Switzerland's First Biennial Transparency Report under the Paris Agreement

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Swiss Federal Office for the Environment, Bern, Switzerland,
an office of the Swiss Federal Department of Environment, Transport, Energy and Communications.

Authors[1]

II.A National circumstances and institutional arrangements: Simon Fellermeyer (FOEN, II.A.8.2), Roger Ramer (FOEN, II.A.8, II.A.9), Annkatrin Rassl (MeteoSwiss, coordination, II.A.5), Nele Rogiers (FOEN, II.A.6.7), Regine Röthlisberger (FOEN, II.A.8, II.A.9), Andreas Schellenberger (FOEN, II.A.6.7), Simon Scherrer (MeteoSwiss, II.A.5), Adrian Schilt (FOEN, coordination, II.A.1–II.A.4, II.A.6–II.A.10), and Cornelia Schwierz (MeteoSwiss, II.A.5).

II.B Switzerland's nationally determined contribution: Regine Röthlisberger (FOEN) and Adrian Schilt (FOEN).

II.C Information necessary to track progress: Regine Röthlisberger (FOEN) and Adrian Schilt (FOEN).

II.D Mitigation policies and measures, actions and plans: Silvan Aerni (FOEN, II.D.1.7), Laura Antonini (SFOE, II.D.2.6, II.D.2.7, II.D.2.10, II.D.10), Samuel Bangerter (SFOE, coordination), Irène Barras (SFOE, II.D.1.9), Jonas Baumgartner (FOT, II.D.3.7), Alexandre Berset (FOEN, II.D.1.8), Franziska Borer Blindenbacher (ARE, II.D.3.1), Olivier Brenner (EnDK, II.D.2.5), Yoann Carnal (FOT, II.D.3.5), Sebastian Dickenmann (SFOE, II.D.3.2, II.D.3.3), Ivano Diconto (SFOE, II.D.2.2), Daniel Felder (FOAG, II.D.5), Lukas Gutzwiller (SFOE, II.D.2.1, II.D.2.2), Frank Hayer (FOEN, II.D.3.6), Silvia Hofer Kellenberger (SFOE, II.D.2.4, II.D.2.9), Michael Hügi (FOEN, II.D.7), Michel Jampen (FOT, II.D.3.7), Thomas Kellerhals (FOEN, II.D.1.7), Reto Meier (FOEN, II.D.3.14), Philipp Mosca (FOT, II.D.3.14), Beat Müller (FOEN, II.D.3.8, II.D.4.1, II.D.4.3, II.D.4.4), Roger Nufer (SFOE, II.D.2.4, II.D.2.9), Marine Pérus (FOEN, II.D.3.4), Roger Ramer (FOEN, II.D.1, II.D.2.4, II.D.2.11, II.D.3.6, II.D.3.14, II.D.8, II.D.10, II.D.11), Theo Rindlisbacher (FOCA, II.D.3.1, II.D.3.9–II.D.3.13), Nele Rogiers (FOEN, II.D.6), Silvia Ruprecht (FOEN, II.D.10), Reto Schafer (FOEN, II.D.1.7), Andreas Schellenberger (FOEN, II.D.6), Sabine Schenker (FOEN, II.D.4.5), Adrian Schilt (FOEN, coordination, II.D.3.6, II.D.8–II.D.11), Loïc Schmidely (FOEN, II.D.4.1, II.D.4.2), Andrin Studer (SMNO, II.D.3.14), Matthias Wagner (FOT, II.D.3.14), Sebastian Weber (FOT, II.D.3.5), Thomas Weiss (SFOE, II.D.3.3), Sophie Wenger Hintz (FOEN, II.D.10), and Markus Wüest (FOEN/SFOE, II.D.1.10).

II.E Summary of greenhouse gas emissions and removals: Adrian Schilt (FOEN).

II.F Projections of greenhouse gas emissions and removals: Daniel Bretscher (Agroscope, II.F.4.3, II.F.4.8), Roger Ramer (FOEN, II.F.2, II.F.4.1, II.F.4.8), Nele Rogiers (FOEN, II.F.1, II.F.4.4, II.F.4.8), Andreas Schellenberger (FOEN, II.F.4.4, II.F.4.8), Sabine Schenker (FOEN, II.F.4.2, II.F.4.6, II.F.4.8), and Adrian Schilt (FOEN, coordination, II.F.1–II.F.3, II.F.4.1, II.F.4.2, II.F.4.5–II.F.4.9).

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VIII Improvements in reporting over time: Authors of the respective sections in the main text.

Annex IV Participation in cooperative approaches: Simon Fellermeyer (FOEN).

[1] ARE: Swiss Federal Office for Spatial Development, EnDK: Conference of Cantonal Energy Directors, FOAG: Swiss Federal Office for Agriculture, FOCA: Swiss Federal Office of Civil Aviation, FOEN: Swiss Federal Office for the Environment, FOT: Swiss Federal Office of Transport, MeteoSwiss: Swiss Federal Office of Meteorology and Climatology, SDC: Swiss Agency for Development and Cooperation, SECO: Swiss State Secretariat for Economic Affairs, SFOE: Swiss Federal Office of Energy, SMNO: Swiss Maritime Navigation Office.

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Correspondence

climatereporting@bafu.admin.ch

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Foreword

We are pleased to contribute to the successful launch of the Enhanced Transparency Framework by submitting Switzerland's first biennial transparency report. Transparency is of fundamental importance to the implementation of the Paris Agreement and to laying the foundation to jointly addressing both the causes and the major challenges of climate change. This report embodies Switzerland's commitment to openness, science-based approaches and international cooperation to mitigate climate change and to minimise its impacts for all countries around the world. Comprehensive reporting and facilitative sharing of experiences are key for effective action that enables us to learn from one another and to build on successful strategies.

Switzerland's dedication to tackling climate change is underscored by recent advances in national legislation. With the new Climate and Innovation Act, the Swiss people approved the net-zero target by 2050 in a popular vote. On the way to this long-term goal, Switzerland has recently started the preparations to revise the CO_2 Act for the time after 2030. However, the implementation of effective policies and measures also poses challenges, both nationally and internationally. The transition to a low-carbon economy and society requires swift action, accompanied by innovative solutions. As we reflect on our progress, we acknowledge both our achievements and the gaps that remain, recognising the need for increased efforts at the domestic and international levels.

The cooperative approaches established under the Paris Agreement allow for joint action and complement national activities. Switzerland engages in various projects which all comply with the rules to ensure environmental integrity, promote sustainable development and avoid double counting.

Since 2010, Switzerland has continuously increased its climate finance and considers it important for all countries that are able to do so to support those most in need. In this spirit, we remain committed to contributing our fair share to the collective climate finance goal of mobilising jointly 100 billion US dollars per year through to 2025 and intend to continue to do so in the context of the new collective quantified goal. Switzerland provides comprehensive information in this report on its climate finance provided and mobilised in 2021 and 2022.

We invite you to take a look at this report, to reflect on its findings and to contact us with any questions or suggestions you may have. We look forward to continuing to work together to bring the Enhanced Transparency Framework to life and, by doing so, help to shape a sustainable future for generations to come.

Katrin Schneeberger
Director
Swiss Federal Office for the Environment, Bern, Switzerland

December 2024

I National inventory report

National inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

I.A General information

Switzerland submits its national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases as a stand-alone report. The most recent submission as of 11 April 2024 (national inventory document) and 11 December 2024 (common reporting tables) is available on the UNFCCC website as well as on the website of the Swiss Federal Office for the Environment.[2] The data of the most recent national inventory report is consistently used throughout Switzerland's first biennial transparency report.

[2] https://unfccc.int/ghg-inventories-annex-i-parties/2024
www.bafu.admin.ch/latest-ghg-inventory

II Tracking progress

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

II.A National circumstances and institutional arrangements

Switzerland's national circumstances are presented in section II.A.1 to II.A.6, followed by a discussion of how the national circumstances affect greenhouse gas emissions and removals over time (section II.A.7). Section II.A.8 presents the institutional arrangements to track progress made in implementing and achieving the nationally determined contribution, while section II.A.9 summarises the arrangements for domestic implementation, monitoring, reporting, archiving of information and stakeholder engagement related to the implementation and achievement of the nationally determined contribution. Changes in institutional arrangements are addressed in section II.A.10.

II.A.1 Government structure

This section provides a general overview of Switzerland's government structure and political organisation. Specific information related to the policymaking process in the context of environmental and climate policy is presented in section II.A.9.

Administrative structures

The following website depicts Switzerland's administrative structures: *https://www.ch.ch/en/demokratie*. The subsequent paragraphs provide a brief overview.

Switzerland is a confederation, subdivided into 26 cantons (states). The legislative authority consists of a bicameral parliament which, when in joint session, is known as the Federal Assembly, i.e. the Swiss Parliament. One chamber of the Swiss Parliament, the National Council, consists of 200 members that represent the population of the country as a whole. The other chamber, the Council of States, represents the cantons. 20 cantons are represented in the Council of States by two members and six half-cantons by one member (leading to a total of 46 members). The legislative system comprises several hierarchical levels and all legislation must ultimately comply with the Federal Constitution of the Swiss Confederation. Both chambers of the Swiss Parliament have equal power, meaning that federal acts or constitutional amendments can only enter into force once they passed both chambers. However, decisions by the Swiss Parliament are subject to optional referendums (federal acts) or mandatory referendums (constitutional amendments) by the Swiss population (see below). The members of the Swiss Parliament are directly elected by the Swiss population for a four-year term, while the Swiss Parliament then elects the Swiss Federal Council for a four-year term as well.

The executive authority at the federal level, the Swiss Federal Council, consists of seven members with equal power. The Swiss Federal Council is supported by the Swiss Federal Chancellery and seven federal departments (federal administration). While the Swiss Federal Council has the power to directly implement the contents of federal acts through ordinances, it proposes changes to the Federal Constitution of the Swiss Confederation or federal acts for parliamentary discussion and approval.

The highest judicative authority in Switzerland is the Federal Supreme Court, representing the final arbiter on disputes in the field of civil law (citizen-citizen), in the public arena (citizen-state), as well as in disputes between cantons or between cantons and the federal government.

In Switzerland, the principle of subsidiarity is of greatest importance, as ingrained in Article 3 and 5a of the Federal Constitution of the Swiss Confederation, stipulating that unless legislative power is explicitly assigned to the Swiss Confederation (federal level), the cantons are sovereign, i.e. entitled to legislate in an area of policy (*Swiss Confederation*, 1999a). This fundamental principle helps to protect minority interests, above all those of the French-, Italian- and Romansh-speaking parts of Switzerland. Accordingly, each canton has its own government, parliament and cantonal court, while responsibilities are shared between the federal authorities and the cantons. Each canton also has its own financial budget and sets its own level of direct taxation (fiscal federalism). Despite a system of fiscal equalisation amongst cantons, substantial differences between cantons remain in the level of taxation of both households and companies.

Relevant inter-ministerial decision-making processes or bodies

Cooperation is an important principle, both vertically across the hierarchic levels of authorities and horizontally within a level of authority. In matters where the federal authorities are responsible for legislation, the role of the cantons is to implement and enforce such legislation. Very often, the cantons have substantial leeway to take local or regional conditions into account. At a lower level, similar autonomy is granted to the municipalities by the cantons. At the same time, cantons cooperate horizontally and have agreements that facilitate harmonised and effective implementation of policies and measures.

The cantons and other interested parties (e.g. business, trade unions, non-governmental organisations etc.) are included in a consultation process whenever the Swiss Federal Council proposes a significant change to the Federal Constitution of the Swiss Confederation, to a federal act or an ordinance. This comprehensive consultation process is a very important phase in the legislative procedure in Switzerland. The aim is to include expert knowledge and to consider proposals of particular interest groups, where possible. This approach allows to estimate and improve the success chances of the proposals in an eventual referendum. Although the outcome of the consultation process is formally non-binding, it is of great importance and reflects an established principle of consensus, which is typical of policymaking and of political culture in Switzerland. However, this political participation process also leads to a relatively slow policymaking process. In particular, new legislation agreed upon by the Swiss Parliament (in a negotiation process that may take up to several years), may potentially be rejected by the Swiss population in case of a referendum (see below).

Within the federal administration, interdepartmental exchange and consultation is an important pillar during the preparation phase of legal provisions or other matters requiring a decision by the Swiss Federal Council. The leading federal offices, mandated by the respective member of the Swiss Federal Council, therefore conduct, as a matter of routine, an interdepartmental official consultation. Then, the received feedbacks are, to the extent possible, taken into account. In the forefront of the respective meeting of the Swiss Federal Council leading to the final decision on the matter, all departments are invited to provide their agreement or reservations in a so-called joint reporting procedure.

Regarding environmental and climate policies, particular interdepartmental decision-making processes and bodies are established (see section II.A.9 for further information).

Political organisation of Switzerland: The people, the supreme political authority

Switzerland is a representative democracy, with strong formal and informal elements of direct democracy. According to the Federal Constitution of the Swiss Confederation, the Swiss people are sovereign and ultimately the supreme political authority. Virtually all important decisions have to be approved by the electorate. The electorate consists of all Swiss adults who are eligible to vote – some 5.5 million citizens in 2022, i.e. around 64 per cent of the resident population. Those under the age of 18 years and foreign nationals have no political rights at federal level. Switzerland is virtually the only country in the world where the people have such extensive decision-making power. The long-standing democratic tradition, but also the comparatively small size of the population are crucial for the operation of this particular system of government. At federal level, Swiss nationals can elect, vote, request for popular initiatives and take a referendum. At cantonal and municipal level, similar rights exist; however, they are not uniform across Switzerland.

As mentioned above, the people elect the 200 members of the National Council and the 46 members of the Council of States every four years. All Swiss citizens over the age of 18 years may take part in elections, both actively and passively. In other words, they may cast their votes and stand for election themselves.

An important formal instrument of direct democracy is the referendum. The optional referendum allows citizens to veto decisions made by the Swiss Parliament. To request a popular vote on a decision by the Swiss Parliament, the collection of 50 thousand valid signatures within 100 days is needed. There is a mandatory referendum on each constitutional amendment passed by the Swiss Parliament. It is thus possible to have a referendum concerning regulations at the level of the Federal Constitution of the Swiss Confederation, formal laws, international treaties, and generally binding federal decrees that are put into effect as a matter of urgency. Both popular initiatives and referendums also exist at the cantonal level. The petition is an informal instrument of public participation and is non-binding.

By means of a popular initiative, which requires the collection of 100 thousand valid signatures within 18 months, citizens can propose amendments to the Federal Constitution of the Swiss Confederation (at the cantonal level also amendments

to a law). Popular initiatives may comprise a general proposal or contain detailed regulations. A popular initiative needs to be accepted by a majority of both the electorate and the cantons to become part of the Federal Constitution of the Swiss Confederation. This requirement for a 'double' majority (population and cantons) mainly serves to protect the interests of sparsely populated rural cantons.

The ballots needed to implement the direct democracy in Switzerland generally take place four times a year and on average involve three to four proposals – in exceptional cases also up to twice as many – that may be adopted or rejected. Often, cantonal and communal ballots are held at the same time.

International relations

Switzerland is a member of several international organisations (e.g. the OECD, the World Bank Group and all specialised agencies of the United Nations). In March 2002, the Swiss population also voted for membership of the United Nations, and since September 2002, Switzerland has been a full member.

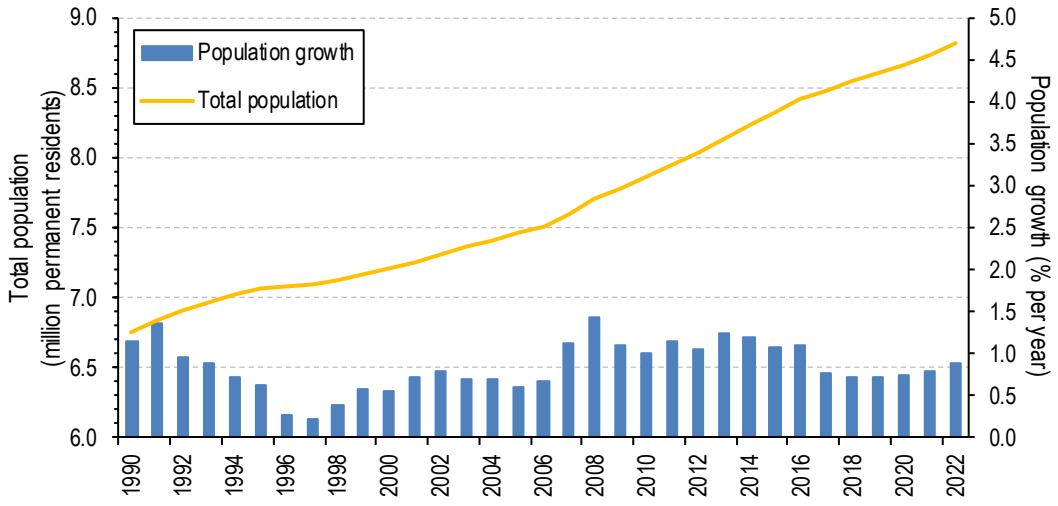
Although not a member state of the European Union, Switzerland has a strong relationship with the European Union and European policy is a high priority of Swiss foreign policy. The legal basis of this close cooperation is formed by bilateral agreements[3], and most Swiss laws have been made compatible with legislation of the European Union. Important stages of this policy have been assessed and approved by the people in referendums. Relations between Switzerland and the European Union have developed over decades. The bilateral agreements have been extended step by step, and the mutual relationship and cooperation is constantly being developed.[4]

Since 2006, Switzerland is a member of the European Environmental Agency (EEA), one of the most important agencies for European cooperation in environmental issues. Concerning climate policy measures, Switzerland often adapts instruments of the European Union. Current examples are the CO_2 emission regulations for newly registered vehicles or the emissions trading scheme.

II.A.2 Population profile

At the end of 2022, Switzerland had a population of 8,815,385 permanent residents (*SFSO*, 2023a). Since the beginning of the 20th century, Switzerland's population has more than doubled, the increase of population from 1990 to 2022 was 31 per cent. Between 2007 and 2016, population growth exceeded one per cent per year, and has now been stable at around 0.77 per cent per year during the last years (Fig. 1). Population growth mainly results from immigration and increasing life expectancy. It is expected that population growth will continue in the future, leading to 10.44 million permanent residents by 2050 (*SFSO*, 2020a).

Fig. 1 > Switzerland's total population (orange) and population growth (blue) between 1990 and 2022. At the end of 2022, Switzerland had 8.82 million permanent residents, of which 4.38 million men and 4.44 million women.



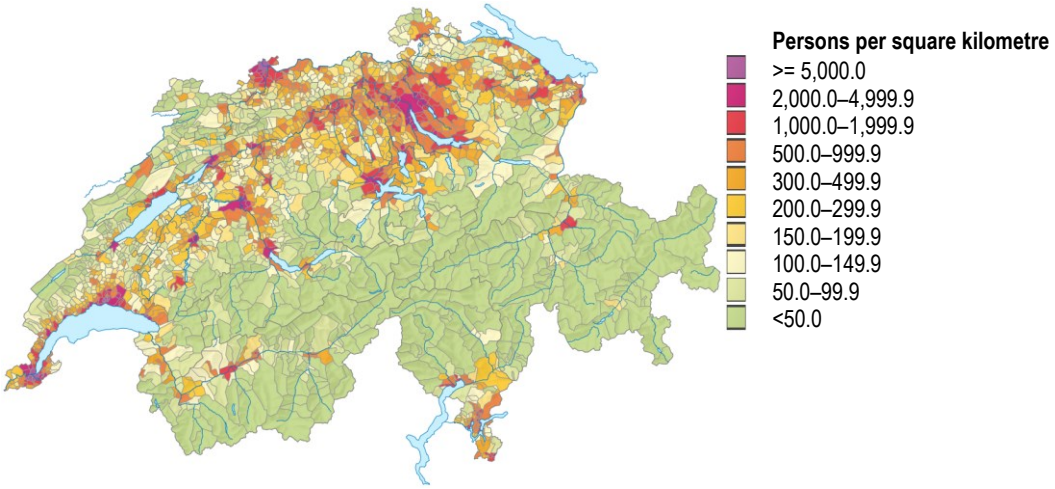
SFSO (2023a)

3 https://www.eda.admin.ch/europa/en/home.html

4 https://www.eda.admin.ch/eda/en/fdfa/fdfa/aktuell/news.html/content/eda/en/meta/news/2024/3/18/100438

Switzerland's population density at the end of 2022 was 214 persons per square kilometre. Population is concentrated on the Central Plateau, the major alpine valleys and the Ticino, while the density is substantially lower in the hilly and alpine regions of the country (Fig. 2).

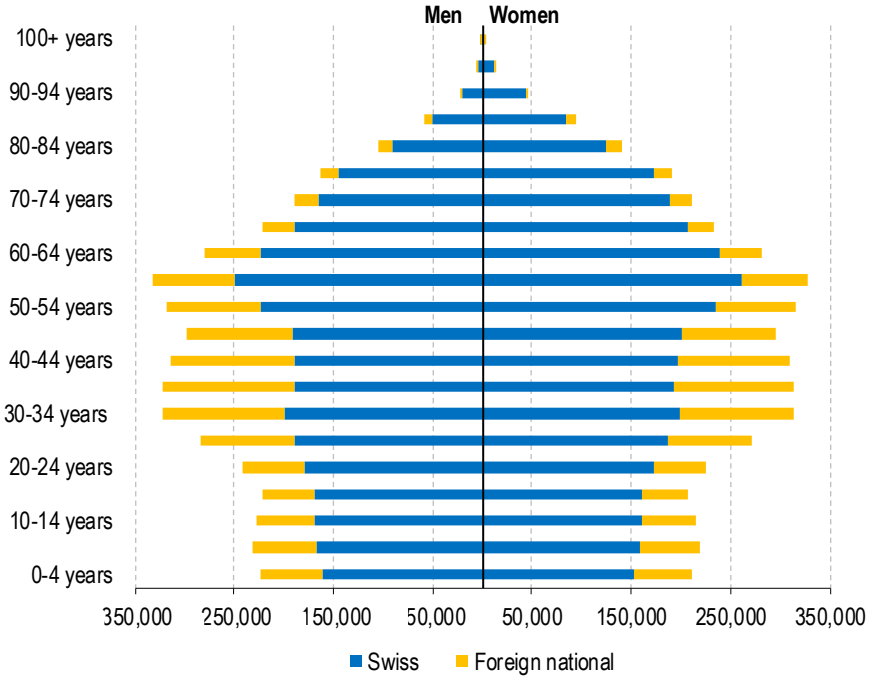
Fig. 2 > Spatial distribution of Switzerland's population at the end of 2022.



SFSO (2023a)

Fig. 3 shows the demographic structure of Switzerland in 2022 by age, sex and nationality. Foreign nationals account for about 26 per cent of the permanent Swiss residential population. A growing proportion of the population is of retirement age, while the share of persons below the age of 20 has been declining since the 1970s. Switzerland has four official languages (German, French, Italian, and Romansh). In 2020, 62 per cent of Switzerland's permanent population indicated German as the main language, 23 per cent French, 8.0 per cent Italian, 0.5 per cent Romansh, and 23 per cent other languages (the sum exceeds 100 per cent as some persons indicated more than one language; *SFSO*, 2022).

