consecutive years of decline (-3% in 2023 compared to 2022). This is mainly due to increasing electrification and the expansion of data centres. Following record-high electricity prices in 2022, the market environment has since improved significantly, leading to lower wholesale prices. The European electricity benchmark³² averaged EUR 74 per MWh in 2024 – 22% lower than in 2023. Annual prices ranged from EUR 36 per MWh in Sweden to EUR 109 per MWh in Ireland. The largest year-on-year price declines occurred in France (-40%) and Sweden (-30%) (sources: OECD / IEA 2025e / COM 2025b + c).

³¹ [US electricity generation mix by source 2024 | Statista](#)

³² [Index of average wholesale electricity prices on the European market](#)

DEVELOPMENTS IN THE EU

Following the EU Parliament elections in June 2024, the new European Commission led by Commission President Ursula von der Leyen took up its work at the end of 2024. The EU Parliament confirmed Dan Jørgensen of Denmark as the new Commissioner for Energy and Housing in November 2024. Ursula von der Leyen set out the European Commission's new priorities for the next five years in the Strategic Agenda 2024–2029³³. Key focuses include strengthening competitiveness and developing the domestic market while continuing the green transition. Von der Leyen's agenda has been shaped by Mario Draghi's September 2024 report on the future of EU competitiveness.³⁴ In the energy sector, the report focuses on centralised planning and large investments, citing energy as one of the main factors behind the EU's competitive lag relative to other regions of the world.

In its energy policy, the new European Commission is placing greater emphasis on economic competitiveness, the practical implementation of existing measures and strengthening economic and geopolitical resilience. Security of supply remains a key concern, particularly against the backdrop of current geopolitical tensions. The diversification of energy sources, the expansion of infrastructure for renewable energies and hydrogen, as well as strategic energy partnerships with third countries are at the centre of these efforts. At the same time, the expansion and integration of electricity and gas grids is being accelerated in order to ensure a flexible and stable energy supply. In addition, there are industrial policy objectives to improve the framework conditions for energy-intensive industries and to strengthen Europe as a location for climate-friendly technologies. These include investments in green hydrogen, carbon capture and storage (CCS), innovative stor-

age technologies and the promotion of technology-neutral approaches, for example in nuclear energy. Another focus is on speeding up planning and authorisation procedures for energy infrastructure projects and reducing regulatory barriers. The aim is to reduce the implementation backlog of existing projects while also increasing public acceptance of the energy transition.

Overall, the approach to energy policy appears pragmatic and business-oriented. The new European Commission is placing less emphasis on new legislative initiatives and more on the consistent implementation, economic feasibility and geopolitical stability of the European energy and climate strategy. Energy policy developments in the EU remain vitally important for Switzerland due to its geographical location and close ties with the EU.

The European Green Deal was a top priority in the last legislative period under Ursula von der Leyen. The new European Commission is focusing on adapting the Green Deal rather than abandoning it. Although the goal of climate neutrality by 2050 remains in place, the political course is changing in the face of growing economic and geopolitical challenges. In future, the European Commission's strategy will focus more strongly on implementing existing measures, providing relief for businesses and farmers, and better linking climate protection with industry and competitiveness (source: COM(2016) 860 final).

Published on 29 January 2025, the European Commission's Competitiveness Compass follows the three pillars of the Draghi report – promoting innovation, decarbonising while strengthening competitiveness, and economic security through reduced

³³ *Priorities 2024–2029 – European Commission* (https://commission.europa.eu/priorities-2024-2029_en)

³⁴ Draghi, Mario: *The future of European competitiveness, Part A + B, September 2024.*

dependencies – and builds on the Green Deal. Energy is a central cross-cutting issue. To promote innovation, the European Commission is focusing on targeted investments, for example through the TechEU programme (e.g. for energy storage), as well as AI applications in the energy sector and better framework conditions for clean technologies. In the area of decarbonisation and competitiveness, the focus is on affordable energy. The Clean Industrial Deal and the Affordable Energy Action Plan (*see below*) are intended to reduce structural energy dependencies, strengthen grid investments and promote new market instruments. To strengthen security of supply, a pact for the Mediterranean³⁵ has been announced, which will promote renewable energies in the region. There are also plans for joint raw material pro-

urement and a strategy to completely move away from Russian energy imports (REPowerEU roadmap).