Fig. 3 > Age distribution by age, sex and nationality in Switzerland at the end of 2022.

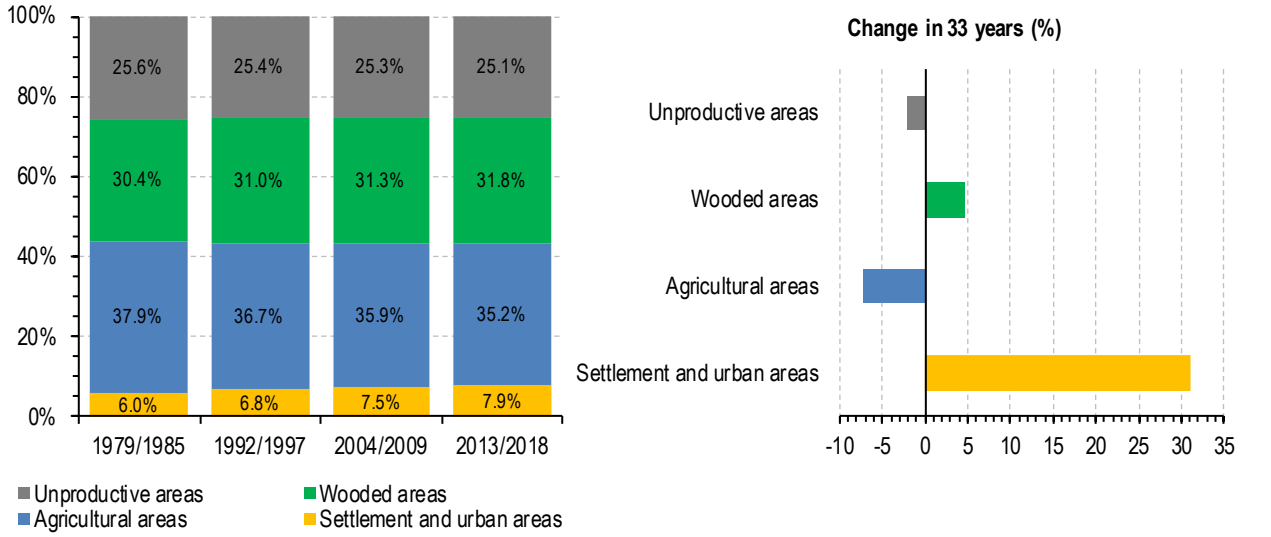


SFSO (2023a)

II.A.3 Geographical profile

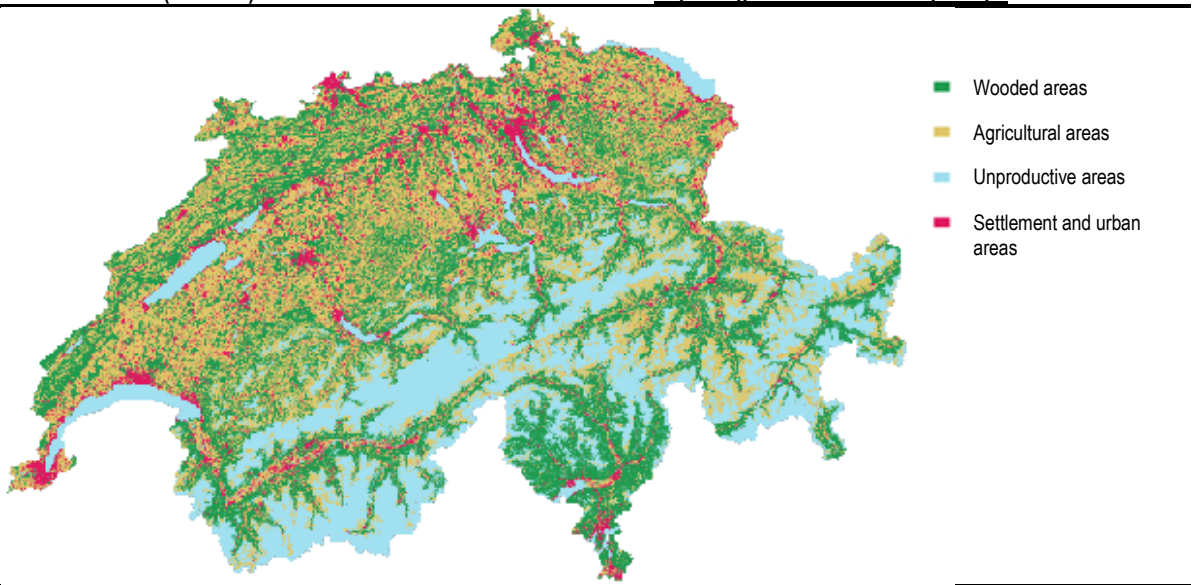
Switzerland, located in the centre of Europe, extends from 45°49' to 47°48' north and from 5°57' to 10°30' east. It covers an area of 41,291 square kilometres, comprising 25.1 per cent unproductive areas, 31.8 per cent wooded areas, 35.2 per cent agricultural areas (including alpine pastures), and 7.9 per cent settlement and urban areas (situation in 2013/2018; *SFSO*, 2021b; Fig. 4, left; Fig. 5). While the settlement and urban areas are relatively small, they increased by 31 per cent between 1985 and 2018, and have continued to expand ever since, mainly at the expense of agricultural areas (*SFSO*, 2021b; Fig. 4, right). Typical land-use changes in Switzerland over the past few decades are documented in the interactive map viewer of the federal geoportal (*https://s.geo.admin.ch/of5od4hcgget*).

Fig. 4 > Evolution of different land-use types in Switzerland over the last 33 years (left) and changes in land use between 1979/1985 and 2013/2018 (right). The agricultural areas include alpine pastures.



SFSO (2021b)

Fig. 5 > Switzerland's land use based on the land-use statistics 2013/2018. For a dynamic visualization of the land use statistics based on the standard nomenclature (NOAS04) of the Swiss Federal Statistical Office see *https://s.geo.admin.ch/0hfvwqzwdepk*.



Based on *SFSO* (2021b)

Switzerland's topography is defined by the Central Plateau, the Jura mountains as well as the Northern, Central and Southern Alps (see also *https://s.geo.admin.ch/czo31ku4vovg*). About half of Switzerland's surface area is located above 1,000 metres above sea level and about one quarter of Switzerland's surface is located above 2,000 metres above sea level (*SFSO*, 2021b). With mean annual precipitation of over 1,400 millimetres, Switzerland is one of the most water-abundant countries in Europe (see also section II.A.5). It also has large water storage reservoirs in the form of natural lakes (130

cubic kilometres), artificial reservoirs (3.5 cubic kilometres), glaciers (53 cubic kilometres) and groundwater (150 cubic kilometres) (*FOEN*, 2021a). This storage volume corresponds to 5.6 times the mean annual precipitation. One third of the annual precipitation evaporates, the rest eventually leaves the country as runoff. The great Rhine and Rhone rivers as well as the main tributaries of the Po and Danube have their sources in the Swiss Alps. The downstream countries depend heavily on runoff from Switzerland for irrigation, cooling, hydro-power production, drinking water, navigation, and other water uses. Changes in the various elements of the Swiss water balance have therefore a direct impact on the downstream riparians.

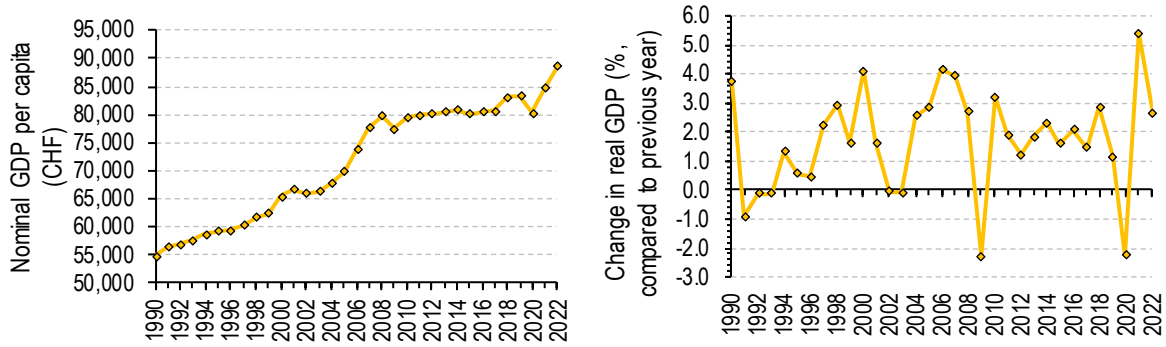
The location in the heart of Europe and in the centre of the European Union leads to substantial imports and exports of goods and services, and to transit freight flows across Switzerland. The Alps represent a natural barrier for transportation in the north-south direction, i.e. between northern Europe and Italy, but a number of tunnels facilitate large-scale transportation on road and rail across the Alps (section II.A.6.2).

II.A.4 Economic profile

Gross domestic product, workforce and gross value added by sectors

Switzerland's nominal gross domestic product was about 782 billion Swiss francs in 2022, corresponding to about 89 thousand Swiss francs per capita (*SECO*, 2024). The nominal gross domestic product per capita increased by 45.7 per cent between 1990 and 2008, and then remained about stable until 2017. After two years (2018 and 2019) with values of about 52 per cent above the 1990 level, the nominal gross domestic product per capita substantially decreased in 2020 due to the measures to contain the corona virus pandemic (Fig. 6, left), but substantially increased again in the years 2021 and 2022. Apart from the decrease in 2020 and a few further exceptions in the early 1990s and in 2009, Switzerland's real gross domestic product increased annually compared to the previous year over the last three decades (Fig. 6, right).

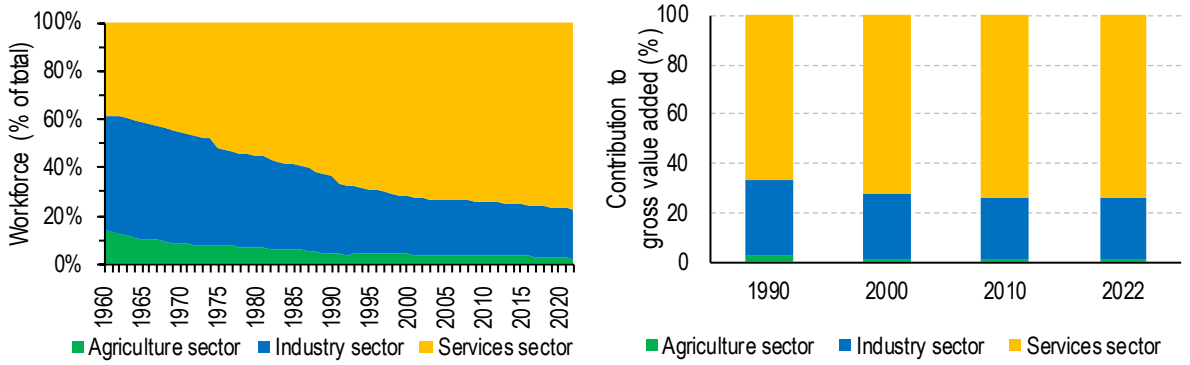
Fig. 6 > Switzerland's nominal gross domestic product (GDP) per capita (left) and percentage change of real gross domestic product (reference year 2015) compared to previous year (right) between 1990 and 2022.



SECO (2024), *SFSO* (2023a)

Between 1960 and 2022 the proportion of the total workforce employed in the different sectors changed substantially (Fig. 7, left); in the agriculture and industry sectors it has fallen from 14.5 and 46.5 per cent to 2.2 and 20.3 per cent, respectively, leading to a substantial increase in the services sector. Accordingly, Switzerland's economy largely depends on the services sector, which in 2022 not only employed 77.5 per cent of the total workforce, but also contributed 73.8 per cent to the gross value added (Fig. 7, right). The structural change to a 'service society' is thus steadily continuing.

Fig. 7 > Contribution of economic sectors to total workforce (left) and gross value added (right) between 1990 and 2022.

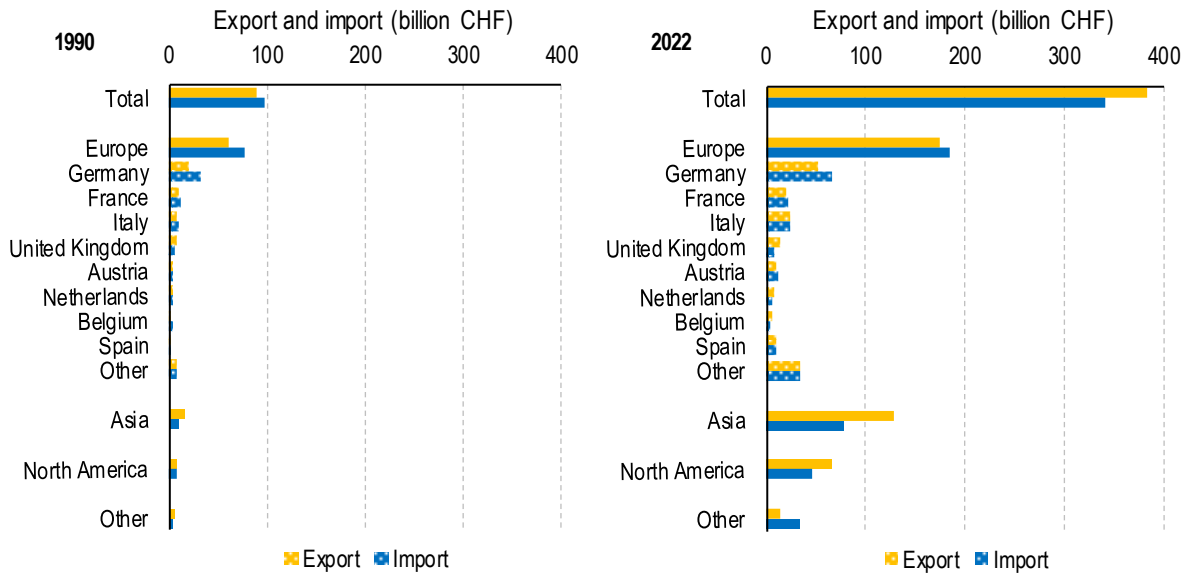


SFSO (2024a), *SECO* (2024)

International trade patterns

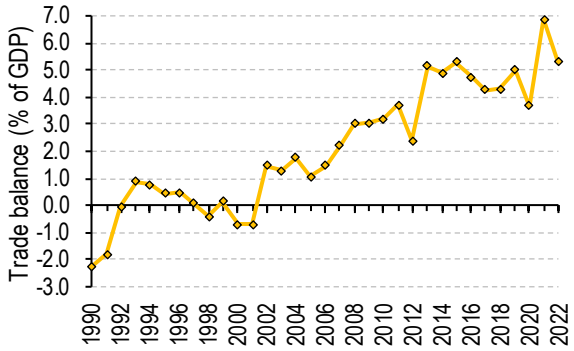
Switzerland has virtually no mineral resources and, historically, no heavy industry. Accordingly, the economy strongly depends on trade with other countries, as Switzerland imports bulk raw materials and exports high-quality goods. In 2022, the value of a tonne of exported goods was about three times higher than the value of a tonne of imported goods (*FOCBS*, 2024). The relatively small size of the domestic market is another factor which has been encouraging Swiss manufacturers to look to foreign markets in order to make investments in research and development worthwhile. As shown in Fig. 8 (left), Switzerland's exports accounted for 88 billion Swiss francs in 1990, while the imports accounted for 97 billion Swiss francs. In 2022, both the exports and imports were substantially higher, accounting for 383 billion and 341 billion Swiss francs, respectively (Fig. 8, right). Switzerland's trade balance (exports minus imports) was about balanced between 1992 and 2001 (within ±1 per cent of the gross domestic product). From 2001 to 2013, exports growth was stronger than imports growth. Between 2013 and 2019, Switzerland's trade balance remained between about four and five per cent of the gross domestic product (Fig. 9), followed by a decrease to 3.7 per cent in 2020 due to the measures to contain the corona virus pandemic. In the years 2021 and 2022, the trade balance reached values of 6.9 and 5.3 per cent of the gross domestic value, respectively. European countries are by far the most important trading partners for Switzerland, accounting for 45.5 per cent of exports and 53.9 per cent of imports in 2022. Largest volumes are traded with Germany, with exports accounting for 51 billion Swiss francs and imports accounting for 67 billion Swiss francs in 2022 (Fig. 8, right). Trade volumes with other European countries are also considerable, often with rather small differences between imports and exports (e.g. for France, Italy and Austria). Trade with North America and Asia is currently heavily biased towards exports. Among the most important traded goods in term of monetary value are chemical and pharmaceutical products, noble metals, jewels and gemstones, machines, instruments and electronics, watches, and precision instruments (*SFSO*, 2024d; Fig. 10).

Fig. 8 > Switzerland's foreign trade (export and import) with important partners in 1990 (left) and 2022 (right).



SFSO (2024b), *SFSO* (2024c)

Fig. 9 > Switzerland's trade balance (export minus import) in per cent of the gross domestic product (GDP) from 1990 to 2022.

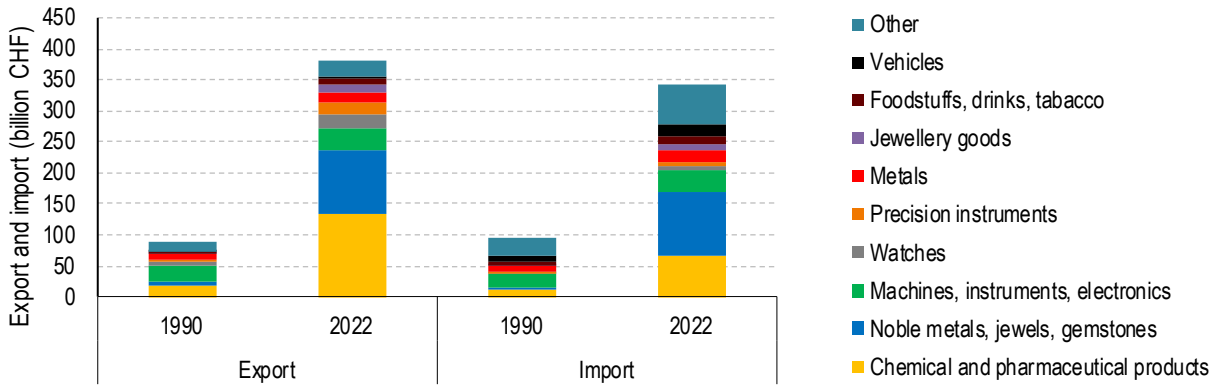


SFSO (2024b), *SFSO* (2024c), *SECO* (2024)

Unemployment, public debt rate and general government spending ratio

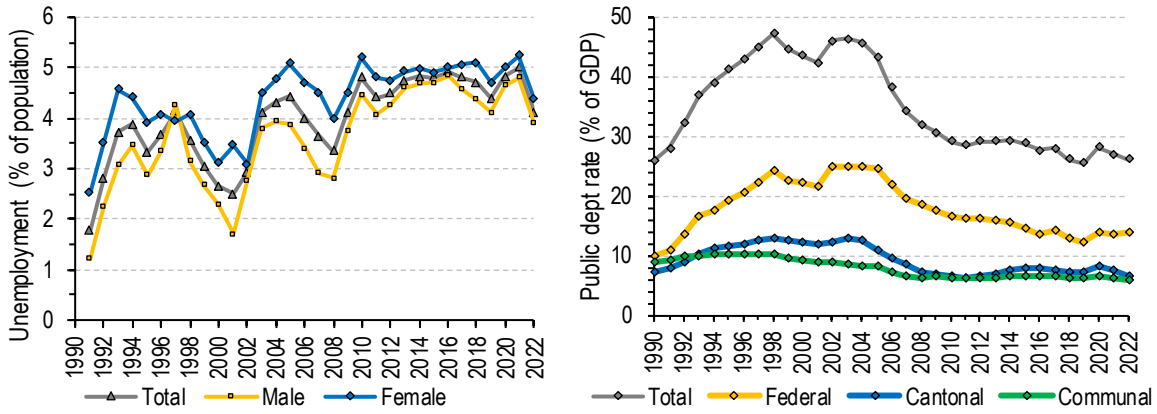
Traditionally a country with low unemployment (less than one per cent), Switzerland experienced a dramatic increase in unemployment from the beginning of the 1990s, as a consequence of the overall economic slow-down. Apart from foreign nationals (both female and male), the category most affected by this development was Swiss women and young people (aged 15 to 25 years). The total rate of unemployment peaked at 4.1 per cent in 1997 and at 4.4 per cent in 2005, and has remained stable at five per cent or below since 2010, with a decrease to 4.1 per cent in the year 2022 (Fig. 11, left). In parallel with rising unemployment, aggregate government spending has exceeded revenues at all three administrative levels (federal, cantonal and communal), which has led to increasing public debt in the early to late 1990s (Fig. 11, right). Following a relatively stable period at a high level of between 40 and 50 per cent of gross domestic product, the revenues exceeded the expenditures between 2004 and 2010, and the total public debt rate has remained stable slightly below 30 per cent of the gross domestic product for the last decade. In 2020, Switzerland's general government spending ratio amounted to 37.8 per cent of the gross domestic product, being one of the lowest of OECD countries (*OECD*, 2021a; Fig. 12). A substantial increase of the government spending ratio occurred from 2019 to 2020 due to fiscal policy measures taken to mitigate the economic consequences of the corona virus pandemic.

Fig. 10 > Switzerland's foreign trade (export and import) by goods in 1990 and 2022.



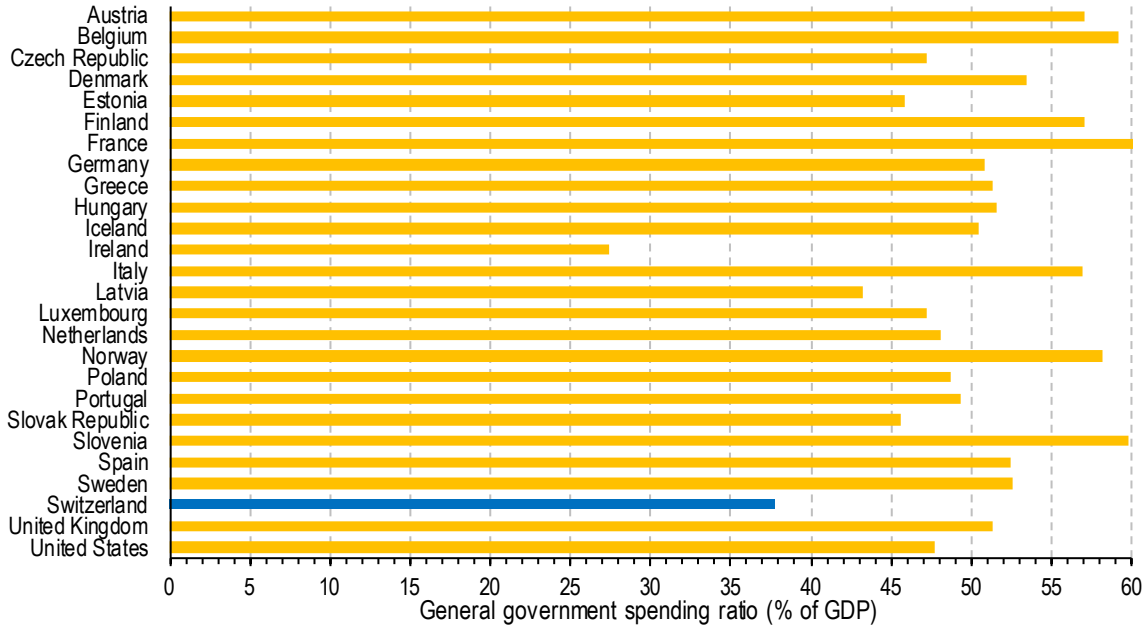
SFSO (2024d)

Fig. 11 > Left: Rates of unemployment (1990–2022). Right: Public debt rate (Maastricht debt ratio) at all administrative levels (federal, cantonal and communal) in percentage of gross domestic product (GDP, 1990–2022).



SFSO (2024e), *FFA* (2024)

Fig. 12 > General government spending ratio in 26 OECD countries in 2020.

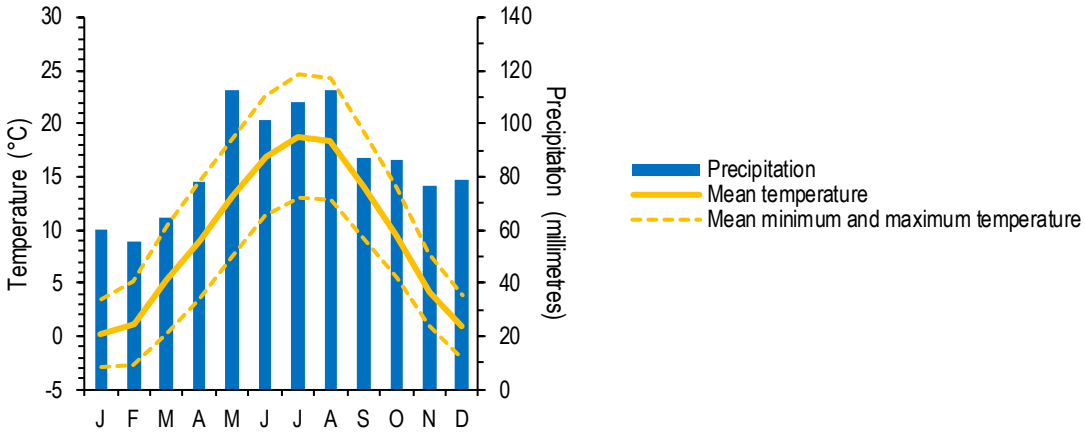


OECD (2021a)

II.A.5 Climate profile

Climatic conditions vary significantly across Switzerland, depending mainly on altitude and location. As an example for local conditions on the densely populated Central Plateau, the climate graph for Switzerland's capital Bern is provided in Fig. 13. Although the Alps – running from south-west to east – act as a major climatic divide, the observed climate change signals are qualitatively similar north and south of the divide. Long-term measurements since 1864 indicate a marked shift towards a warmer climate (*Begert and Frei,* 2018; *FOEN and MeteoSwiss,* 2020). Changes in mean precipitation are less clear. Trends in annual mean precipitation are predominantly positive but not statistically significant in most regions over the last 100 years (1921–2020). There are indications for a robust increase in winter precipitation when analysing time series starting in 1901 or before (*Scherrer et al.*, 2015), and evidence for an increase in the frequency and intensity of heavy precipitation has been presented (*Scherrer et al.*, 2016; *Bauer and Scherrer*, 2024). Pronounced trends are also found for cloudiness and sunshine duration (see below). For expected future developments and impacts thereof see *CH2018* (2018) as also described in section 6.1 of Switzerland's eighth national communication and fifth biennial report. In the following, more detailed information is provided with regard to temperature, precipitation, climate indices, and extreme events.

Fig. 13 > Climate graph for Bern/Zollikofen, Switzerland's capital, located on the Central Plateau at 553 metres above sea level. Provided are mean values for the most recent normal period 1991–2020. The mean annual temperature during this period is 9.3 degrees Celsius, the mean minimum and maximum temperatures are 4.7 and 14.0 degrees Celsius. Mean annual precipitation is 1,022 millimetres.

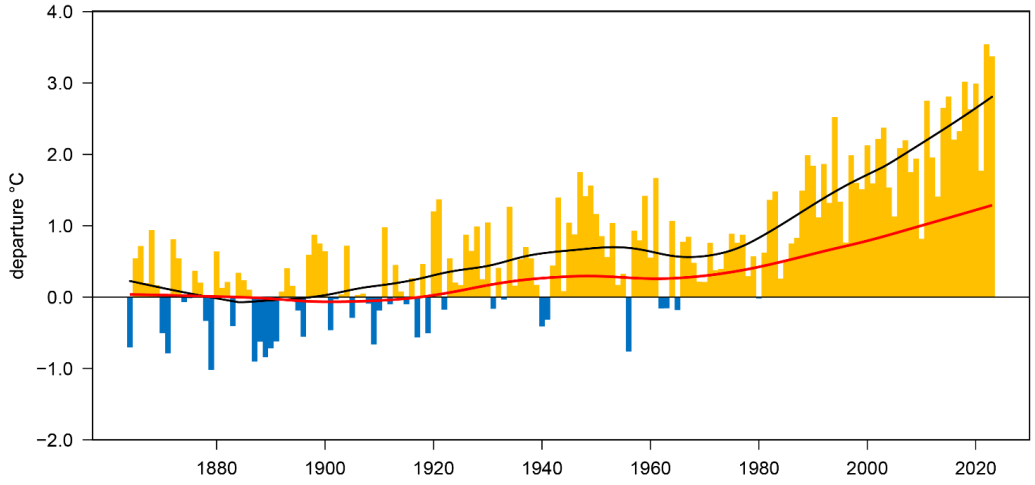


MeteoSwiss (2022)

Temperature

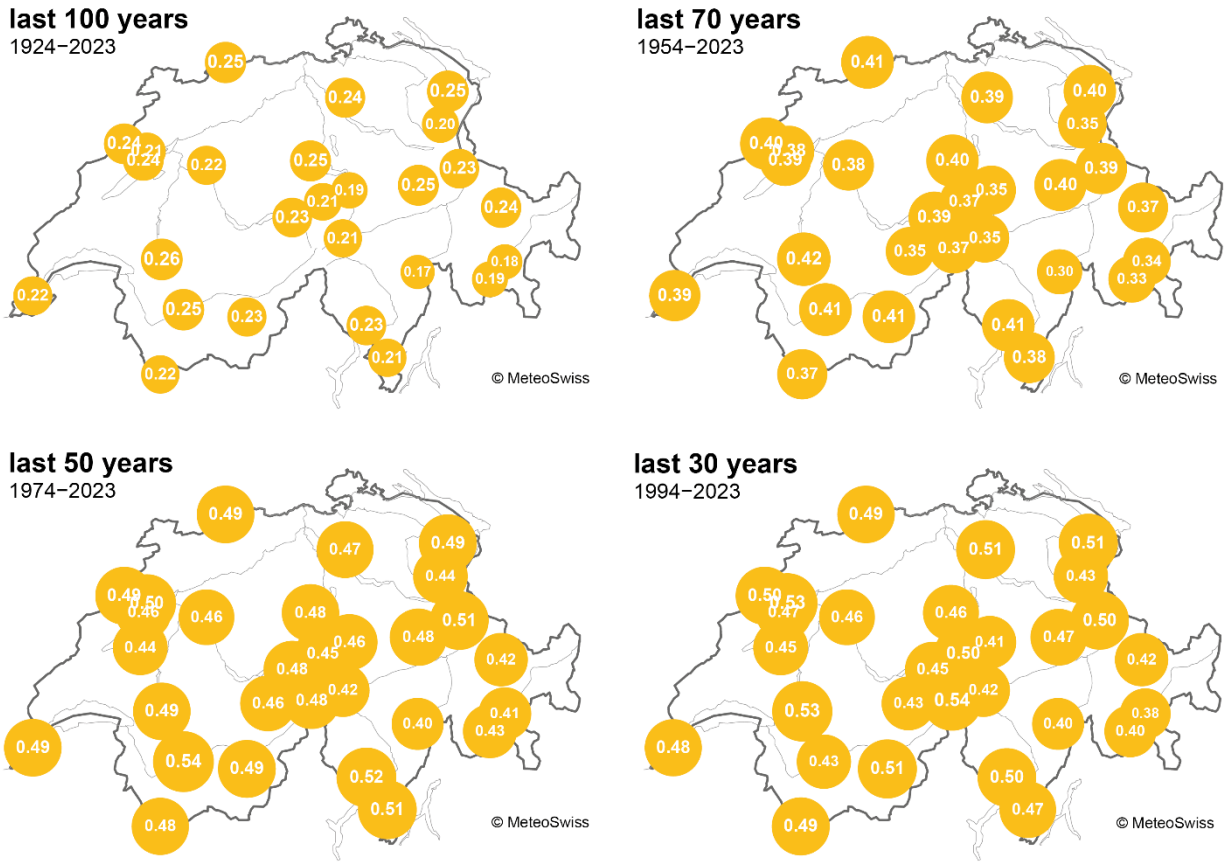
Fig. 14 shows the annual temperature anomaly in Switzerland with respect to 1871–1900 pre-industrial conditions. Annual temperature has increased by 2.8 degrees Celsius between 1864 and 2023 (based on *Scherrer et al.*, 2024). Temperature trends have accelerated substantially for more recent time periods (Fig. 15). This is illustrated by linear trends for different sub-periods. Over the last 100 years (1924–2023), annual temperature has increased by about 0.17 to 0.25 degrees Celsius per decade with no pronounced differences between geographical locations (north-south, low-high altitudes). The trend magnitude is similar for all seasons with a slight tendency to somewhat higher values in summer and winter (up to 0.31 degrees Celsius per decade). Annual temperature trends for the last 70 years (1954–2023) are 0.30 to 0.42 degrees Celsius per decade, for the last 50 years (1974–2023) 0.40 to 0.54 degrees Celsius per decade, and for the last 30 years (1994–2023) 0.38 to 0.54 degrees Celsius per decade. The trends are roughly in agreement with the trends in other parts of Central Europe. In the last 30 years, the trends were largest and significant in summer (0.50 to 0.79 degrees Celsius per decade) and autumn (0.43 to 0.74 degrees Celsius per decade), insignificant for most stations but with a positive sign in winter (0.26 to 0.66 degrees Celsius per decade) and insignificant but with a positive sign in spring (0.14 to 0.35 degrees Celsius per decade). The temperature change in Switzerland since pre-industrial time is slightly more than twice as high as the global mean temperature increase.

Fig. 14 > Global and Swiss mean annual temperature anomalies 1864–2023 (annual temperature shown as deviation from the pre-industrial mean of 1871–1900). The years in Switzerland with positive anomalies (warmer) are shown in orange and those with negative anomalies (cooler) in blue. The black smooth line represents the climate trend using a local linear regression curve (see *Scherrer et al.*, 2024). The red smooth line shows the corresponding global temperature anomalies according to the HadCRUT5 dataset (*Morice et al.*, 2021).



MeteoSwiss[5]

Fig. 15 > Observed trends for annual mean temperature in Switzerland for homogenised station data. Shown are linear trends in degrees Celsius per decade of the last 100 years (1924–2023, top left), the last 70 years (1954–2023, top right), the last 50 years (1974–2023, bottom left) and the last 30 years (1994–2023, bottom right). All trends are positive and statistically significant on the five per cent significance level.



MeteoSwiss[6]

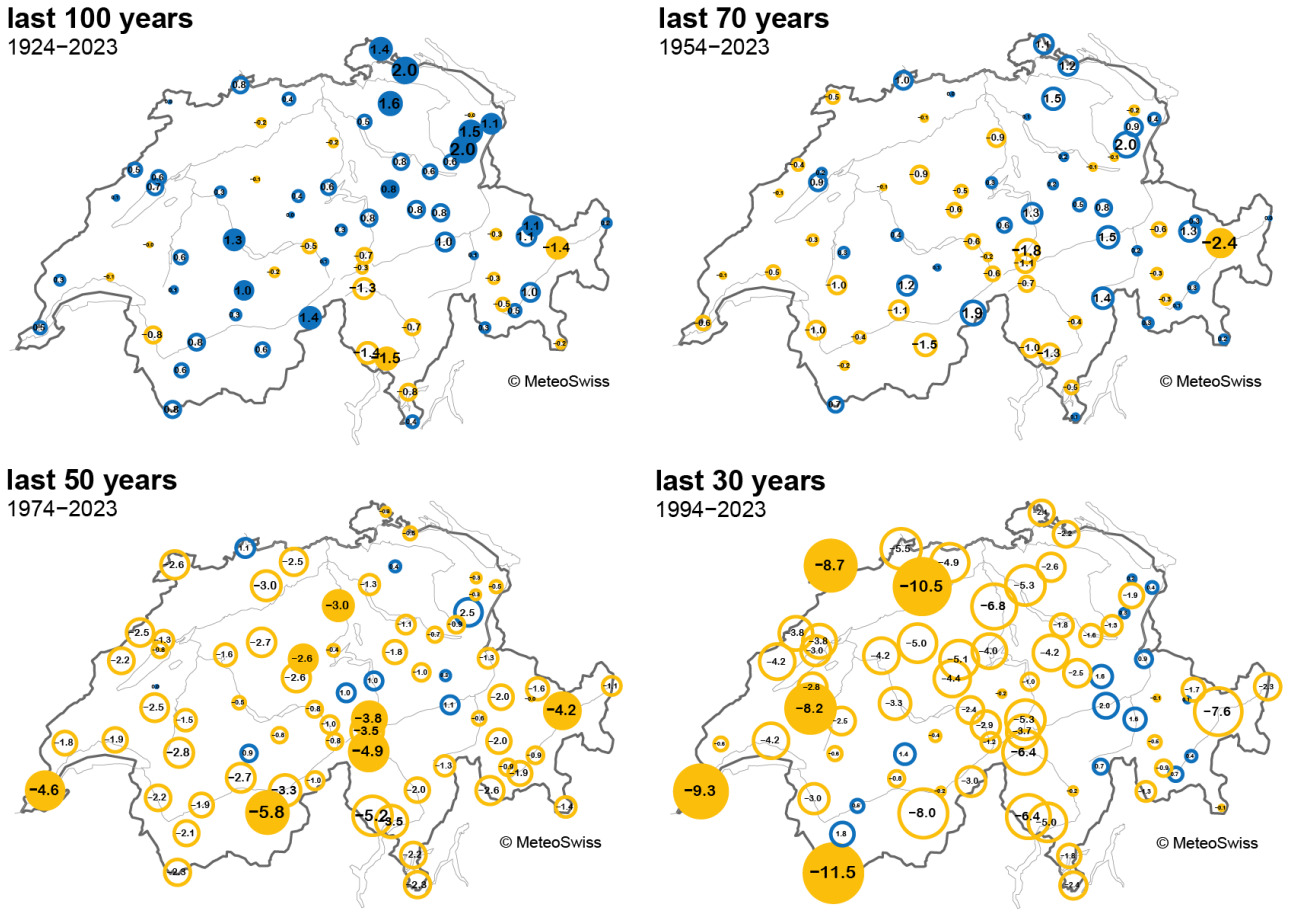
5 https://www.meteoschweiz.admin.ch/service-und-publikationen/applikationen/ext/climate-evolution-series-public.html

6 https://www.meteoschweiz.admin.ch/service-und-publikationen/applikationen/ext/climate-stationtrend.html

Precipitation

Fig. 16 shows the annual precipitation trends in Switzerland for the last 100 years (1924–2023), the last 70 years (1954–2023), the last 50 years (1974–2023) and the last 30 years (1994–2023) years. In contrast to temperature, precipitation trends are insignificant for most stations and time periods considered. Some significantly positive trends are found in northern Switzerland and the Alps considering a time period of 100 years. For the majority of the stations however, the trend magnitudes are insignificant. Predominantly negative trends, some of them significant, are found for the last 30 and 50 years. This is a good example to show that internal decadal variability can still be larger than any underlying long-term trend. Also on the seasonal scale, most trends in mean precipitation are insignificant or not consistent over time (not shown). There are, however, robust indications for changes in heavy precipitation. Since 1901, the intensity of the annual one-day precipitation maxima has increased by about 10 per cent and the frequency of the all-day 99th percentile events (i.e. precipitation sums of more than 25–105 millimetres per day, depending on the region) by about 25 per cent on average (*Bauer and Scherrer*, 2024). The observed changes are consistent with climate model projections, with theoretical understanding of a human-induced change in the energy budget and water cycle and with detection and attribution studies of extremes on larger spatial scales.

Fig. 16 > Observed trends in annual precipitation in Switzerland for homogenised station data. Shown are linear trends in per cent per decade of the last 100 (1924–2023, top left), the last 70 years (1954–2023, top right), the last 50 years (1974–2023, bottom left) and the last 30 years (1994–2023, bottom right). Positive trends (i.e. more precipitation) are shown in blue, negative trends (i.e. less precipitation) are shown in orange. Filled circles: Trends that are statistically significant (five per cent significance level), open circles: non-significant trends.



MeteoSwiss[7]

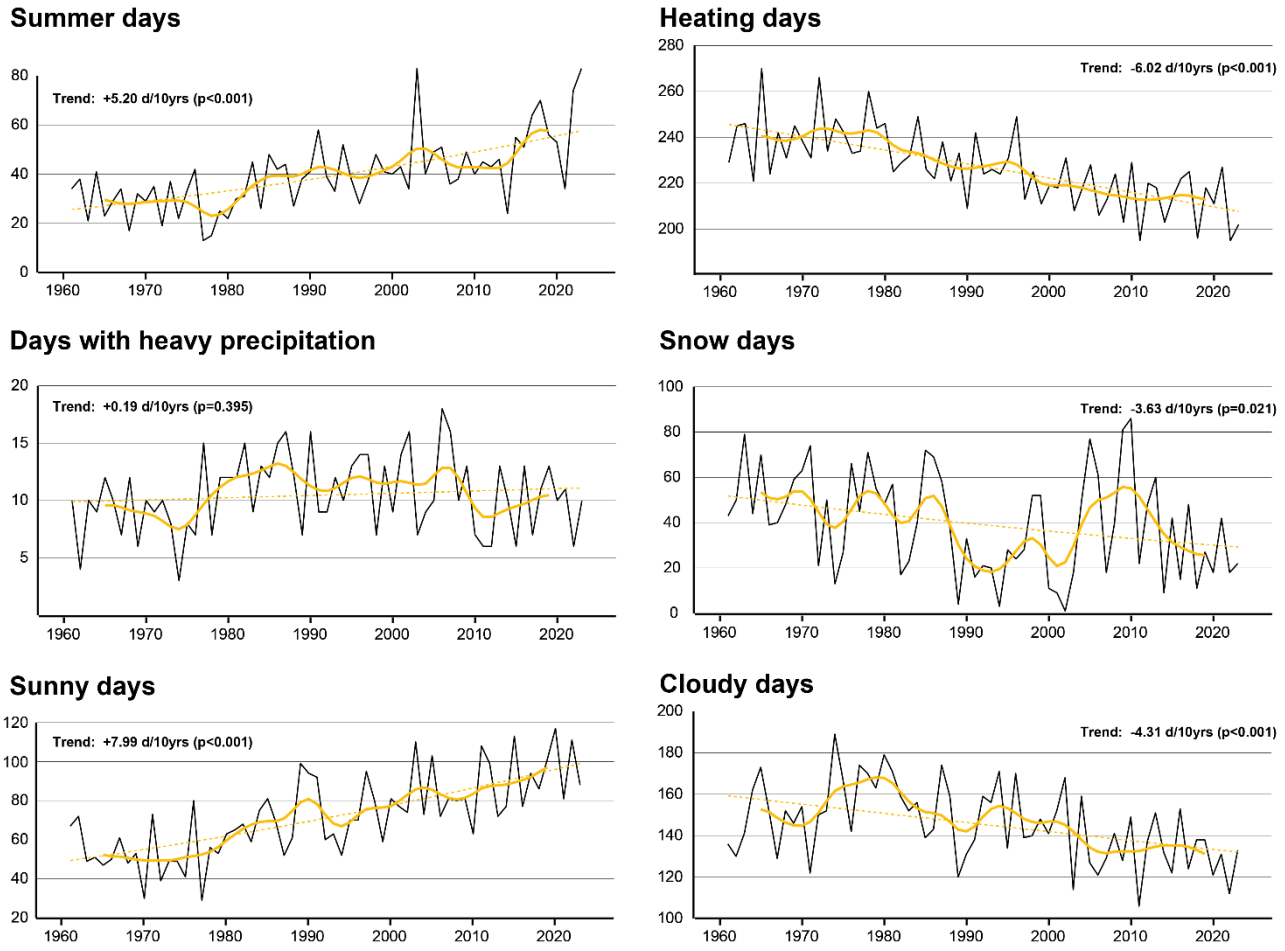
Climate indices

Fig. 17 shows the evolution of some important climate indices at the station Bern/Zollikofen for the time period from 1961–2023. This station can be considered as representative for the general evolution on the densely populated Central Plateau. The average number of summer days has more than doubled from roughly 25 days per year in the 1960s to more than 50 days per year today (Fig. 17, top left). This increase is highly significant and very similar trends are found for

[7] https://www.meteoschweiz.admin.ch/service-und-publikationen/applikationen/ext/climate-stationtrend.html

most stations on the Central Plateau. In contrast, the number of heating days has decreased by about 15 to 20 per cent in the same time period (Fig. 17, top right). The number of days with heavy precipitation (Fig. 17, middle left) has increased somewhat, although the trend is not statistically significant. Similar insignificant increases are found for most stations on the Central Plateau. A decrease is found for the number of snow days (Fig. 17, middle right). The number of sunny days (relative sunshine duration larger than 80 per cent, Fig. 17, bottom left) shows a significant increase whereas the number of cloudy days (relative sunshine duration less than 20 per cent) is decreasing (Fig. 17, bottom right). These trends are consistent with most stations on the Central Plateau. Trends in sunshine duration have been negative especially in the period of the late 1940s to about 1980. Today's values are now back to the level seen in the late 19th, early 20th century.

Fig. 17 > Climate indices for the period 1961–2023 at the station Bern/Zollikofen. Observed annual number of summer days (days with maximum temperature ≥25 degrees Celsius, top left), heating days (days with a daily average temperature below 12 degrees Celsius, top right), days with heavy precipitation (daily precipitation >20 mm, middle left), snow days (days with snow depth of at least one centimetre, middle right), sunny days (days with relative sunshine duration larger than 80 per cent, bottom left) and cloudy days (days with relative sunshine duration lower than 20 per cent, bottom right). Homogenised station data are used for the temperature-based and precipitation-based indices. The solid orange line represents 11-year Gaussian low pass filtered data, the dashed orange line the linear fit (logistic regression).