The Compass identifies five horizontal success factors: reducing bureaucracy, removing barriers in the internal market, enabling more efficient financing, promoting skills and high-quality jobs and ensuring better coordination. They also address energy – for example, by reducing bureaucracy (e.g. Decarbonisation Accelerator Act), improving coordination and creating new financing instruments. The strategic shift is striking: decarbonisation is now primarily understood as an economic competitiveness factor rather than a socio-ecological task, as was the case in the Green Deal (sources: COM 2025a / COM(2025) 30 final).

³⁵ The EU intends to promote the expansion of renewable energies in countries including Algeria, Morocco, Tunisia and Egypt, and to make them available for use by the EU.

INTERNATIONAL CLIMATE POLICY

With respect to the further implementation of the **Paris Climate Change Agreement**, the signatory states met in November and December 2024 for the 29th UN Climate Change Conference in Baku (COP29). A new collective financial target for the period after 2025 was adopted at COP29. The countries have agreed on a new financial target of USD 300 billion per year, which is to be achieved from 2035. This will enable investment in climate measures to be stepped up and help to support the poorest countries in particular. In addition, COP29 saw the adoption of further effective implementation rules for the global market mechanism. This enables countries under the Paris Agreement to implement climate protection projects abroad and have the resulting emissions reductions credited towards their national climate targets. Switzerland has worked towards rules that prevent double counting of emissions reductions and establish an effective market for emissions reductions.

The Paris Agreement, adopted in December 2015 and effective since 4 November 2016, succeeded the Kyoto Protocol's second commitment period. It requires all countries to implement greenhouse gas emission reduction measures, aiming to limit the global average temperature increase to well below 2 °C above pre-industrial levels, while pursuing efforts to limit the increase to 1.5 °C. Additional objectives include enhancing adaptation to unavoidable climate change impacts and aligning financial flows with low-emission, climate-resilient development. The Convention has been adopted by 198 parties to

the United Nations Framework Convention on Climate Change (UNFCCC); 195 countries, as well as the EU, have ratified it.

Switzerland, which signed the Paris Agreement in 2015 and ratified it in autumn 2017, has set a target to halve total greenhouse gas emissions by 2030 compared with 1990 levels. For national implementation of the agreement by 2030, a partial revision of the CO₂ Act for the period after 2024 took effect from 1 January 2025.

Switzerland's Paris Agreement ratification legally mandates climate change mitigation and adaptation measures. The country is required to submit Biennial Transparency Reports to the UN Framework Convention on Climate Change Secretariat regarding greenhouse gas emission trends, planned reduction and adaptation measures, and international climate policy funding contributions. Under the Paris Agreement, member states are also obliged to submit Nationally Determined Contributions (NDCs) every five years. These are national climate action plans that reflect a country's commitment to reducing its greenhouse gas emissions. Switzerland submitted its updated NDC with targets for 2035 on time in January 2025. The Intergovernmental Panel on Climate Change (IPCC) released its sixth assessment cycle synthesis report at the end of March 2023, summarising climate change science, impacts, risks, mitigation and adaptation knowledge (sources: Federal Council, 2024I + 2021 / FOEN, 2024 / IPCC, 2021 + 2023).

SWITZERLAND'S INTERNATIONAL COOPERATION IN THE ENERGY SECTOR

On 20 December 2024, the Federal Council took note of the substantive conclusion of the negotiations on the broad **package to stabilise and further develop relations between Switzerland and the EU**, including an **electricity agreement**. The negotiations were formally concluded with the initialling of the agreements by the chief negotiators on 21 May 2025. On 13 June 2025, the Federal Council opened the public consultation process on the approval and implementation of the package to stabilise and further develop relations between Switzerland and the European Union. The consultation ran until 31 October 2025. The adoption of the dispatch to Parliament is planned for the first quarter of 2026.