MeteoSwiss[8]

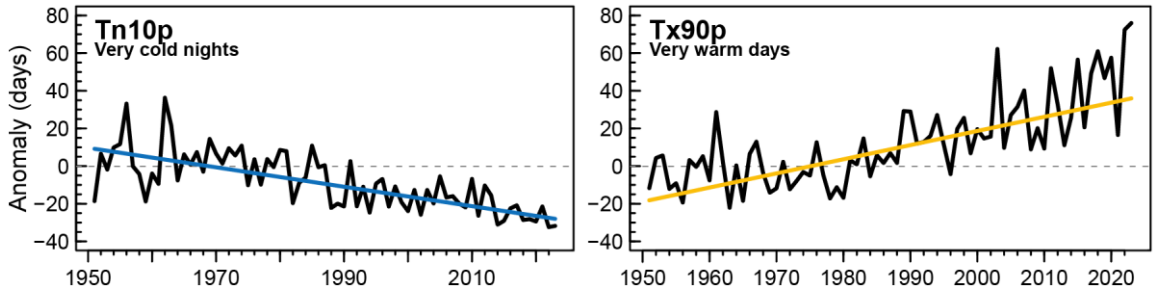
Extreme events

Numerous extreme climate and weather events struck Switzerland during the last decades (flooding, heat waves, dry periods, storms, etc.). However, due to the strong natural variability, it is challenging to provide evidence for changes in the frequency or intensity of extreme events, in particular in view of Switzerland's relatively small area. Nevertheless, most meteorological stations in Switzerland show a highly significant trend to less very cold nights as well as an increase in very warm days (Fig. 18). Further, the frequency and intensity of heavy precipitation events have increased at most (>90 per cent) of the meteorological stations in Switzerland (*Bauer and Scherrer*, 2024). For small scale processes such as flash floods, debris flows, landslides, hail events etc. it is very hard to analyse trends because of a relatively short

8 https://www.meteoschweiz.admin.ch/service-und-publikationen/applikationen/ext/climate-indicators-public.html

observational record and limited process understanding (*SCNAT*, 2016; *CH2018,* 2018). Extreme events, including related risks, vulnerability and damages, are further discussed in chapter 6 of Switzerland's eighth national communication and fifth biennial report.

Fig. 18 > Observations of very cold nights (daily minimum temperature amongst the lowest 10 per cent) and very warm days (daily maximum temperature amongst the highest 10 per cent) in Switzerland, 1951–2023. The mean Mann-Kendall trends for the period 1951 to 2023 are –5.2 days per 10 years for Tn10p and +7.5 days per 10 years for Tx90p. Both trends are highly significant ($p<10^{-3}$).



SCNAT (2016), updated by MeteoSwiss with data from 1951–2023

II.A.6 Sector details

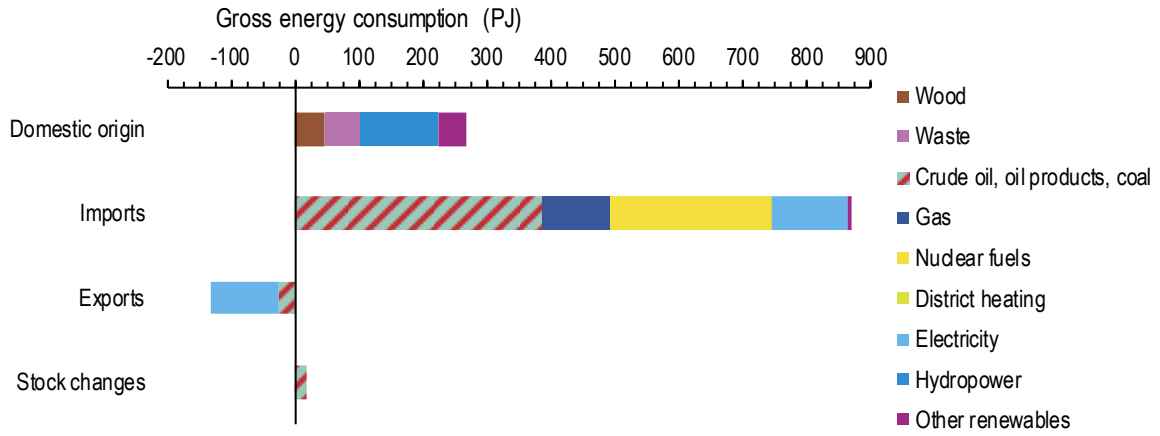
II.A.6.1 Energy

Energy supply and final energy consumption

As there are no domestic gas, oil, coal or nuclear fuel resources, Switzerland's primary energy sources are limited to wood, hydropower, waste and other forms of renewable energy sources (wind and solar power, biogas, etc.). Accordingly, Switzerland's energy system largely depends on fossil energy imports, while it is almost self-sufficient regarding carbon-free electricity, as highlighted in the detailed energy flow diagram (Fig. 20).

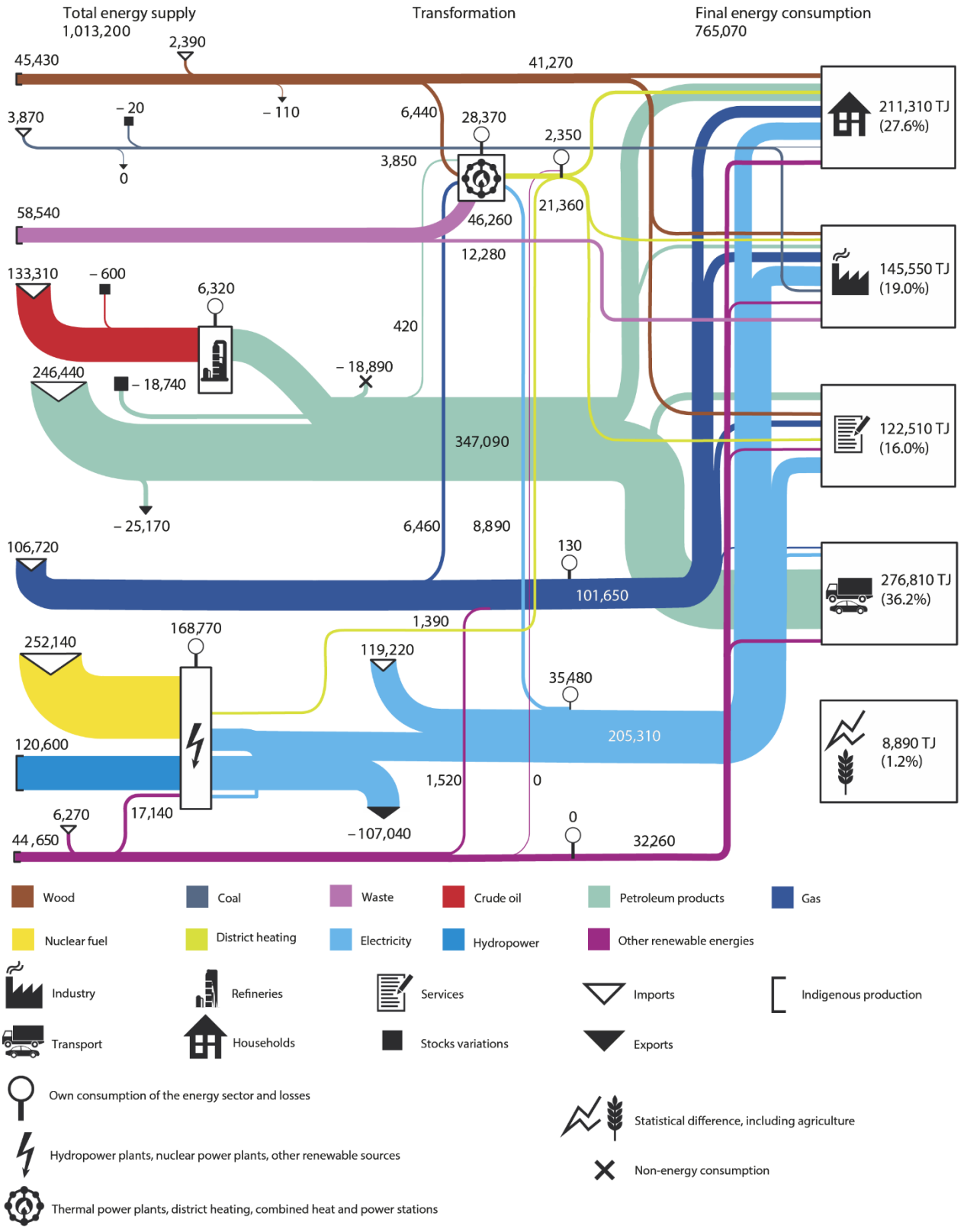
In 2022, gross energy consumption amounted to 1,025,380 terajoules, composed as follows (see Fig. 19): (i) 269,220 terajoules were of domestic origin (44.8 per cent hydropower, 21.7 per cent waste, 16.9 per cent wood, 16.6 per cent other renewable energy sources), (ii) 870,360 terajoules were imported (43.6 per cent crude oil and oil products, 12.3 per cent gas, 29.0 per cent nuclear fuel, 13.7 per cent electricity, 1.0 per cent wood and other renewable energy resources, and 0.4 per cent coal), (iii) exports accounted for a total of 132,320 terajoules (80.9 per cent electricity, 19.0 per cent oil products, 0.1 per cent wood), and (iv) the remaining 18,120 terajoules corresponded to stock changes of mainly crude oil, but also oil products and coal (*SFOE*, 2023a).

Fig. 19 > Switzerland's gross energy consumption in 2022 (1,025,380 terajoules).



SFOE (2023a)

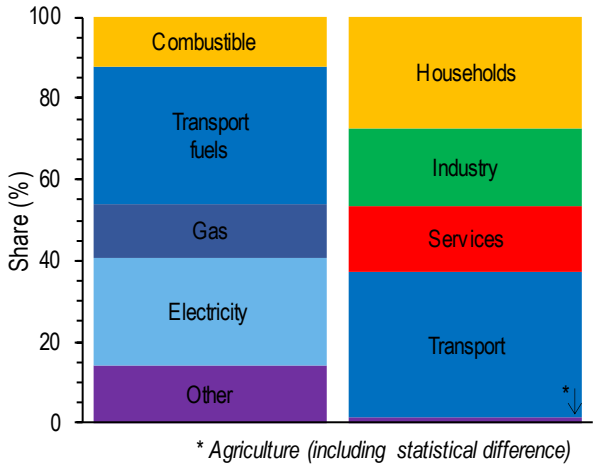
Fig. 20 > Energy flows in Switzerland in 2022 (numbers in terajoules). Gross energy consumption of 1,025,380 terajoules corresponds to total energy supply (1,013,200 terajoules) adjusted by imports (119,220 terajoules) and exports (–107,040 terajoules) of electricity.



SFOE (2023a)

In 2022, the final energy consumption totalled at 765,070 terajoules. The shares of the different energy carriers as well as the consumption in the sectors transport, services, industry, households, and agriculture (including statistical difference) are shown in Fig. 21.

Fig. 21 > Switzerland's final energy consumption in 2022 (765,070 terajoules). The category other includes wood, waste, other renewables, and district heating.



SFOE (2023a)

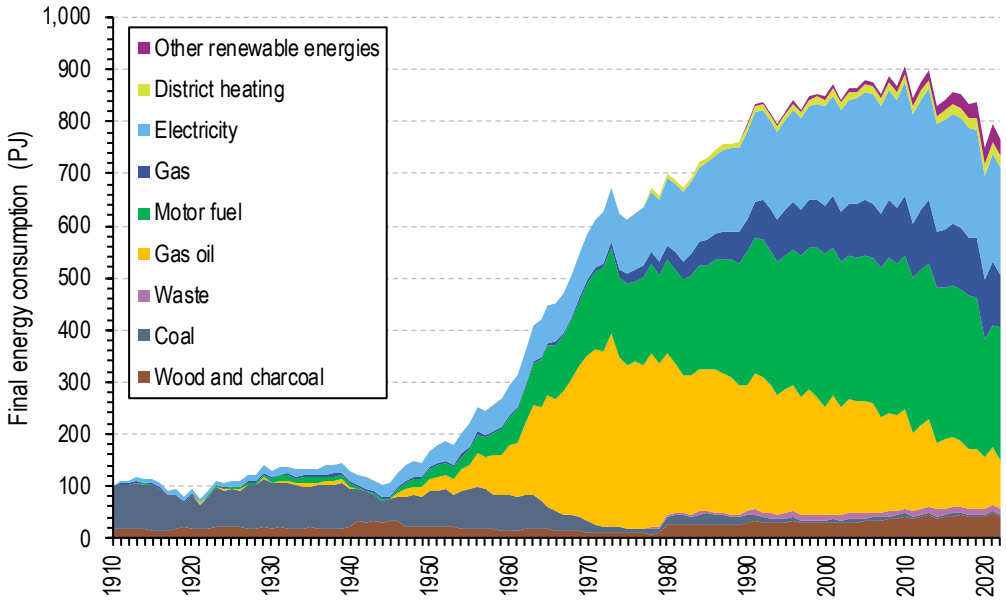
Final energy consumption started to increase substantially after the first half of the last century, with the largest increases seen in gas oil, motor fuel and electricity (Fig. 22). In order to average the strong impact of meteorological conditions on heating demand, leading to rather large year-to-year variations in the final energy consumption (see also sections II.A.5 and the data presented in chapter II.E), mean values over several years are discussed in the following. Compared to the mean final energy consumption between 1910 and 1915, the mean final energy consumption was more than sevenfold higher between 2017 and 2022. The highest final energy consumption, over a period of five years, occurred between 2009 and 2013, 10.1 per cent higher compared to 1988 to 1992. However, final energy consumption has slightly decreased for about the last decade. In 2020, final energy consumption was remarkably below usual values due to the measures to contain the corona virus pandemic. Renewable energy sources (not including hydropower) still contributed a minor share of 4.2 per cent to the final energy consumption in 2022. Nevertheless, supported by the SwissEnergy programme (section II.D.2.3), renewable energy sources gained importance during the last years. Between 1990 and 2022, the annual generation of solar electricity increased from 4 to 13,888 terajoules (over the last five years it increased by a factor of 2.3), while the annual generation of wind electricity increased from 0 to 540 terajoules.

The evolution of final energy consumption by households, services, industry and transport is shown in Fig. 23 (left), relative to 1990. The final energy demand in the transport sector shows an increase of up to about 20 per cent between 1990 and about the last decade, with fluctuations that correlate with the economic development, e.g. periods of stagnation from 1993 to 1996 and from 2001 to 2003, and periods of growth (gross value added) from 1997 to 2000 and 2004 to 2008. The decrease in 2015 mostly results from the collapsing 'fuel tourism'[9] as a consequence of a sudden drop in the exchange rate between the Euro and the Swiss franc once the Swiss National Bank ceased sustaining a minimal exchange rate. In 2020, the measures to contain the corona virus pandemic led to a strong decrease of final energy consumption in the transport sector, followed by a partial recovery until 2022. As mentioned above, final energy demand of households strongly depends on meteorological conditions. The extraordinary decreases from e.g. 2006 to 2007, 2010 to 2011, 2013

[9] Due to fluctuating fuel price differences between Switzerland and its neighbouring countries, gas stations in the vicinity of the national borders sell varying amounts of fuels to customers across the border. This amount of fuel is referred to as 'fuel tourism' and is large enough to have a relevant influence on Switzerland's total fuel sales. The value for fuel tourism can be negative (in case of net fuel imports – e.g. for diesel oil in the years 2015–2021, since it was cheaper in the neighbouring countries) or positive (in case of net fuel exports – e.g. for gasoline in most years, since it has been cheaper in Switzerland). The evolution of fuel tourism mainly depends on the development of the exchange rate between the Euro and the Swiss franc. In the greenhouse gas inventory, fuel tourism is recorded together with the statistical difference, i.e. as the difference between nationwide sales (top-down) and modelled consumption (bottom-up). *Keller and Wüthrich* (2014) provide a more reliable estimate of the effective fuel tourism. In their study, they analysed the effective sales of diesel oil and gasoline near the national borders. For the years 2002 to 2013, they estimate that fuel tourism for gasoline led to between 250 million and 440 million litres per year of additional sales, while for diesel oil it led to between 45 million litres per year of reduced sales and 50 million litres per year of additional sales. Fuel tourism thus led to additional CO_2 emissions of up to slightly over one million tonnes per year (highest value estimated for 2007, corresponding to slightly over five per cent of total CO_2 emissions from gasoline and diesel oil). Since the decrease in 2015, fuel tourism has been substantially less important. During the last years, although no detailed analysis is available, it may have accounted for a few hundred thousand tonnes of CO_2 per year at most (see estimates provided in energy units in Table 1 of *SFOE*, 2023e).

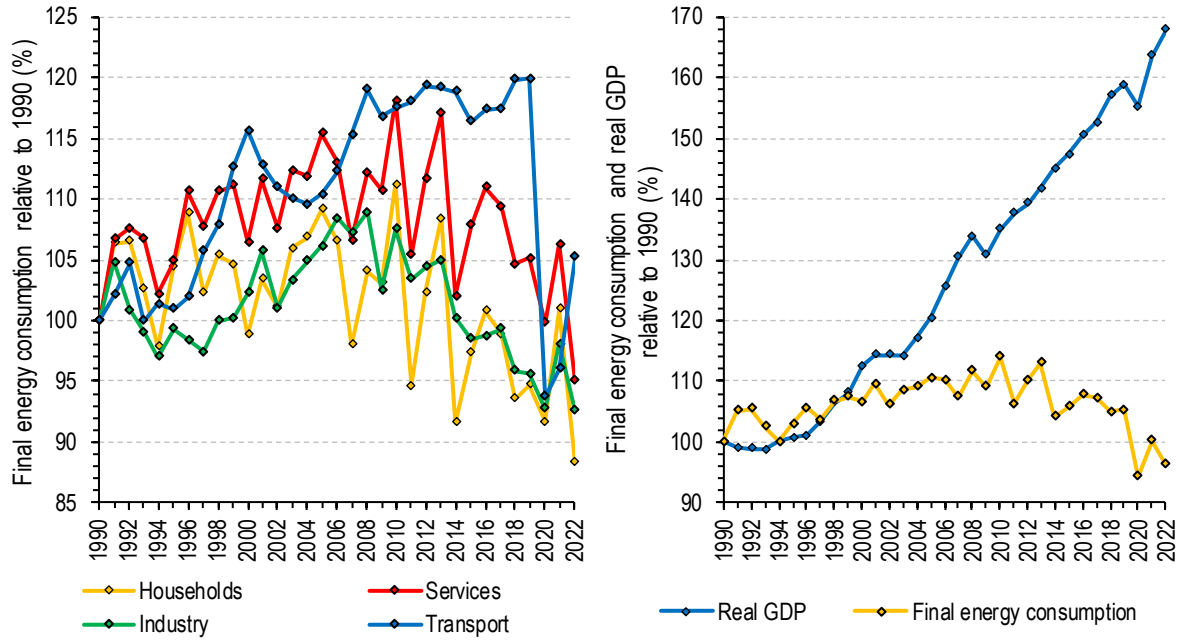
to 2014, and 2021 to 2022 reflect the changes from relatively cool to relatively warm winters. From 1990 to 2022, the number of buildings and apartments, as well as the average floor space per person have increased (section II.A.6.5). Both phenomena have resulted in an increase in the total area heated. Over the same period, however, higher standards have been specified for insulation and for combustion equipment efficiency for both new and renovated buildings, compensating for the energy consumption from the additional area heated (section II.D.2.5). The final energy consumption of services has also been influenced by the meteorological conditions as well as efficiency improvements. The final energy consumption of the industry sector has shown a decreasing trend since about a decade. Supported by the contributions of households and services, this decreasing trend has been reflected in the total final energy consumption as well, while the real gross domestic product has continued to strongly increase (Fig. 23, right). The reasons for these diverging developments are, on the one hand, an increase in energy efficiency thanks to modern production processes leading to a lower energy input per gross value added. On the other hand, starting in the early 1990s, the production of many energy-intensive goods have been sourced out to foreign countries, leading to an even more service-based economy in Switzerland. Although energy-intensive goods have still been consumed in Switzerland, the energy required for their production has no longer been accounted for in the national total.

Fig. 22 > Final energy consumption between 1910 and 2022 according to energy source.



SFOE (2023a)

Fig. 23 > Final energy consumption by households, services, industry and transport between 1990 and 2022, relative to 1990 (left). Final energy consumption and real gross domestic product (GDP, reference year 2015) between 1990 and 2022, relative to 1990 (right).

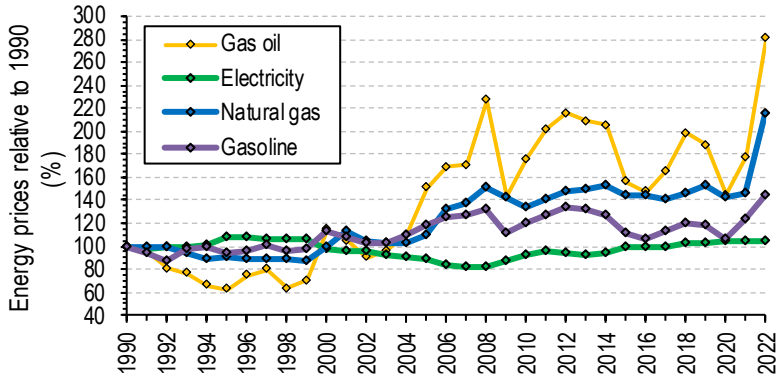


SFOE (2023a)

Energy prices, taxes and subsidies

The evolution of energy prices at the level of consumers is shown in Fig. 24. Prices for gas oil reached historic low values in the mid-1990s, then substantially increased to between 40 to more than 100 per cent above the prices in 1990. Prices for natural gas and gasoline show similar patterns, although the maximum prices – reached after 2010 – were about 50 and 30 per cent above the prices in 1990, respectively. Until 2008, prices for electricity decreased to about 80 per cent of the prices in 1990, however, then continuously increased to reach again the 1990 level during the most recent years. During the last two years, energy prices for gas oil, natural gas and gasoline substantially increased as a result of shortages in the aftermath of the corona virus pandemic as well as the Russian invasion of the Ukraine.

Fig. 24 > Relative development of real energy prices (level of consumers, basis 2020) in Switzerland between 1990 and 2022.



SFOE (2023a)

In Switzerland, energy prices at the level of consumers are composed of the basic price, the value-added tax, as well as various energy taxes and climate levies. Regarding the value-added tax, the normal rate of 7.7 per cent applies (8.1 per cent as of 1 January 2024). Energy taxes and climate levies depend on the fuel type and were as follows (as of 1 January 2022; e.g. *FOCBS*, 2022a):

- Heating and process fuels: (i) mineral oil tax (e.g. 3.00 Swiss francs per 1,000 litres of gas oil or 2.10 Swiss francs per 1,000 kilograms of natural gas) and (ii) CO_2 levy (e.g. 318.00 Swiss francs per 1,000 litres of gas oil or 321.60 Swiss francs per 1,000 kilograms of natural gas);

- Motor fuels: (i) mineral oil tax (e.g. 453.00 Swiss francs per 1,000 litres gasoline, 481.10 Swiss francs per 1,000 litres of diesel oil, or 112.50 Swiss francs per 1,000 kilograms of natural gas), (ii) mineral oil surtax (e.g. 315.20 Swiss francs per 1,000 litres of gasoline, 314.60 Swiss francs per 1,000 litres of diesel oil, or 109.70 Swiss francs per 1,000 kilograms of natural gas), and (iii) for the partial compensation of CO_2 emissions from motor fuels (section II.D.3.4), the permitted compensation surcharge on motor fuels amounts to a maximum of 50.00 Swiss francs per 1,000 litres;
- Kerosene: As in other countries, kerosene used for international flights is exempt from taxation, but similar taxes as for other motor fuels apply for kerosene used for domestic flights.

Additionally including transport costs and the trade margin, consumers had to pay the following energy prices as of January 2022 (*FOCBS*, 2022b):

- Gasoline (per litre): 1.780 Swiss francs, including 50.5 per cent of taxes and levies;
- Diesel oil (per litre): 1.830 Swiss francs, including 50.9 per cent of taxes and levies;
- Gas oil (per litre): 0.959 Swiss francs, including 32.6 per cent of taxes and levies.

Tab. 1 shows the relative comparison of energy prices in Switzerland and its neighbouring countries as of January 2022 (*FOCBS*, 2022b), i.e. before the increases that started in the course of 2022. The price for gasoline in Switzerland was about the same as in Germany and Italy, but somewhat higher compared to France and Austria. Diesel oil was generally more expensive in Switzerland compared to its neighbouring countries. With regard to gas oil, energy prices in Switzerland were in the middle of the field, despite the relatively high CO_2 levy (see section II.D.1.6).

Tab. 1 > Energy prices in Switzerland and its neighbouring countries as of January 2022, including all taxies and levies (relative prices with prices for Switzerland set to 100.0).

Country	Gasoline	Diesel oil	Gas oil
Switzerland	100.0	100.0	100.0
Germany	100.0	89.1	92.6
France	94.8	87.0	112.0
Italy	100.3	89.9	150.6
Austria	81.2	78.1	93.2

FOCBS (2022b)

Switzerland promotes, on the national and international level, the regulation of fuel consumption and associated greenhouse gas emissions by means of CO_2 pricing, as highlighted in the OECD's report on effective carbon rates (*OECD*, 2021b). According to the OECD data explorer[10], Switzerland's effective carbon rates[11] for emissions from all sectors (excluding emissions from the combustion of biomass) cover, by 2021, 42 per cent of total emissions with a rate exceeding 120 Euro per tonne of CO_2, 84 per cent of total emissions with a rate exceeding 60 Euro per tonne of CO_2, and 91 per cent of total emissions with a rate exceeding 30 Euro per tonne of CO_2, respectively. In particular, the carbon rates for emissions from road transport cover 100 per cent of total emissions with a rate exceeding 120 Euro per tonne of CO_2. In comparison with other countries, Switzerland's effective carbon rates are exceptionally high. This is the case because of comprehensive fuel taxes in the transport sector (e.g. the mineral oil tax), the CO_2 levy on heating and process fuels (see section II.D.1.6), a highly decarbonised electricity supply as well as high coverage of emissions from the industry sector by the emissions trading scheme (see section II.D.1.7).

[10] *https://data-explorer.oecd.org* (shares of CO_2 emissions from energy priced)

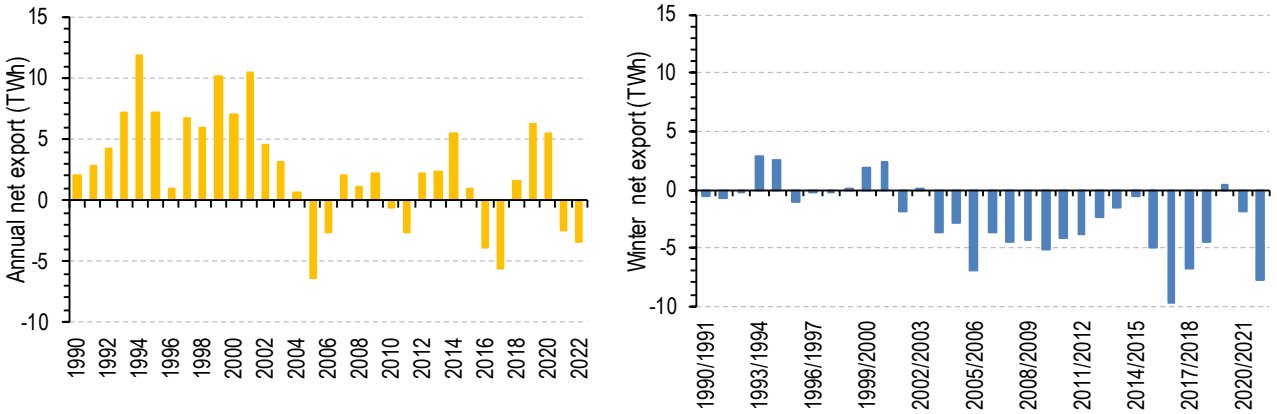
[11] According to *OECD* (2021b), effective carbon rates are the total price that applies to CO_2 emissions from energy use as a result of market-based policy instruments. They are the sum of taxes and tradable emission permit prices, and have three components:

- Carbon taxes, which typically set a tax rate on energy based on its carbon content;
- Specific taxes on energy use (primarily excise taxes), which are typically set per physical unit or unit of energy, but which can be translated into effective tax rates on the carbon content of each form of energy;
- The price of tradable emission permits, regardless of the permit allocation method, representing the opportunity cost of emitting an extra unit of CO_2.

Electricity trade

According to the Swiss electricity statistics (*SFOE*, 2023b), electricity is traded across Switzerland's borders on a fairly large scale. In 2022, exports accounted for 29.7 terawatt-hours and imports for 33.1 terawatt-hours, corresponding to a substantial amount relative to the total inland electricity production of 63.5 terawatt-hours. Switzerland exchanges electricity with its neighbouring countries Austria, France, Germany, Italy and Liechtenstein. Apart from the years 2005, 2006, 2010, 2011, 2016, 2017, 2021, and 2022, Switzerland's annual electricity exports exceeded the imports by up to more than 10 terawatt-hours (Fig. 25, left). However, during winter time the situation is different, as Switzerland's imports generally exceed the exports (Fig. 25, right). Among the factors affecting the volume of electricity traded across the borders of Switzerland are hydrological and climatic conditions.

Fig. 25 > Switzerland's net export of electricity from 1990 to 2022. Positive values refer to exports, negative values refer to imports. Left: Total annual net exports. Right: Net exports during winter time.



SFOE (2023b)

II.A.6.2 Transport

Overview

Switzerland's transport infrastructure is in a very advanced state. Individual and freight transport is facilitated by the road and rail networks, which overall occupy about two per cent of the total land surface. Public transport is of great importance, meaning that virtually every location can be reached by train or, in particular in more remote regions of the Alps, by scheduled public buses.

The road network is divided into national roads (2,255 kilometres, thereof 1,544 kilometres highways), cantonal roads (17,227 kilometres) as well as communal and private roads (65,406 kilometres, *SFSO*, 2023d). Most Swiss people live within a distance of 10 kilometres of a highway access.

The rail network, which is fully electrified, currently has a total length of 5,317 kilometres and includes 1,735 stations. To enhance capacity, reduce travel times, and to allow for synchronised timetables between major connecting stations, several railway projects have been implemented since 1987. Under the first stage of the project RAIL 2000, implemented until 2004, the length of the rail network did not increase significantly, but a schedule with 30-minutes intervals could be widely introduced between all major cities, in particular reducing travel time between Zurich and Bern by 13 minutes. To foster the shift from road to rail, three new railway tunnels, constructed in the framework of the project New Rail Link through the Alps, substantially increased transalpine transport capacity and speed – the Lötschberg base tunnel (34.6 kilometres) opened in December 2007, the Gotthard base tunnel (57.1 kilometres) opened in December 2016, and the Ceneri base tunnel (22.6 kilometres) opened in December 2020. Thanks to the Gotthard base tunnel, the highest elevation for transalpine railway traffic is now as low as 549 metres above sea level. The Federal Act on the Future Development of the Railway Infrastructure (*Swiss Confederation*, 2009) and the Federal Decree on the Financing and Development of Railway Infrastructure (FABI, approved by a popular vote in 2014) regulate the next steps of the modernisation and development of the Swiss rail network, focusing on a further increase of capacity and even better access to the major tunnels crossing the Alps and the high-speed network in neighbouring countries (*FOT*, 2023).

The three national airports Zurich, Geneva and Basel-Mulhouse[12] are the most important aviation infrastructures of Switzerland. A dense network of flight routes connects Switzerland with Europe and important destinations worldwide. More than 100 airlines are serving Switzerland, with five operating as Swiss companies (*LUPO*, 2016).

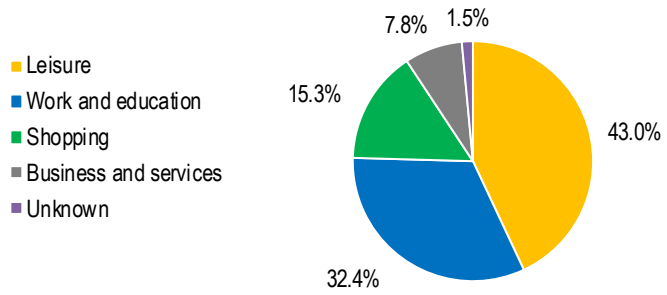
Last but not least, the Federal Constitution of the Swiss Confederation mandates the federal government to coordinate pedestrian and hiking networks as well as – since a recent popular vote – also cycle paths (see section II.D.3.1).

Passenger transport (land-based)

In 2021, each Swiss over the age of six years travelled an average daily distance within Switzerland of 30.0 kilometres, spending 80 minutes (75 minutes without waiting times). In 1994, 2000, 2005, 2010, and 2015 the average daily travel distance was 31.3, 35.0, 35.2, 36.7, and 36.8 kilometres, respectively. The average daily travel distance by car slightly increased between 1994 and 2000, has remained stable at about 23.8 kilometres thereafter, and slightly decrease to 20.8 kilometres in 2021. In contrast, the average daily travel distance using public transport has steadily increased from 5.6 kilometres in 1994 to 9.0 kilometres in 2015 (corresponding to an increase of more than 61 per cent), followed by a decrease to 5.9 kilometres in 2021. Travel distances for leisure purposes have increased since 1994, accounting for a share of 43.0 per cent of the total travel distance within Switzerland in 2021. In contrast, travel distances related to work and education accounted for a share of 32.4 per cent, while travel distances for shopping purposes accounted for a share of 15.3 per cent (Fig. 26; *SFSO and ARE*, 2023). While the average daily travel distance per person has remained about constant after 2010, passenger kilometres have continued to increase as a result of population growth (Fig. 1 and Fig. 27; *SFSO*, 2023b); the evolution in the years 2020 and 2021 is strongly affected by the measures to contain the corona virus pandemic.

Between 1980 and 2022, motorised private transport (total passenger kilometres) has increased by 35.6 per cent and public transport on road and rail (total passenger kilometres) has increased by 74.2 per cent. In 2022, 20.6 per cent of total motorised passenger kilometres were travelled by public transport means (3.7 per cent public road, 16.9 per cent rail). Non-motorised transport (walking, cycling, hiking, etc.) accounted for almost eight billion passenger kilometres in 2022.

Fig. 26 > Shares of different purposes on total travel distance within Switzerland (i.e. excluding travel distances abroad) in 2021.

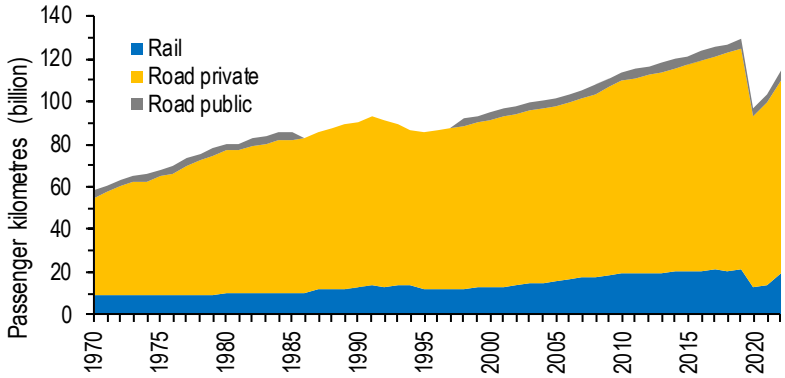


SFSO and ARE (2023)

The number of cars in Switzerland has increased from 3.0 million in 1990 to 4.7 million in 2022 (*SFSO*, 2024j), i.e. today less than two persons share a car on average. According to *SFOE* (2023c), the weight of new passenger cars has continuously increased since 1990. Nevertheless, the average specific emissions of new passenger cars decreased from about 200 grams of CO_2 per kilometre in 2002 to about 120 grams of CO_2 per kilometre in 2022, thanks to more efficient motors and a continuous shift from gasoline to diesel oil. Between about 2015 and 2019, the balance of the following evolutions resulted in about constant average specific emissions: (i) the efficiency (fuel consumption per distance) of gasoline and diesel oil cars did not further improve (because the weight has continued to increase), (ii) the share of new passenger cars fuelled by diesel oil decreased from about 40 per cent to about 25 per cent, and (iii) the share of electric vehicles started to increase slightly. Since 2020, the average specific emission of new passenger cars has again been decreasing, in particular thanks to the increase in the share of electric vehicles (26.1 per cent of newly registered passenger cars were electric vehicles in 2022).

[12] The airport Basel-Mulhouse is located in France, but operated jointly by France and Switzerland.

Fig. 27 > Passenger kilometres by motorised traffic on road (private and public) and rail from 1970 to 2022. Road public data from 1986 to 1997 is missing. A strong decrease in passenger kilometres occurred from 2019 to 2020 due to the measures to contain the corona virus pandemic.

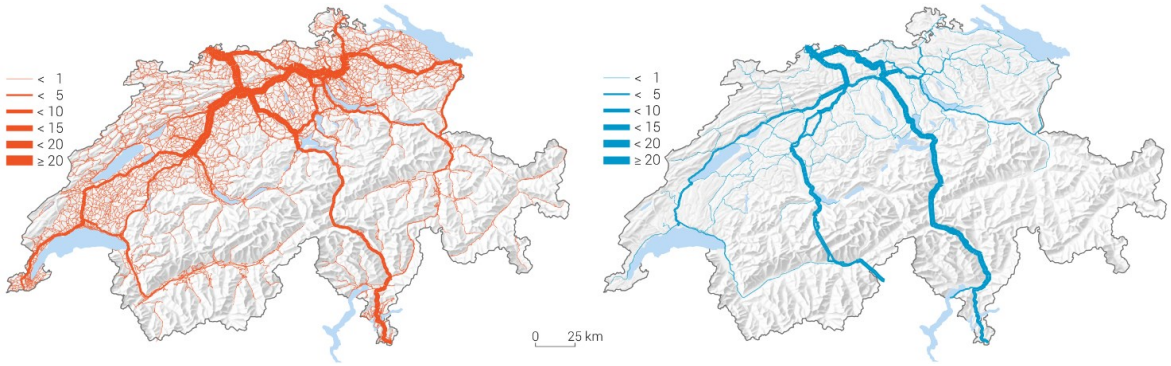


SFSO (2023b)

Freight transport (land-based)

Freight transport in Switzerland is focussed on the Central Plateau and the major transalpine routes (Fig. 28; *SFSO*, 2017b). While freight transport on road and rail has been increasing since the mid-19th century, the shares of freight transported on rail decreased from more than 50 per cent before 1982 to around 40 per in the early 1990s (Fig. 29; *SFSO*, 2024g). It has remained about constant afterwards, mostly due to the restrictions on road freight transport inscribed in the Federal Constitution of the Swiss Confederation in 1994[13], the implementation of the distance-related heavy vehicle charge and corresponding bilateral agreements with the European Union. Moreover, in contrast to France and Austria, the transalpine freight transport in Switzerland is dominated by rail (Fig. 30; *SFSO*, 2023c), inter alia, thanks to newly constructed railway tunnels.

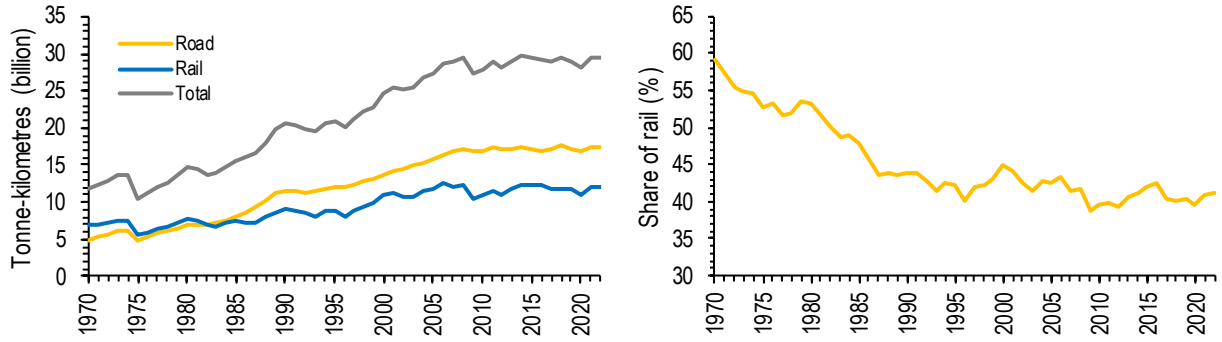
Fig. 28 > Freight transport in Switzerland on road (left, red) and rail (right, blue) in 2015 (numbers correspond to million tonnes per year).



SFSO (2017b)

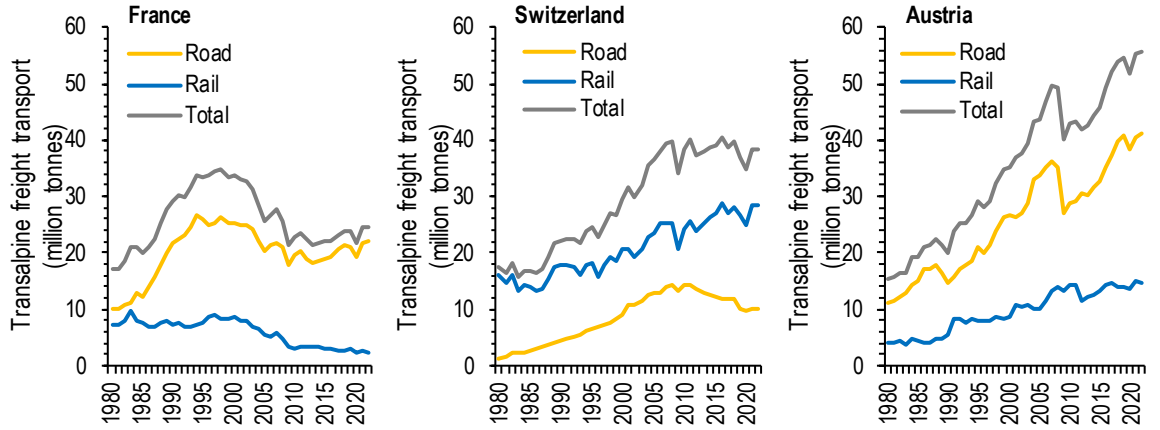
[13] Federal Constitution of the Swiss Confederation, Article 84 'Alpine transit traffic': (i) The Swiss Confederation shall protect the Alpine region from the negative effects of transit traffic. It shall limit the nuisance caused by transit traffic to a level that is not harmful to people, animals and plants or their habitats, (ii) Transalpine goods traffic shall be transported from border to border by rail. The Swiss Federal Council shall take the measures required. Exceptions are permitted only when there is no alternative. They must be specified in detail in a federal act, (iii) The capacity of the transit routes in the Alpine region may not be increased. This does not apply to by-pass roads that reduce the level of transit traffic in towns and villages.

Fig. 29 > Freight transport on rail and road (tonne-kilometres, right) and share of rail (left) between 1970 and 2022.



SFSO (2024g)

Fig. 30 > Transalpine freight transport including inland, import, export and transit on road (orange) and rail (blue) from 1980–2022 in France (left), Switzerland (centre) and Austria (right). For Switzerland, transalpine freight transport is dominated by rail, which was responsible for 74 per cent of the total of 38.3 million tonnes transported in 2022.

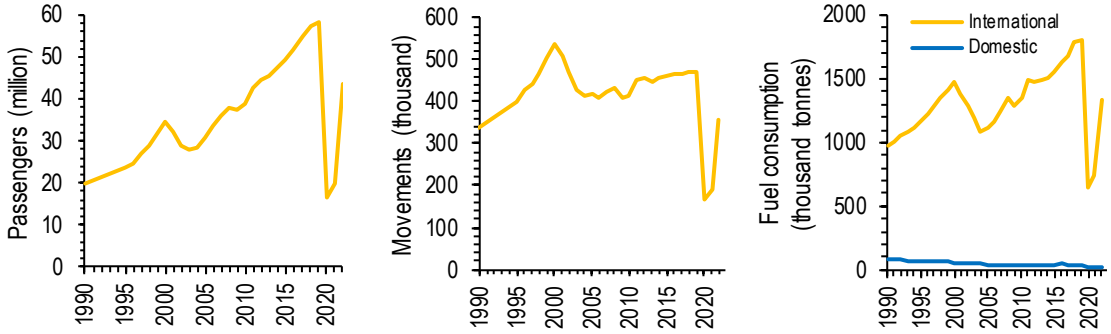


SFSO (2023c)

Aviation

In Switzerland, thanks to the relatively short distances and the dense and efficient road and railway networks, the share of domestic aviation is negligible. However, due to the establishment of a dense network of flight routes to Europe and direct flights to important destinations worldwide, the number of scheduled and charter flights departing from and landing in Switzerland has increased considerably between 1990 and 2000. After 2001, the grounding of the national airline and a general crisis in aviation led to a reduction of flight movements in Switzerland (Fig. 31).

Fig. 31 > Left: Number of passengers between 1990 and 2022 (included are all local and transit passengers of scheduled and charter flights of all national and regional airports of Switzerland). Centre: Number of aircraft movements between 1990 and 2022 (included are all domestic and transit passengers of scheduled and charter flights of all national and regional airports of Switzerland). Right: Amount of fuel sold between 1990 and 2022 within Switzerland for domestic and international aviation.



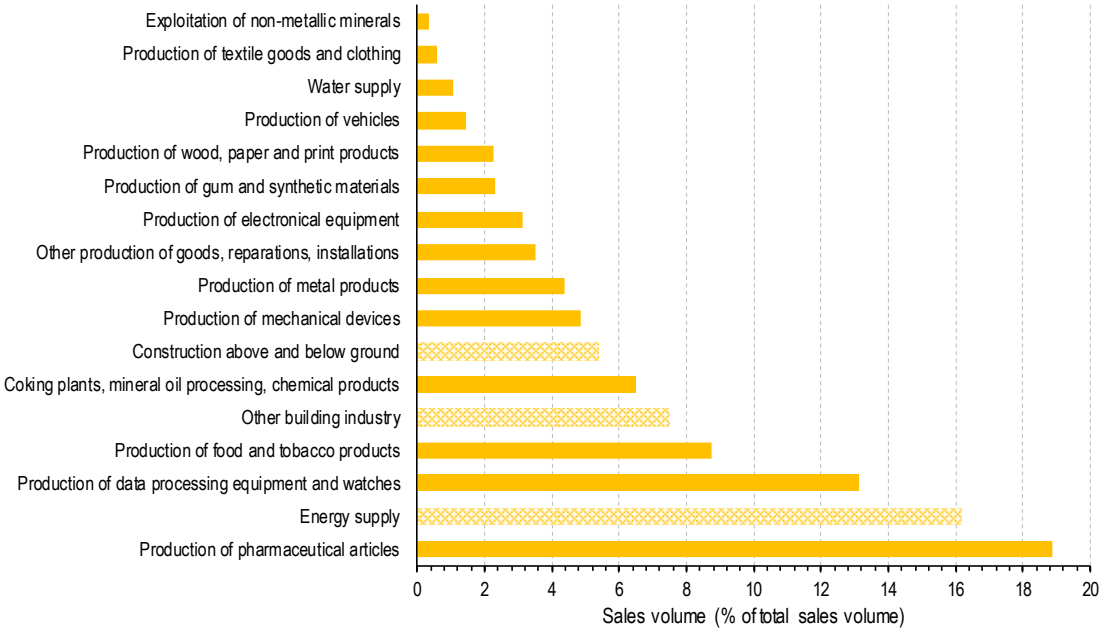
SFSO (2023f) and queries from database *https://www.pxweb.bfs.admin.ch*.