The electricity agreement would make Switzerland part of the **EU internal electricity market**. The agreement would make a significant contribution to strengthening security of supply and ensuring stable grid operation. Close integration into the European electricity system could be secured under international law and Swiss players would gain equal access to the EU internal electricity market. The electricity agreement would also provide significant opportunities to trade flexible Swiss hydropower on the market and simplify the implementation of Energy Strategy 2050.

With the electricity agreement, Switzerland would adopt the **body of EU law on electricity**, subject to the exceptions and clarifications listed in the agreement. EU electricity law essentially consists of the EU Clean Energy Package of 2019 and includes the EU Internal Electricity Market Regulation and Directive (EU/2019/943 and EU/2019/944), the Regulation on risk-preparedness in the electricity sector (EU/2019/941), the Regulation on the EU Agency of Energy Regulators (ACER) (EU/2019/942) and the Regulation on Energy Market Integrity and Transparency (REMIT, EU/1227/2011). Switzerland would also adopt parts of the Renewable Energy Directive (EU/2018/2011) and guarantee a high level of environmental protection in the electricity sector analogous to six relevant EU directives. As an internal

market agreement, the electricity agreement would also apply the institutional rules that Switzerland specifically negotiated with the EU for legal supervision, application of law, adoption of law and dispute settlement. Furthermore, Switzerland would ensure independent but equivalent state aid monitoring in the electricity sector in accordance with what is known as the two-pillar approach.

Switzerland would implement the electricity agreement in two stages. The first stage, involving amendments to the Electricity Supply Act, the Energy Act and the Federal Act on Supervision and Transparency on the Wholesale Energy Markets, would coincide with the entry into force of the electricity agreement. This would contain the elements essential for the functioning of the internal electricity market, including the coupling of the Swiss market with the EU market and market liberalisation for all end consumers. The latter would give all end consumers the right to choose their electricity supplier freely. End consumers with an annual consumption below a certain threshold have the right to remain in a regulated basic supply with regulated prices. Market liberalisation for all end consumers would be accompanied by comprehensive measures to ensure a functioning market and consumer protection. The first stage would also include additional requirements for the unbundling of the transmission system operator Swissgrid and for large distribution network operators with more than 100,000 customers, as well as adjustments to the purchase and remuneration obligation for electricity from small production facilities and the rules for supervision and transparency in the electricity sector. A second stage would come no later than three years after the electricity agreement enters into force. This would contain further technical elements of market and grid regulation. In addition, the authority to regulate grid tariffs is to be transferred to ElCom within five years of the agreement coming into force.

In the context of **regional cooperation**, Switzerland has maintained active, permanent observer status in the Pentalateral Energy Forum since February

2011. This forum facilitates voluntary cooperation among energy ministers from Germany, France, Belgium, the Netherlands, Luxembourg, Austria and Switzerland. The Penta Forum focuses on electricity market integration, grid operation, electricity supply security and the future of the energy system. The participating countries regularly conduct joint exercises to manage electricity crises. The most recent exercise was held in Luxembourg in September 2025, with representatives from Swissgrid and the SFOE participating for Switzerland.

Energy sector interdependencies with neighbouring countries necessitate stronger **bilateral relations** in energy and climate matters. During a working visit to Norway in June 2025, Federal Councillor Albert Rösti and Norwegian Energy Minister Terje Aasland signed an agreement on CO₂ storage. This agreement will enable Switzerland to export and store CO₂ in Norway while trading CO₂ removed from the atmosphere ('negative emissions'). Swiss companies will be able to purchase negative emissions from Norway and vice versa. This is in accordance with the international standards of the Paris Agreement. Similar agreements with Denmark followed in September 2025, allowing the export and permanent storage of Swiss CO₂ in Denmark. In the field of renewable energies, Switzerland is monitoring the development of green hydrogen as an energy source and the development of the future European infrastructure (hydrogen backbone). Since 2024, Switzerland has participated as an observer in the Trilateral Working Group on the Hydrogen Southern Corridor formed by Austria, Italy and Germany.