Since about 2004, the number of movements (scheduled and charter flights) remained about stable at slightly above 400 thousand movements per year. Nevertheless, the number of passengers (including transfer passengers) steadily increased and almost reached 60 million in 2019, about three times as much as in 1990 and about 1.7 times as much as in the year 2000. In 2019, the fuel consumption was, however, 1.2 times as much as in the year 2000. The strong increase in energy efficiency per passenger kilometre is considered to be the result of operating larger aircraft at even increased load factors, fleet renewal (new aircraft technology) as well as operational optimisations. The measures to contain the corona virus pandemic had a dramatic impact on aviation in 2020. Compared to the previous year, the number of passengers decreased by 72 per cent, the number of flight movements decreased by 64 per cent, and fuel consumption decreased by 64 per cent. By 2022, the figures are already approaching the level seen before the corona virus pandemic.

II.A.6.3 Industry and services

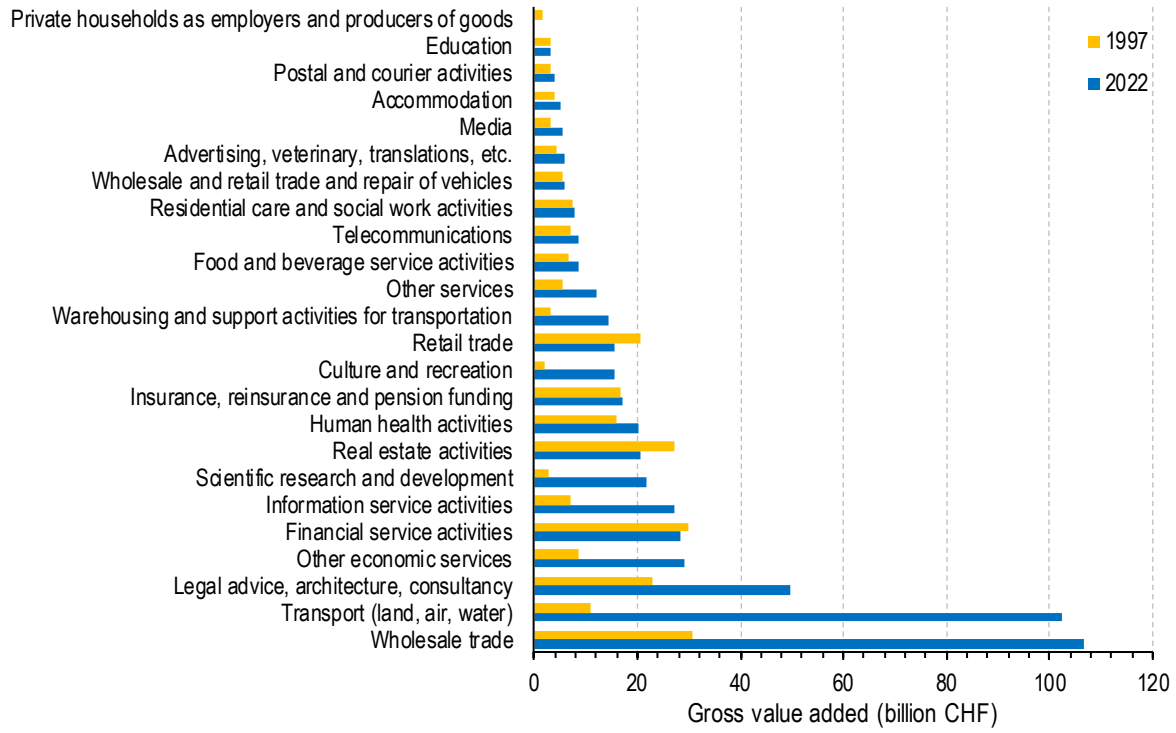
The structure of its industry sector clearly reflects the fact that Switzerland is relatively poor in natural resources. Once evolving from the textile industry – which marked the beginning of industrialisation in Switzerland – mechanical engineering continued to form an important pillar of Switzerland's industry. Currently, in addition to mechanical devices and engines, Switzerland's industry is specialised in the production of data processing equipment and high-precision instruments, particularly watches and goods for medical uses (medical technique). Of importance are further the food processing and chemical industries, in particular the production of pharmaceutical articles. An overview of goods imported to and exported from Switzerland is provided in Fig. 10, while Fig. 32 shows the sales volume within the industry sector in 2022. As highlighted in section II.A.4 (in particular in Fig. 7), Switzerland's economy is largely based on the services sector. The services sector is highly diverse, the most important contributions (in descending order) to the total gross value added currently come from (i) wholesale trade, (ii) transport (land, air, water), (iii) legal advice, architecture, consultancy, (iv) other economic services, (v) financial service activities, (vi) information service activities, and (vii) scientific research and development (Fig. 33).

Fig. 32 > Sales volume within the industry sector in 2022. Shown are the relative contributions of different branches to the total sales volume of about 649 billion Swiss francs. Included are sales volumes from energy supply and the building industry (lighter colour).



SFSO (2024h)

Fig. 33 > Gross value added by different branches of the services sector in Switzerland in 1997 and 2022.

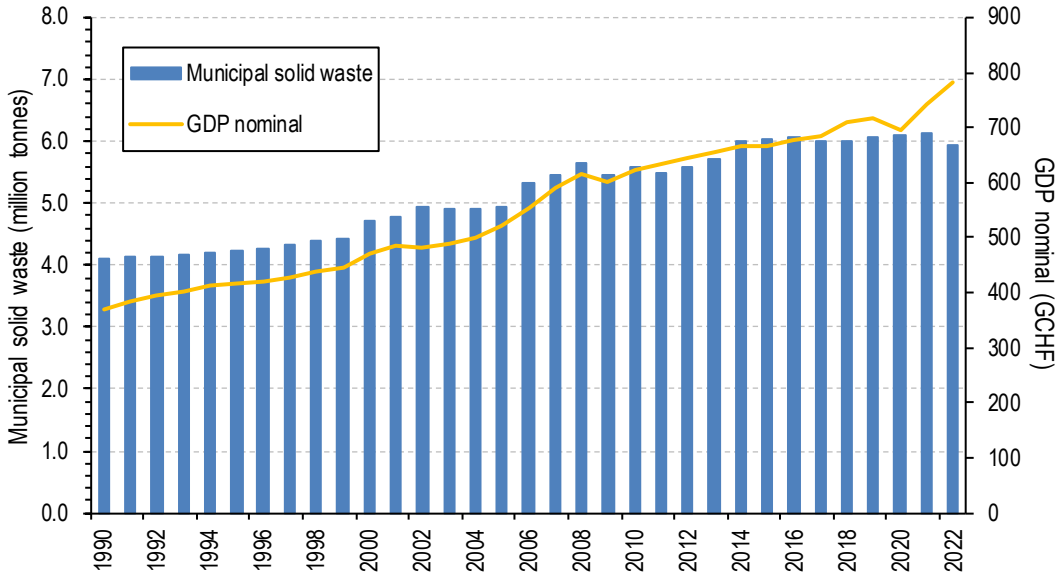


SFSO (2016), *SFSO* (2024i)

II.A.6.4 Waste

With regard to waste treatment, Switzerland has an efficient infrastructure, high standards and clear legislative stipulations in place. The evolution of the amount of municipal solid waste is highly related to increasing prosperity and the steady growth of population. This is shown in Fig. 34, where the evolution of the total amount of municipal solid waste in Switzerland is provided together with the nominal gross domestic product.

Fig. 34 > Evolution of the total amount of municipal solid waste in Switzerland, 1990–2022 (since 2004 without imports of municipal solid waste), together with the nominal gross domestic product.



FOEN (2023a), *SECO* (2024)

As incineration is mandatory for combustible waste since the year 2000, inputs into solid waste disposal sites have dropped to zero. According to the latest waste statistics (*FOEN*, 2023c; Tab. 2), which covers Switzerland and the principality of Liechtenstein, the total amount of waste (including municipal solid waste, construction waste, industrial

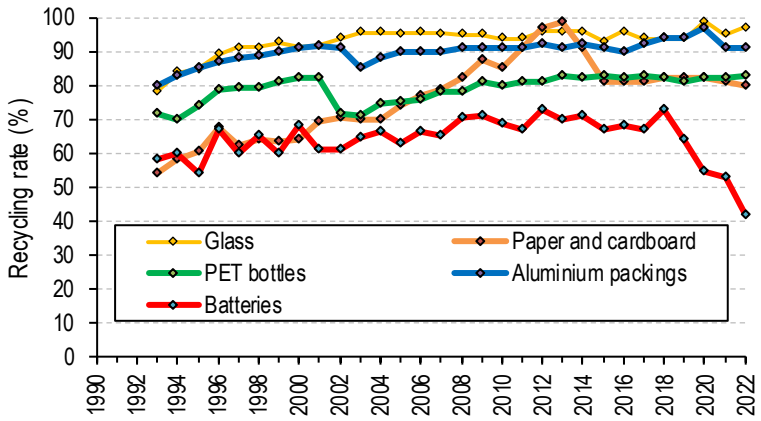
and commercial solid waste, sewage sludge, special waste) incinerated amounted to 3.85 million tonnes (corresponding to 435 kilograms per inhabitant) in 2022. Thereof, 0.33 million tonnes originated from abroad, as Switzerland imports waste to operate waste incineration plants at full capacity for power and heat generation. In addition, 3.10 million tonnes (corresponding to 350 kilograms per inhabitant) of municipal solid waste were collected separately (including compost, paper and cardboard, glass, cans, tinfoil, aluminium, PET, textiles, electrical and electronic devices, batteries). The amount of municipal solid waste collected separately for recycling purposes more than doubled since 1990, indicating that today recycling systems are highly developed and supported by the population in Switzerland. In particular, separate collection of PET bottles, which are relevant regarding CO_2 emissions as they comprise petrochemical material, has increased significantly in recent years, with currently 83 per cent of the total PET bottles being recycled. Recycling rates of paper and cardboard, glass, aluminium packings, and waste-paper currently all also exceed 80 per cent of the total amounts (Fig. 35). In addition to municipal solid waste, 15.9 million tonnes of construction waste are generated annually in Switzerland. Thereof, 8.4 million tonnes stem from infrastructures such as streets, railways, as well as systems for water, wastewater, gas and electricity systems (*FOEN*, 2016a), and 7.5 million tonnes stem from the building infrastructure (*FOEN*, 2015a). Where possible, construction waste is recycled on site. Finally, 1.94 million tonnes of waste were classified as special waste in 2022 (*FOEN*, 2023c; Tab. 2). In Switzerland, the wastewater of virtually the entire population (about 97 per cent) is sewered to a wastewater treatment plant.

Tab. 2 > Amount of waste in Switzerland (CH) and the principality of Liechtenstein (FL) in 2022. The provided number for sewage sludge is an estimate for 2021 covering Switzerland only.

Type of waste	Total (tonnes)	Per capita (kilograms per inhabitant)
Municipal solid waste incinerated (CH, FL)	2 843 000	321
Imports of municipal solid waste for incineration	334 000	38
Waste incinerated in waste incineration plants (municipal solid waste, construction waste, industrial waste, sewage sludge, special waste)	3 853 000	435
Special waste (CH, FL)	1 940 000	219
Sewage sludge (CH, dry matter, 2021)	191 300	22
Municipal solid waste collected separately (CH, FL), thereof:	3 100 191	350.1
Paper and cardboard	*1 104 300*	*124.7*
Compost (digested at central composting sites)	*1 405 000*	*158.7*
Waste glass	*343 500*	*38.88*
Electric and electronic devices	*121 000*	*13.7*
Textiles	*59 300*	*6.7*
PET bottles	*36 300*	*4.1*
Cans	*13 100*	*1.5*
Aluminium packings	*14 600*	*1.6*
Batteries	*3 091*	*0.3*

FOEN (2023c)

Fig. 35 > Evolution of recycling rates in Switzerland, 1993–2022.[14]



SFSO (2024k)

[14] The sharp decline in the recycling rate for batteries can be explained by the sharp increase in sales of lithium batteries. As these have a much longer service life than conventional batteries, they have not yet reached the recycling stream, resulting in a lower recycling rate. It can be assumed that the balance between sales and returns will be restored over time and the recycling rate will become meaningful again.

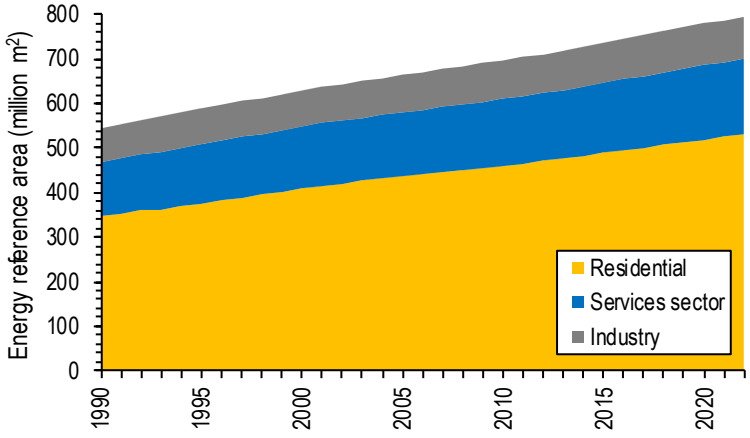
II.A.6.5 Building stock and urban structure

Building stock

The Swiss Federal Statistical Office keeps track of the building stock in Switzerland. The investigations are based on a complete inventory according to data extracted from the registry of buildings and apartments, with a focus on buildings with (at least partial) residential use. The following points are noteworthy (*SFSO*, 2024f[15]):

- At the end of 2022, the building stock in Switzerland consisted of 1.8 million buildings with at least partial residential use. This corresponds to an increase of 38 per cent compared to 1990, an increase of 22 per cent compared to the year 2000, and an increase of nine per cent compared to 2010. Currently, 57 per cent of all buildings are one-family homes, 28 per cent multi-family homes, and the rest are buildings with residential and non-residential use. 30 per cent of all buildings were constructed before 1946, 31 per cent between 1946 and 1980, 21 per cent between 1981 and 2000, and 18 per cent between 2001 and 2020;
- At the end of 2022, there was a stock of 4.7 million apartments in Switzerland. This corresponds to an increase of 50 per cent compared to 1990, an increase of 33 per cent compared to the year 2000, and an increase of 16 per cent compared to 2010. The average area was about 100 square metres and has been stable since about the year 2000;
- In accordance with the increase in buildings and apartments, the energy reference area, i.e. the area heated or cooled, has steadily increased for all types of buildings. Between 1990 and 2022, the energy reference area of buildings in the services sector has increased by 38 per cent, of buildings in the industry sector by 29 per cent, and of buildings for residential use by 53 per cent (*SFOE*, 2023d; Fig. 36);
- In 2022, 57 per cent of all buildings were heated with fossil fuels (i.e. gas oil or natural gas, while coal became negligible). However, because multi-family homes are more often heated with fossil fuels, an even bigger share of the Swiss population (64 per cent) currently lives in buildings heated with fossil fuels (Fig. 37). While fossil heating systems are, thus, still dominating, heat pumps accounted for about 72 per cent of heating systems installed in newly constructed buildings during 2011–2022 (Fig. 38);
- Homeownership rates in Switzerland stay relatively low, as only about 36 per cent of households in Switzerland lived in their own homes in 2022. While the percentage of homeowners has continuously increased since 1970 (when it was at 28.5 per cent), it is still low compared to other European countries. The low homeownership rates may, to some extent, represent a hurdle with regard to the modernisation of buildings.

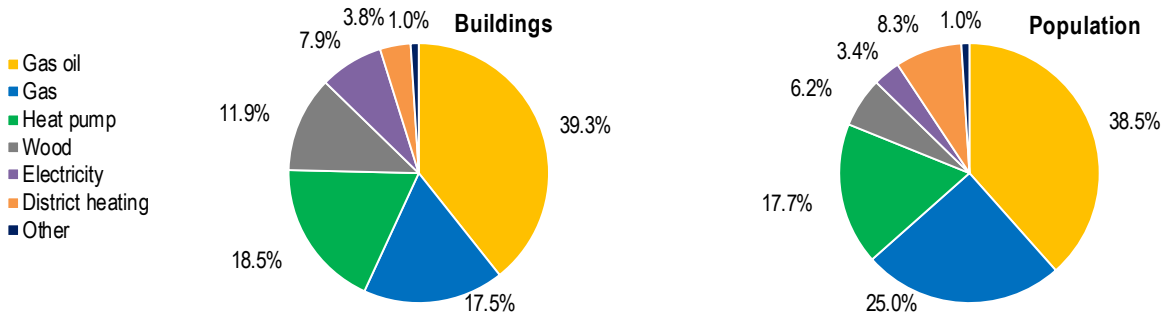
Fig. 36 > Energy reference area in Switzerland between 1990 and 2022.



SFOE (2023d)

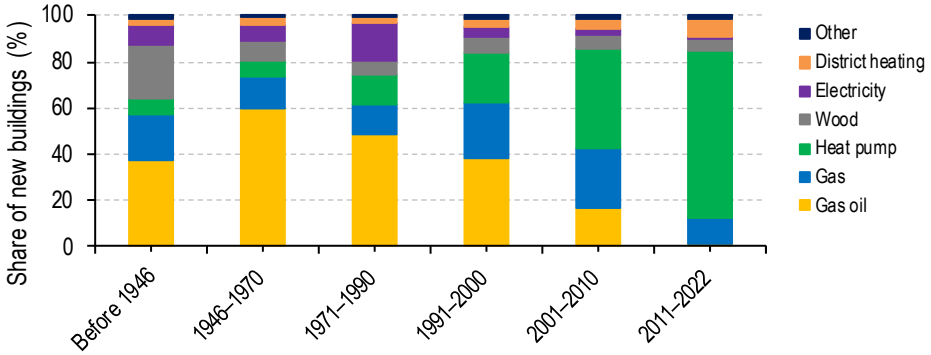
[15] See also the tables available on *https://www.bfs.admin.ch/bfs/en/home/statistics/construction-housing.html*.

Fig. 37 > Relative distribution of energy sources for heating systems in buildings in 2022.[16] Left: Buildings. Right: Population. 'Other' includes solar thermal, other sources and no source.



SFSO (2024f)

Fig. 38 > Share of energy sources for heating systems in different construction periods (new constructions).[16] 'Other' includes solar thermal, other sources and no source.



SFSO (2024f)

Urban structure

Constrained by the topography, Switzerland's settlements originally developed along rivers, lakes and valleys – which formed the major trading routes – as well as on the Central Plateau. The formation of settlements has continued incessantly, although not homogeneously in every area due to different factors such as industrialisation and the development of the rail and road networks. Today, Switzerland's urban structure may be best described by the term 'network city', i.e. a large number of interconnected 'nodes' with high densities of population, goods and information which have an extensive and efficient mutual exchange. As showcased in Fig. 39, agricultural areas and forests are an integral part of Switzerland's urban structure. Information regarding Switzerland's population density and the spatial distribution of population is provided in section II.A.2 (in particular Fig. 2).

Fig. 39 > Example of Switzerland's urban structure (Kloten, Wallisellen, Opfikon, Hard).

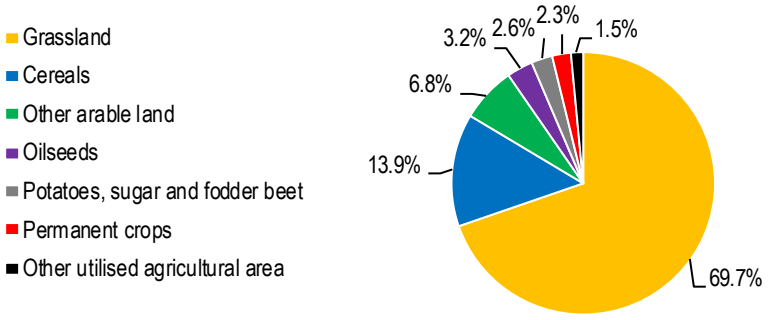
OcCC (2007)

[16] The registry of buildings and apartments is not fully up-to-date regarding heating systems, in particular because replacements of fossil heating systems in existing buildings is not always reported to authorities at the communal and cantonal levels. Accordingly, the provided numbers likely overestimate the current share of fossil energy carriers to some extent.

II.A.6.6 Agriculture

Switzerland's agricultural areas (excluding alpine pastures) accounted for 1.042 million hectares in 2022, corresponding to 25.2 per cent of the total land surface (*SFSO*, 2023e). When alpine pastures are included, the agricultural areas cover more than a third of the total land surface. The agricultural areas (excluding alpine pastures) are cultivated according to the shares shown in Fig. 40, with about 70 per cent being grassland. Due to the spread of settlement and urban areas as well as wooded areas, the agricultural areas (including alpine pastures) are steadily decreasing, namely by 7.3 per cent between 1979/1985 and 2013/2018 (Fig. 4).

Fig. 40 > Use of agricultural areas (excluding alpine pastures) in Switzerland, 2022.

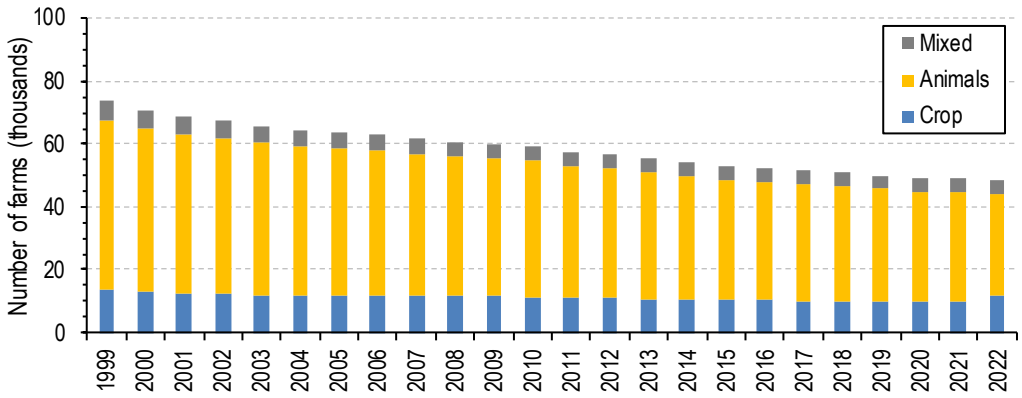


SFSO (2023e)

According to the Swiss Federal Statistical Office (*SFSO*, 2023e), the number of farms has decreased from about 111 thousand in 1975 to about 48 thousand in 2022 (Fig. 41). This decrease corresponds to the closure of about three farms each day between 1999 and 2022. In concert with the decreasing number of farms, the area per farm has more than doubled since 1975 and a substantial decrease in employees in the agriculture sector has occurred. While in 1960 still 14.5 per cent of the population worked in the agriculture sector, this share decreased to 2.2 per cent in 2022 (*SFSO*, 2024a).

The large share of grassland implicates that the majority of farms keep ruminants (Fig. 41). Nevertheless, as shown in Tab. 3, the number of cattle decreased by 18 per cent between 1990 and 2022, while the swine population decreased by 25 per cent. In contrast, an increase occurred for poultry (+119 per cent). Noteworthy, the milk yield of mature dairy cattle increased from 13.2 kilograms per head and day in 1990 to 19.4 kilograms per head and day in 2022 (*FOEN*, 2024a). Since the early 1990s, and increasingly since a new agricultural article has been stipulated in the Federal Constitution of the Swiss Confederation in 1996, agricultural policy has become more commercially and environmentally sound, shifting towards more environmentally-friendly farming methods. As a consequence, the required ecological standards are met by almost all farms and the share of organic farms was around 15 per cent in 2022 (*SFSO*, 2023e).

Fig. 41 > Number of farms and their economic orientation in Switzerland, 1999–2022.



SFSO (2023e)

Tab. 3 > Livestock population in Switzerland in the years 1990, 2000, 2010, and 2022.

	1990	2000	2010	2022
	1 000 head			
Cattle	1 855	1 588	1 591	1 525
Whereof mature cattle	*783*	*669*	*589*	*543*
Horses, mules and asses	34	62	82	81
Swine	1 965	1 670	1 750	1 475
Sheep	395	421	434	403
Goat	68	62	83	*92*
Poultry	7 310	7 160	10 629	*15 975*
Rabbit	61	28	35	*16*

FOEN (2024a)

II.A.6.7 Forest

The results of the first five years of the fifth national forest inventory (NFI5/2018–2022; *Abegg et al.*, 2023) indicate that 32 per cent of Switzerland's area is covered by forests (see Fig. 42). This percentage is matched or even exceeded by some of Switzerland's neighbouring countries[17]: Austria (47 per cent), Germany (33 per cent), Italy (32 per cent), and France (32 per cent). Forest cover is not evenly distributed across Switzerland. Approximately 55 per cent of forests are located at higher elevation above 1,000 metres above sea level. The Alps have therefore the highest forest cover, with forest areas still expanding, especially through abandonment of subalpine grasslands. Forest exploitation is concentrated in the central lowlands (about 40 per cent of total wood harvest), which are more easily accessible than alpine regions and therefore less cost-intensive in terms of harvest.

Following the most recent national forest inventory data, 33 per cent of Swiss woodland is privately owned, whereas 67 per cent is public property. The majority of the state-owned woodland belongs to bourgeois communities and cooperatives (38 per cent) as well as political communities (28 per cent; comprising municipalities and cantons). Only one per cent of Swiss woodland is owned by the Swiss Confederation.

Since the first national forest inventory (NFI1/1982–1986; *EAFV/BFL*, 1988), the forested area has grown by 11.6 per cent. The regional differences are striking: the greatest increase was recorded in the Alps (+22.8 per cent) and the Southern Alps (+20.3 per cent) as a consequence of natural regeneration of abandoned agricultural land, whereas the forested area in the central lowlands (+0.2 per cent) and the Jura mountains (+1.1 per cent) only slightly changed.

According to the results of the first five years of the fifth national forest inventory (NFI5/2018–2022; *Abegg et al.*, 2023), Switzerland's forests consist of 415 million cubic metres of wood or on average of 343 cubic metres per hectare. Of this, 32 per cent are deciduous trees such as beech (18 per cent) and 68 per cent are coniferous trees such as spruce (42 per cent) and fir (16 per cent).[18] Standing volume of living trees increased between the first national forest inventory and the fourth national forest inventory (NFI4/2009–2017; *Brändli et al.*, 2020) to 421 million cubic metres of wood or on average of 350 cubic metres per hectare. The highest increase was observed in alpine forests, which are difficult to access and exploit. This increase was mainly due to a slight decrease in harvest and also a lower share of mortality. The observed decrease in standing volume since the fourth national forest inventory has been primarily due to a higher mortality as a consequence of increased stress from drought and insects (*Allgaier Leuch and Fischer*, 2023). In the period between the fourth and fifth national forest inventories, cut and natural mortality together accounted for 8.9 cubic metres per hectare per year compared to 6.7 cubic metres per hectare per year in the period between the first and the second (NFI2/1993–1995; *Brassel and Brändli*, 1999), 8.2 cubic metres per hectare per year between the second and third (NFI3/2004–2006; *Brändli*, 2010), and 8.0 cubic metres per hectare per year between the third and the fourth (NFI4/2009–2017; *Brändli et al.*, 2020). The average annual growth rate of 8.8 cubic metres per hectare per year between the fourth and the fifth inventories was in the range of previously observed values, i.e. 9.2 cubic metres per hectare per year between the first and

[17] https://www.fao.org/faostat/en/#data/SDGB (accessed 20.06.2024)

[18] https://s.geo.admin.ch/96ecc516cd

the second, 8.7 cubic metres per hectare per year between the second and third, and 9.3 cubic metres per hectare per year between the third and the fourth.

Since 1998, a few scattered forest areas have obtained certification for sustainable forest management under the FSC system (*http://www.fsc.org*) or the Q/PEFC system (*http://www.pefc.org*). Starting in the year 2000, group certifications enabled larger areas joining the scheme, so that the area of certified forest increased by 100 thousand hectares per year. In 2005, this trend began to slab. At the moment, 44 per cent of the Swiss forest area are certified under either one or both of the two certifying systems (*Abegg et al.*, 2023).

Fig. 42 > Switzerland's current forest area. The red areas show areas damaged by the storm 'Lothar' in 1999. For more details see the website of the federal geoportal indicated below the map.

geo.admin.ch (*https://s.geo.admin.ch/652974182314*)

II.A.7 How national circumstances affect greenhouse gas emissions and removals over time

Switzerland's greenhouse gas emissions and removals, disaggregated by gas and by sector, are presented in detail in chapter II.E. This section provides information on how the national circumstances presented in the sections II.A.1 to II.A.6 affect greenhouse gas emissions and removals, and how the national circumstances and changes therein affect greenhouse gas emissions and removals over time. In this regard, the Swiss Federal Office for the Environment annually publishes a report which discusses the influence of key parameters on greenhouse gas emissions in Switzerland (*FOEN*, 2024b). Based on the latest update of this report, the relationship between key parameters – reflecting Switzerland's national circumstances – and greenhouse gas emissions resulting from different activities[19] are discussed in the following.

[19] For the discussion in section II.A.7, the disaggregation does not completely agree with the definitions of sectors in other chapters of Switzerland's first biennial transparency report, but corresponds to the definitions according to *FOEN* (2024b) and the national legislation as follows:

- Emissions related to industry: 1A1 'Energy industries' / 1A2 'Manufacturing industries and construction' / 1B 'Fugitive emissions from fuels' / 2 'Industrial processes and product use' (without emissions of F-gases);
- Emissions related to services: 1A4a 'Commercial/institutional';
- Emissions related to households: 1A4b 'Residential' / 6Ad 'Other' (only fire damage buildings);
- Emissions related to transport: 1A3 'Transport' / 1A5 'Other' / 6Ad 'Other' (only fire damage motor vehicles);
- Emissions related to agriculture: 3 'Agriculture' / 1A4c 'Agriculture/forestry/fishing';
- Emissions related to waste: 5 'Waste'.

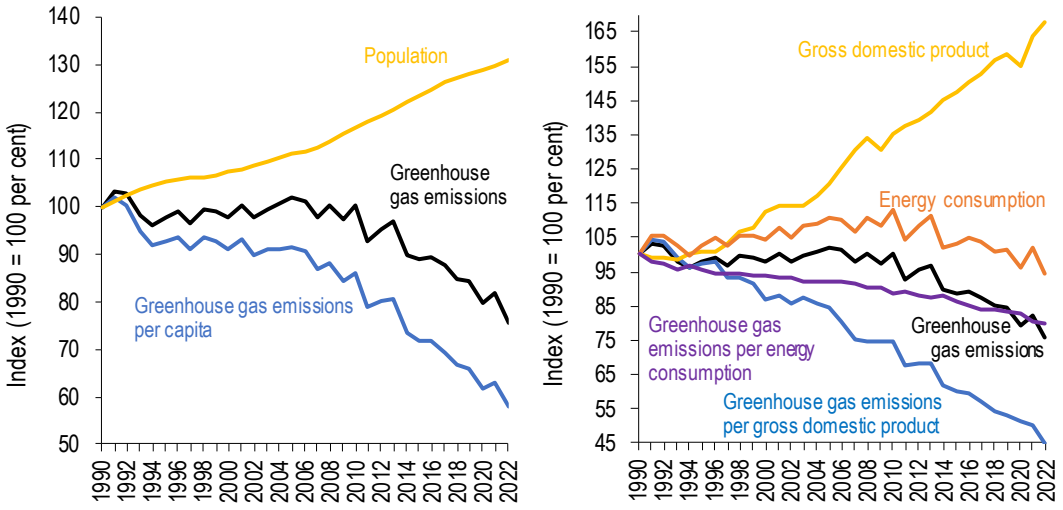
Emissions from international aviation are discussed separately.

Total greenhouse gas emissions

Fig. 43 shows the relative evolution of Switzerland's total greenhouse gas emissions. When compared to relevant key parameters, the following important observations emerge:

- Over the period from 1990 to 2022, total greenhouse gas emissions were first stable and then started to decrease, despite a substantial population growth (+30.9 per cent). Accordingly, per capita greenhouse gas emissions decreased by 42.3 per cent, from 8.2 tonnes of CO_2 equivalents per capita in 1990 to 4.8 tonnes of CO_2 equivalents per capita in 2022;
- At the same time, Switzerland's gross domestic product substantially increased, but economic growth and greenhouse gas emissions evolved decoupled from each other. Accordingly, greenhouse gas emissions per gross domestic product decreased by 55.0 per cent, from 122 grams of CO_2 equivalents per Swiss franc in 1990 to 55 grams of CO_2 equivalents per Swiss franc in 2022;
- Year-to-year variations in total greenhouse gas emissions were to a large part the consequence of changing meteorological conditions (such as heating degree days and solar insolation), which had a major influence on the demand on heating fuel during winter time. Nevertheless, multi-annual mean greenhouse gas emissions have been decreasing over time, indicating the increasing energy-efficiency, as well as the ongoing substitution of heating and process fuels by renewable energy sources and natural gas;
- For 2020, the measures to contain the corona virus pandemic affected many of the parameters shown in this section (e.g. gross domestic product, gross value added, energy consumption, transport volumes, etc.) and, thus, greenhouse gas emissions linked to these parameters were exceptionally low;
- The reporting under the UNFCCC (i.e. the national greenhouse gas inventory) does not include 'grey emissions', i.e. emissions from the production of imported goods and energy as well as from the disposal of products abroad. Switzerland mainly depends on imported energy and the Swiss economy is strongly based on the services sector. Traditionally, heavy industry is virtually absent in Switzerland due to a lack of local mineral resources. This implies that substantial grey emissions are associated with Switzerland's imports of goods. Currently, greenhouse gas emissions in Switzerland based on a 'consumption perspective' ('greenhouse gas footprint') account for 13 tonnes of CO_2 equivalents per capita, with about one third of emissions occurring within Switzerland and about two thirds of emissions occurring abroad (see section 6 in *FOEN*, 2024b).

Fig. 43 > Evolution of Switzerland's total greenhouse gas emissions, together with population (left panel) as well as Switzerland's gross domestic product and total energy consumption (right panel), 1990–2022 (relative evolutions with reference year 1990). The respective panels also show the greenhouse gas emissions per capita, per gross domestic product, and per energy consumption.



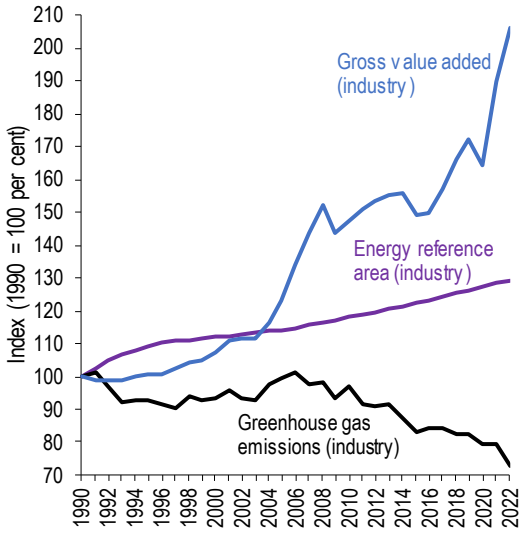
FOEN (2024b)

Greenhouse gas emissions related to industry

Fig. 44 shows the relative evolution of Switzerland's greenhouse gas emissions related to industry.[19] When compared to relevant key parameters, the following important observations emerge:

- Despite a substantial increase in gross value added as well as in the energy reference area related to industry, greenhouse gas emissions related to industry were 27.4 per cent lower in 2022 compared to 1990;
- Accordingly, Switzerland's industry managed to decouple – to a certain degree – economic growth and greenhouse gas emission.

Fig. 44 > Evolution of Switzerland's greenhouse gas emissions related to industry[19], together with the gross value added and the energy reference area related to industry, 1990–2022 (relative evolutions with reference year 1990).



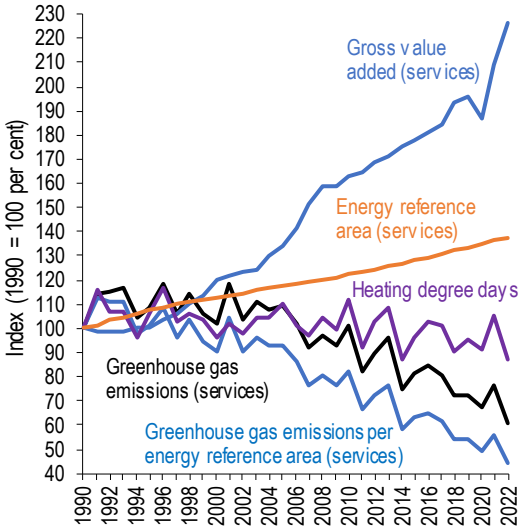
FOEN (2024b)

Greenhouse gas emissions related to services

Fig. 45 shows the relative evolution of Switzerland's greenhouse gas emissions related to services.[19] When compared to relevant key parameters, the following important observations emerge:

- Greenhouse gas emissions related to services were mostly driven by the influence of meteorological conditions (such as heating degree days and solar insolation);
- Despite a substantial increase in the gross value added and the energy reference area related to services, greenhouse gas emissions related to services showed a prolonged decrease (overlain by the year-to-year variability caused by meteorological conditions);
- From 1990 to 2022, the greenhouse gas emissions per energy reference area related to services decreased by 55.9 per cent.

Fig. 45 > Evolution of Switzerland's greenhouse gas emissions related to services[19], together with the gross value added and the energy reference area related to services as well as heating degree days, 1990–2022 (relative evolutions with reference year 1990). Also shown are the greenhouse gas emissions related to services per energy reference area.



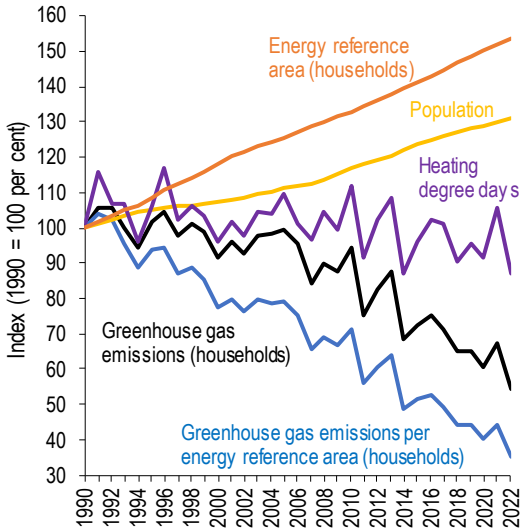
FOEN (2024b)

Greenhouse gas emissions related to households

Fig. 46 shows the relative evolution of Switzerland's greenhouse gas emissions related to households.[19] When compared to relevant key parameters, the following important observations emerge:

- Like the greenhouse gas emissions related to services, greenhouse gas emissions related to households were strongly driven by meteorological conditions (such as heating degree days and solar insolation);
- Apart from the strong influence of meteorological conditions, greenhouse gas emission related to households showed a decreasing trend, despite the fact that the energy reference area related to households, i.e. the heated or cooled living space, as well as population were steadily increasing;
- Accordingly, greenhouse gas emissions related to households per energy reference area steadily decreased (by 64.6 per cent from 1990 to 2022), thanks to improving insulation standards, the renovation of older buildings, and the increasing replacement of heating fuel by natural gas and renewables (heating pumps, wood, etc.).

Fig. 46 > Evolution of Switzerland's greenhouse gas emissions related to households[19], together with the energy reference area related to households as well as population and heating degree days, 1990–2022 (relative evolutions with reference year 1990). Also shown are the greenhouse gas emissions related to households per energy reference area.



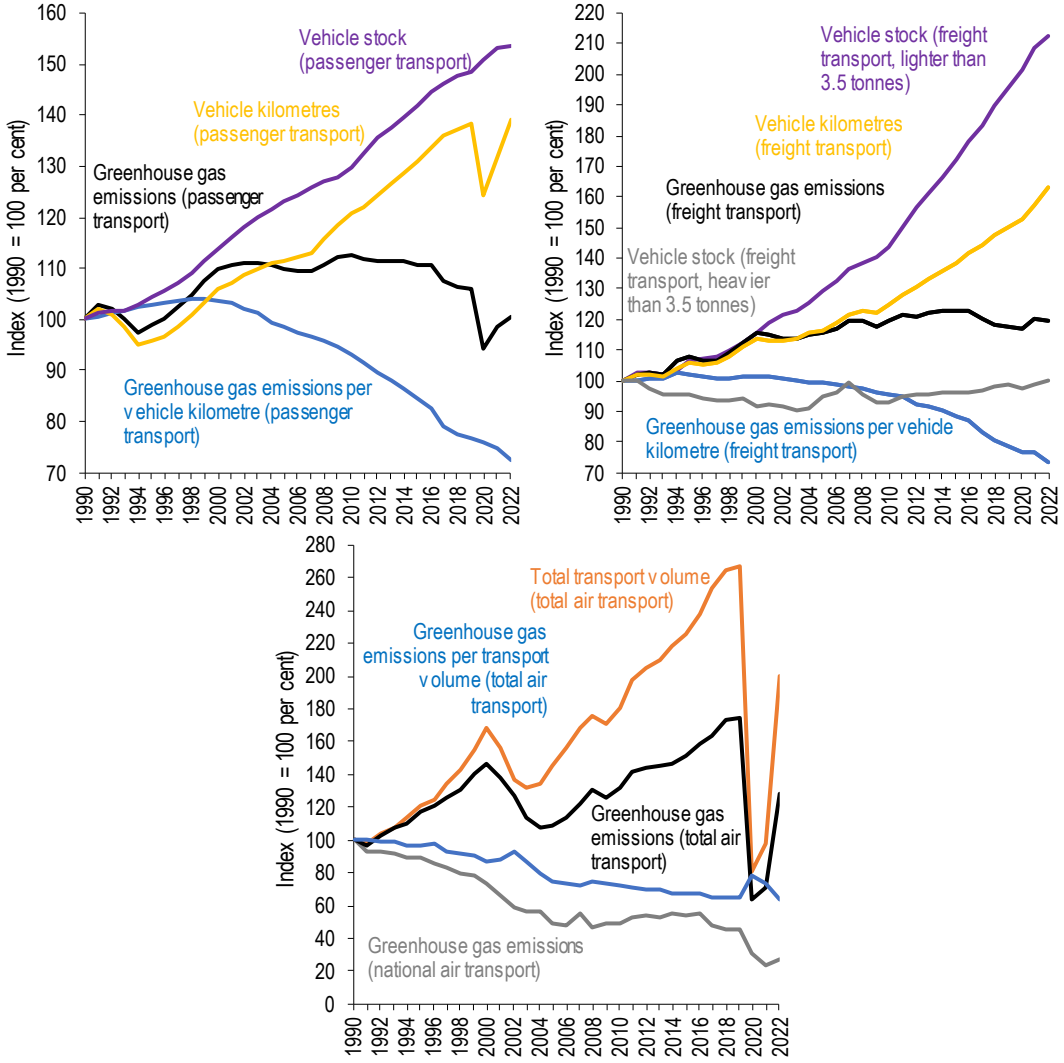
FOEN (2024b)

Greenhouse gas emissions related to transport

Fig. 47 shows the relative evolution of Switzerland's greenhouse gas emissions related to transport.[19] When compared to relevant key parameters, the following important observations emerge:

- The vehicle stock of private transport increased by 53.7 per cent between 1990 and 2022 and the vehicle kilometres increased by 39.1 per cent between 1990 and 2022 (falling to 24.3 per cent above the level of 1990 in 2020 due to the measures to contain the corona virus pandemic);
- Greenhouse gas emissions related to private transport increased by about 10 per cent between 1990 and around the year 2000, then remained about constant, with a slightly decreasing trend emerging during the last years (and a strong temporal decrease standing out for 2020 due to the measures to contain the corona virus pandemic). The greenhouse gas emissions per vehicle kilometre show a decreasing trend over the last about 20 years, which can be explained by technological progress, i.e. more efficient motors, as well as the increasing use of diesel oil;
- The evolution of the vehicle stock of freight transport needs to be looked at by weight category: The stock of vehicles lighter than 3.5 tonnes increased by 112.7 per cent between 1990 and 2022, while the stock of vehicles heavier than 3.5 remained about constant;
- While greenhouse gas emission related to freight transport increased by 19.4 per cent between 1990 and 2022, greenhouse gas emissions related to freight transport per vehicle kilometre decreased by 26.9 per cent over the same time period;
- The total transport volume of air transport (including passenger and freight on national and international flights) increased by 167.6 per cent between 1990 and 2019, with a temporary decrease between 2001 and 2004 as a consequence of the grounding of the national airline and a general crisis in aviation. In 2020, an exceptionally large decrease to 18.7 per cent below the level of 1990 occurred due to the measures to contain the corona virus pandemic, but by 2022 transport volumes were again more than double the level of 1990. In contrast to total transport volume, national transport volume is of minor importance and steadily decreased from 1990 to 2005, remained at around 50 per cent of the transport volume in 1990 until 2017, and decreased again in the last few years;
- Greenhouse gas emissions related to air transport generally followed the same evolution as the transport volume, but thanks to increasing efficiency, the greenhouse gas emissions per transport volume decreased by over a third between 1990 and today.

Fig. 47 > Evolution of Switzerland's greenhouse gas emissions related to passenger transport (upper left panel), freight transport (upper right panel) and air transport (lower panel, for total air transport and national air transport)[19], together with the vehicle stocks and vehicles kilometres of passenger transport and freight transport, as well as the total transport volume by air, 1990–2022 (relative evolutions with reference year 1990). Also shown are the greenhouse gas emissions related to passenger transport and freight transport per vehicle kilometre as well as the greenhouse gas emissions related to air transport per air transport unit (corresponding to one person or 100 kilograms).