Switzerland is involved in **multilateral cooperation** within international energy institutions such as the International Renewable Energy Agency (IRENA) in Abu Dhabi and the Sustainable Energy Committee of the United Nations Economic Commission

for Europe (UNECE) in Geneva. Key topics include e-mobility, digital innovations, the fair transition to sustainable energy sources and technical cooperation with countries in Eastern Europe, the Caucasus and Central Asia. International Energy Agency (IEA) membership remains crucial. In June 2025, Switzerland took part in the tenth Global Conference on Energy Efficiency. SFOE Director Benoît Revaz was present as a ministerial declaration was approved in which the governments reaffirmed their commitment to stronger energy efficiency measures and emphasised important measures for greater progress in all end-use sectors. Switzerland values the IEA's role in member countries' energy security, international research, and energy transition support through system electrification. Switzerland also contributed as a responsible actor to the work of the UN's International Atomic Energy Agency (IAEA), focusing on global nuclear safety and security, safeguards and technical cooperation, and supporting member states' nuclear technology applications in medicine, water and agriculture.

In recent years, Switzerland has also been actively involved in negotiations to modernise the Energy Charter Treaty (ECT) of 17 December 1994, a multilateral agreement to promote trade, investment and energy efficiency in the energy sector.³⁶ After around four years of negotiations, the reform was definitively adopted by the Energy Charter Conference – the governing and decision-making body for the treaty process – in December 2024. The reform remains broadly supported internationally despite the subsequent withdrawal of the EU and EURATOM, as well as several EU member states, including Germany, France and Spain. The majority of EU member states remain in the ECT. The revised version modernises investment protection standards in line with developments in multilateral forums and treaty practice in bilateral investment agreements,

³⁶ Energy Charter Treaty, SR 0.730.0

increases the integrity and transparency of dispute settlement and clarifies the right of states to regulate in the public interest. A new option to exclude fossil fuels from investment protection has been introduced for contracting parties that so wish. Switzerland is making targeted use of this option to exclude particularly climate-damaging energy sources. The modernised treaty is in line with the Federal Council's negotiating mandate and is in Switzerland's interests. The Federal Council is expected to open the ordinary consultation process for the ratification of the modernised treaty at the beginning of next year (sources: Federal Council 2022b+2023b + 2024e+ f+g + m + 2025a + b) / DETEC, 2024 + 2025 / SFOE 2025d).

➔ For more detailed indicators regarding **INTERNATIONAL ENVIRONMENT** see the full monitoring report.



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LIST OF FIGURES

- | | | |
|-----------|-------------------|--|
| 9 | Figure 1: | Final energy consumption per person since 2000 (indexed) |
| 10 | Figure 2: | Electricity consumption per person since 2000 (indexed) |
| 11 | Figure 3: | Electricity production from renewable energy (excluding hydropower) since 2000 (in GWh) |
| 12 | Figure 4: | Anticipated average production of electricity from hydropower plants (in GWh) since 2000 |
| 16 | Figure 5: | Overview of network projects, status and proposed date of operation (status: 15 October 2024) |
| 19 | Figure 6: | Accumulated duration of project phases of network plans at network level 1 as at 15 October 2024 in years |
| 24 | Figure 7: | Inventory of underground cabling in the distribution network (in kilometres) |
| 26 | Figure 8: | Share of smart meters compared with conventional meters |
| 28 | Figure 9: | Diversification of the energy supply: proportion of energy sources to final energy consumption |
| 29 | Figure 10: | Import surplus and domestic production (in TJ) and proportion of energy imports to gross energy consumption (in %) |
| 35 | Figure 11: | Final consumer expenditure for energy (estimates in million Swiss francs) and significant influencing factors (indexed) |
| 37 | Figure 12: | Average nominal final consumer prices for heating oil and diesel (including taxes) for industry, in USD (based on market exchange rates) |
| 39 | Figure 13: | Average nominal final consumer prices of electricity and gas, including taxes for the industrial sector, in USD (based on market exchange rates) |
| 43 | Figure 14: | Per capita energy-related CO ₂ emissions (in tonnes of CO ₂ per capita) |
| 44 | Figure 15: | Energy-related CO ₂ emissions overall and by sector (in million tonnes of CO ₂) |
| 47 | Figure 16: | Public expenditure for energy research by field of research (in CHF million [real figures]) |

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