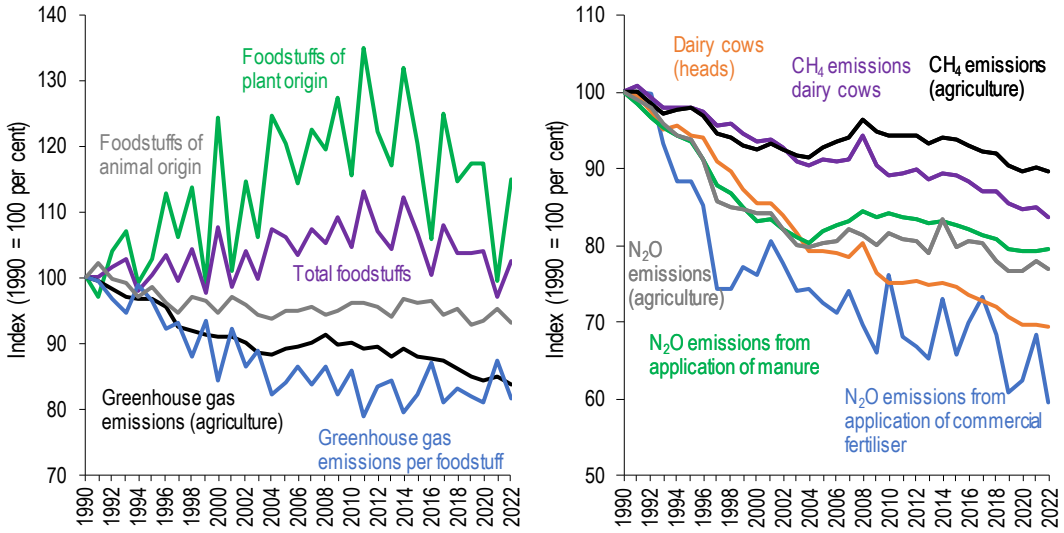
FOEN (2024b)

Greenhouse gas emissions related to agriculture

Fig. 48 shows the relative evolution of Switzerland's greenhouse gas emissions related to agriculture.[19] When compared to relevant key parameters, the following important observations emerge:

- From 1990 to 2022, production of foodstuffs of animal origin decreased and the production of foodstuffs of plant origin increased (showing rather large inter-annual variability), overall resulting in a slight increase of total foodstuffs. As over the same time period, greenhouse gas emissions related to agriculture decreased by 16.2 per cent, the greenhouse gas intensity (greenhouse gases emitted per unit of foodstuff produced) overall decreased by 18.4 per cent. The decrease in greenhouse emissions related to agriculture about followed the decrease in the production of foodstuffs of animal origin;
- From 1990 to 2022, CH_4 emissions related to agriculture decreased by 10.2 per cent, mainly driven by CH_4 emissions from dairy cows, which decreased along with the number of heads. Over the same time period, N_2O emissions related to agriculture decreased by 23.1 per cent, induced by decreasing application of manure and commercial fertiliser.

Fig. 48 > Left: Evolution of Switzerland's greenhouse gas emissions related to agriculture[19], together with foodstuffs produced (total, of plant origin, and of animal origin), 1990–2022 (relative evolutions with reference year 1990). Also shown are the greenhouse gas emissions related to agriculture per foodstuff. Right: Evolution of Switzerland's CH_4 and N_2O emissions related to agriculture[19], together with CH_4 emissions from dairy cows and their number (heads) as well as N_2O emissions from the application of manure and of commercial fertiliser, 1990–2022 (relative evolutions with reference year 1990).



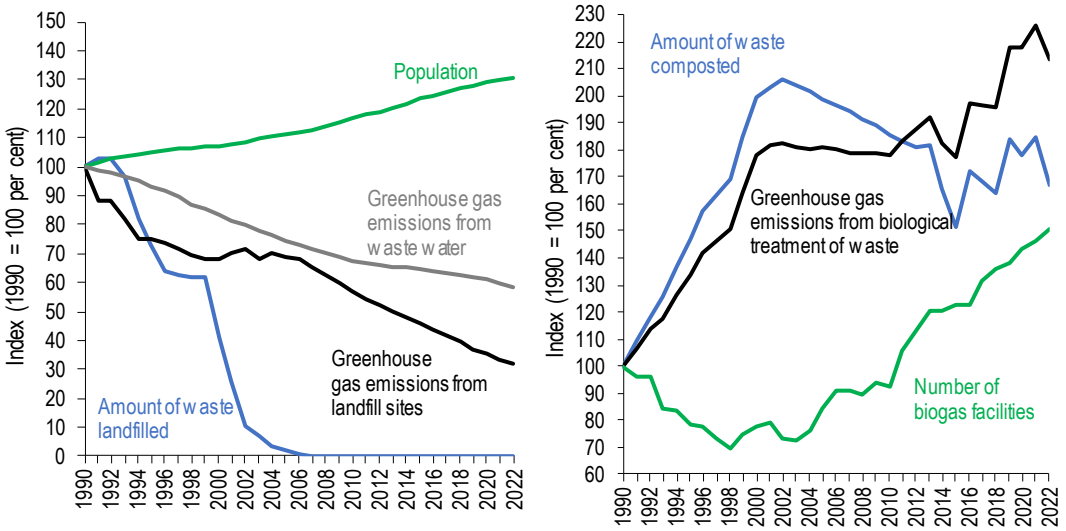
FOEN (2024b)

Greenhouse gas emissions related to waste

Fig. 49 shows the relative evolution of Switzerland's greenhouse gas emissions related to waste.[19] When compared to relevant key parameters, the following important observations emerge:

- Despite the increase in Switzerland's population by 30.9 per cent, greenhouse gas emissions from wastewater treatment decreased by 41.4 per cent from 1990 to 2022. This decoupling has been achieved thanks to continuous improvements in nitrogen removal at centralised wastewater treatment plants, which also reduce N_2O emissions;
- Greenhouse gas emissions from landfilled waste decreased by 68.2 from 1990 to 2022. This decrease is caused by the ban on landfilling of combustible waste since the year 2000. However, the greenhouse gas emissions do not closely follow the amount of waste deposited, as the major part of greenhouse gas emissions since the year 2000 has resulted from waste landfilled in the years to decades before;
- Greenhouse gas emissions from biological treatment of waste increased by about 80 per cent from 1990 to about the year 2000, mainly caused by an increase in the amount of waste composted. The increasing number of biogas facilities (+51 per cent from 1990 to 2022) led to a further increase of greenhouse gas emissions during about the last decade.

Fig. 49 > Left: Evolution of Switzerland's greenhouse gas emissions from landfills and waste water treatment, together with Switzerland's population and the amount of waste landfilled, 1990–2022 (relative evolutions with reference year 1990). Right: Evolution of Switzerland's greenhouse gas emissions from biological treatment of waste, together with the amount of waste composted and the number of biogas facilities, 1990–2022 (relative evolutions with reference year 1990).



FOEN (2024b)

II.A.8 Switzerland's institutional arrangements to track progress made in implementing and achieving the nationally determined contributions

This section addresses Switzerland's institutional arrangements in place to track progress made in implementing and achieving the nationally determined contributions. Section II.A.8.1 focuses on the arrangements to track greenhouse gas emission reduction objectives, while section II.A.8.2 presents the institutional arrangements for tracking internationally transferred mitigation outcomes. Switzerland's arrangements related to the implementation and achievement of the nationally determined contributions is reported in section II.A.9. Changes to institutional arrangements are reported in section II.A.10.

II.A.8.1 Arragements for tracking greenhouse gas emission reduction objectives

The Swiss Federal Office for the Environment is responsible for matters relating to climate protection (for details of the underlying legal mandates see section II.A.9.1). In particular, Article 131 of the CO_2 Ordinance to the second CO_2 Act requires the Swiss Federal Office for the Environment (i) to maintain the greenhouse gas inventory, and (ii) to calculate, based on the greenhouse gas inventory, whether the emission reduction target under the CO_2 Act has been met.

The national inventory report – which is annually submitted to the UNFCCC and also published on the website of the Swiss Federal Office for the Environment[20] – is fundamental for tracking the greenhouse gas emission reduction objectives Switzerland committed to on the national and international level. Institutional arrangements related to Switzerland's national greenhouse gas inventory system are documented in section 1.2 of Switzerland's national inventory document (see also chapter I).

The Swiss Federal Office for the Environment publishes and regularly updates the evolution of greenhouse gas emissions according to the greenhouse gas inventory – including a detailed comparison with Switzerland's emission reduction targets – on the following websites (every update is accompanied by a press release):

- *www.bafu.admin.ch/greenhouse-gas-inventory*
- *www.bafu.admin.ch/climate-target-achievement*

[20] *www.climatereporting.ch*

As part of its mandate, the Swiss Federal Office for the Environment is also responsible for the reporting to the UNFCCC within the enhanced transparency framework, and thus regularly reports an account of progress made by Switzerland towards achieving of its nationally determined contributions.

II.A.8.2 Switzerlands' arrangements for tracking internationally transferred mitigation outcomes

Switzerland's emissions trading registry[21] is used for the tracking of internationally transferred mitigation outcomes (ITMOs) which are recognised by Switzerland under Article 6.2 of the Paris Agreement. The internationally transferred mitigation outcomes which have been first transferred from Switzerland's partner countries are issued in Switzerland's emissions trading registry as 'international attestations'. Switzerland's emissions trading registry tracks the holder of the units, transfers between accounts, use towards the nationally determined contribution (surrendering under the CO_2 Act) as well as voluntary cancellations. Information on the specific mitigation purpose of a cancellation other than use towards the nationally determined contribution will be collected from the account holders on a voluntary basis. Furthermore, Switzerland provides all relevant information on the underlying authorizations and project documentation of its cooperative approaches on the website of the Swiss Federal Office for the Environment.[22] The bilateral agreements that set the framework for the cooperation under Article 6.2 with the partner countries are available on the same website.[23] Switzerland has already submitted its initial report[24] under Article 6 to the UNFCCC Centralized Accounting and Reporting Platform (CARP)[25] and will submit its agreed electronic format (AEF) and regular information on its cooperative approaches as mandated under decision 2/CMA.3[26] as soon as the format has been agreed by the conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

II.A.9 Arrangements for domestic implementation, monitoring, reporting, archiving of information and stakeholder engagement related to the implementation and achievement of the nationally determined contributions

This section presents an overview of Switzerland's legal, institutional, administrative and procedural arrangements for domestic implementation, monitoring, reporting, archiving of information and stakeholder engagement related to the implementation and achievement of its nationally determined contributions under Article 4 of the Paris Agreement. Section II.A.9.1 provides specific information related to the fundamental settings of Switzerland's policymaking process in the context of environmental and climate policy (a general overview of the government structure – including background information on the general political organisation in Switzerland as well as the well-established stakeholder engagement – is presented in section II.A.1). Section II.A.9.2 addresses strategies for sustainable development as well as long-term mitigation strategies, while section II.A.9.3 presents the principles and instruments of Switzerland's environmental and climate policy, including enforcement and administrative procedures. Switzerland's arrangements for the monitoring and evaluation of policies and measures are provided in section II.A.9.4, those for the archiving of information in section II.A.9.5.

II.A.9.1 Environmental and climate policy framework in Switzerland (policymaking process)

The Federal Constitution of the Swiss Confederation forms the overarching framework for environmental and climate policy in Switzerland. The commitment to sustainable development and long-term preservation of natural resources is listed prominently under the main aims in the general provisions (*Swiss Confederation*, 1999a, Article 2). Following the United Nations Conference on Environment and Development held in Rio in 1992, the Swiss Federal Council established an interdepartmental sustainable development committee consisting of all federal agencies with responsibilities in the field of sustainable development. This committee defined the priorities for action and oversaw implementation and monitoring of progress with the intention to make sustainability assessments an integral part of decision-making and policy evaluation. On 14 December 2018, the Swiss Federal Council established the 2030 Agenda steering committee, replacing the interdepartmental sustainable development committee.[27] The 2030 Agenda steering committee – where

21 https://www.emissionsregistry.admin.ch

22 www.bafu.admin.ch/projects-abroad

23 www.bafu.admin.ch/bilateral-climate-agreements

24 https://unfccc.int/sites/default/files/resource/230517_InitialReport_Switzerland.pdf

25 https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/cooperative-implementation/centralized-accounting-and-reporting-platform

26 https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf#page=11

27 https://www.are.admin.ch/are/en/home/sustainable-development/coordination/2030agenda-steering-committee.html

federal agencies which bear the main responsibility are represented at senior management level – coordinates the efforts to achieve the 2030 agenda for sustainable development of the United Nations. This includes monitoring the progress regarding achievement of the sustainable development goals in Switzerland, preparing the national reports to the United Nations, setting priorities to reflect the main challenges and opportunities for Switzerland, setting national targets, coordinating appropriate measures and cooperating with the cantons, communes and non-state actors.

Further, by decision of the Swiss Federal Council, an interdepartmental committee on climate of the federal authorities ('IDA-Klima') was established as of 14 April 2008. The committee is responsible for the coordination between different policy areas and assures a coherent climate policy of the Swiss Confederation in compliance with the UNFCCC. The committee, led by the Swiss Federal Office for the Environment, thus coordinates the activities of all federal offices involved in climate policy.

The Swiss Confederation and the cantons coordinate through various channels. Generally, the cantons are always invited to participate in consultations for every new law or ordinance or respective major revisions. When the cantons are directly affected by policies and measures, they are included in the earlier stages of the policymaking process. There are various bodies to ensure this coordination, both formal and informal. An example is the 'Cercle Climat', an association that wants to help harmonise cantonal measures in areas such as buildings, mobility and agriculture. With respect to climate policy, the CO_2 Act also defines specific responsibilities of the cantons in certain areas. For example, the Swiss Confederation is responsible for the coordination of measures to adapt to climate change (Article 8 of the second CO_2 Act), while the cantons are responsible for the implementation of measures. In the buildings sector, the CO_2 Act explicitly states that the cantons must ensure that CO_2 emissions from buildings heated with fossil fuels are reduced in line with targets. To this end, they issue standards for new and existing buildings based on the current state of the art (see section II.D.2.5).

As stipulated in Article 39 of the second CO_2 Act (*Swiss Confederation*, 2011) and more generally also in Article 12 of the Ordinance on the Organisation of the Federal Department of the Environment, Transport, Energy and Communications (*Swiss Confederation*, 1999c), the Swiss Federal Office for the Environment is responsible for matters relating to climate protection, including reporting obligations in this policy area. The related Ordinance on the Reduction of CO_2 Emissions (*Swiss Confederation*, 2012), in its chapter 11, details the responsibilities for the implementation of specific measures.

II.A.9.2 Strategies for sustainable development and long-term mitigation strategies

The Swiss Federal Council set out its main policy focus areas for sustainable development in its 2030 sustainable development strategy (*Swiss Federal Council*, 2021b), adopted as part of the Swiss government's regular legislative planning cycle. This strategy represents an important contribution on the part of Switzerland to achieving the 2030 agenda for sustainable development of the United Nations. An overview of Switzerland's implementation of the 2030 agenda for sustainable development of the United Nations is available in Switzerland's country report published in May 2022 (*Swiss Federal Council*, 2022) as well as in the mid-term report published in January 2024 (*Swiss Federal Council*, 2024).[28]

The 2030 sustainable development strategy, the sixth of its kind since 1997, focuses on three priority topics (including goals and strategic directions), each covering a specific issue which is of central importance to the sustainable development of Switzerland: (i) sustainable consumption and production, (ii) climate, energy and biodiversity, and (iii) equal opportunities and social cohesion. The strategy is accompanied by an action plan; the latest version covering the years 2024–2027 contains 22 measures in the priority areas of the 2030 sustainable development strategy. With a view to achieving the defined goals, the 2030 sustainable development strategy provides a model role for the federal government, outlines horizontal (cross-sectoral) measures such as sustainability monitoring, sustainability assessments, the promotion of local sustainability processes and projects, and closer collaboration with other stakeholder groups. Finally, the 2030 sustainable development strategy sets out the institutional framework for its implementation.

One of the Swiss Federal Council's overarching objectives with regard to the incorporation of the sustainable development principle into the activities of the Swiss government is to combat global warming. By ratifying the UNFCCC in 1993, the Kyoto Protocol in 2003, the Doha Amendment to the Kyoto Protocol in 2015, and the Paris Agreement in 2017, Switzerland internationally committed to contribute to the stabilisation of greenhouse gas emissions at a level that prevents dangerous anthropogenic interference with the climate system. In the long term, this requires that Switzerland

[28] See also the statistical appendix to the mid-term report available on https://www.bfs.admin.ch/bfs/en/home/statistics/sustainable-development/monet-2030/information-system.assetdetail.28725642.html.

reduces its greenhouse gas emissions to net zero. This target lays the foundations for Switzerland's long-term climate strategy to 2050, submitted by Switzerland to the UNFCCC secretariat on 28 January 2021 (*Swiss Federal Council*, 2021a) and currently revisited in fulfilment of a mandate given by the Conference of the Parties in Glasgow.[29] As summarised in a respective factsheet (*FOEN*, 2022), the strategy formulates ten basic strategic principles[30] that will shape Switzerland's climate policy in the coming years. The strategy also presents climate goals and emission pathways for the buildings, industry, transport, agricultural and food sectors, financial markets, synthetic gases, aviation and the waste industry. The long-term climate strategy shows that Switzerland – by consistently applying already known and proven technologies – can reduce its greenhouse gas emissions by 2050 to around 90 per cent of the 1990 level. The remaining emissions must be balanced with negative emission technologies. The Swiss Federal Council aims at strengthening the pioneering role of Switzerland in this field and adopted a roadmap on 18 May 2022 (see section II.D.10 for further details).

Efforts in other policy areas are also helping Switzerland to achieve its long-term climate targets. Climate, energy, spatial planning, agriculture and tax policies – to name a few – are interrelated and, thus, closely coordinated. The respective policies are themselves guided by strategies, such as the Energy Strategy 2050 (see section II.D.2.1) or the climate strategy for agriculture and food (see section II.D.5.8).

The Swiss government is also engaged in elaborating and coordinating adaptation efforts, as reflected in the Swiss adaptation strategy (see section 6.4 of Switzerland's eighth national communication and fifth biennial report) and the corresponding adaptation actions (see section 6.6 of Switzerland's eighth national communication and fifth biennial report).

II.A.9.3 Principles and instruments of Switzerland's environmental and climate policy, including enforcement and administrative procedures

Deduced from the Federal Constitution of the Swiss Confederation, the principles and instruments of Switzerland's environmental policy are stipulated in the Swiss Federal Act on the Protection of the Environment (Environmental Protection Act, *Swiss Confederation*, 1983), in force since 1985 and revised several times since. The Environmental Protection Act is based on the following three main principles: (i) the principle of precaution, (ii) the control/limitation of ecological damage at the source, and (iii) the polluter pays principle. Consequently, Swiss environmental policy is addressing a wide spectrum of issues, ranging from pollution of air, water and soil, and exposure to noise, to protecting stratospheric ozone or reducing and managing waste. Several policy areas are linked directly or indirectly to the reduction of Switzerland's greenhouse gas emissions. Fiscal incentives are recognised as an essential instrument for promoting the efficient use of resources. The main instruments are the definition of legally binding emission limits, introduction of levies on substances or practices with negative environmental impacts as well as the obligation of environmental impact assessments for particular facilities and installations.

Switzerland's climate policy is based on the Federal Constitution of the Swiss Confederation, in particular Article 74 (environmental protection) and Article 89 (energy policy). The Climate and Innovation Act defines Switzerland's long-term greenhouse gas emission reduction targets and sets the pace for the implementation of specific policies and measures (see section II.D.1.5). To this end, the Swiss Federal Act on the Reduction of CO_2 Emissions (CO_2 Act; *Swiss Confederation*, 2011; see sections II.D.1.2, II.D.1.3, and II.D.1.4) is revised and strengthened on a regular basis. It defines objectives, instruments, measures and general rules of implementation of climate policy on the needed level of detail. The CO_2 Act also contains provisions related to enforcement and evaluation. The implementation of the CO_2 Act is further detailed in the Ordinance on the Reduction of CO_2 Emissions (CO_2 Ordinance; *Swiss Confederation*, 2012), where, inter alia, specific responsibilities for the implementation of measures are assigned. Tab. 4 shows detailed references to enforcement and administrative procedures for some core policies and measures defined in the second CO_2 Act and the corresponding CO_2 Ordinance.

[29] See decision 1/CMA.3, paragraph 33: 'Invites Parties to update the strategies referred to in paragraph 32 above regularly, as appropriate, in line with the best available science'.

[30] The ten basic strategic principles of Switzerland's long-term climate strategy to 2050 are: Seize opportunities, assume responsibility, reduce domestic emissions, reduce emissions across entire value chains, use all energy sources efficiently, the Swiss Confederation and the cantons gear activities to achieving net zero, socially acceptable, economically viable, improve environmental quality, openness to technology.

Tab. 4 > Enforcement and implementation responsibilities for core provisions of the second CO_2 Act (*Swiss Confederation*, 2011) and the corresponding CO_2 Ordinance (*Swiss Confederation*, 2012).

Instrument/measure	CO_2 Act	CO_2 Ordinance	Enforcement	Implementation level
Objectives	Article 3	Article 3	If a sector-specific interim target is not achieved, the Swiss Federal Department of Environment, Transport, Energy and Communications, after hearing the cantons and affected parties, shall request the Swiss Federal Council for additional measures.	Federal government
CO_2 levy on heating and process fuels	Articles 29–33	Articles 93–103	The CO_2 Ordinance defined a reduction pathway that needed to be followed (Article 94). If the targets set in the CO_2 Ordinance were not met, the CO_2 levy increased automatically. The last target year was 2020.	Federal government
Emissions trading scheme	Articles 15–21	Articles 40–65	Companies taking part in the emissions trading scheme have to cover their emissions with emission allowances issued in Switzerland or in the European Union. Emissions not covered entail a sanction of 125 Swiss francs per tonne of CO_2 equivalents.	Federal government
Negotiated reduction commitments (for exemption from the CO_2 levy)	Articles 31–32	Articles 66–79	Companies have to commit to reduce their greenhouse gas emissions. If commitments are not fulfilled, a sanction of 125 Swiss francs is due per tonne of CO_2 equivalents that has been emitted in excess and excess emissions need to be covered with emission allowances.	Federal government
National buildings refurbishment programme	Article 34	Articles 104–113	Annual reporting on effectiveness of implementation.	Cantons and contractual agreement between the federal government and the cantons
Building codes of the cantons	Article 9	Article 16	Regulated at cantonal level. Cantons have to report annually to the federal government on their activities.	Cantons
CO_2 emission regulations for newly registered vehicles	Articles 10–13	Articles 17–37	If targets are not met, importers of vehicles (passenger cars and light duty trucks) have to pay a sanction.	Federal government
Partial compensation of CO_2 emissions from motor fuel use	Articles 26–28	Articles 86–92	If the obligation to compensate is not fulfilled, a sanction of 160 Swiss francs per tonne of CO_2 must be paid. Additionally, the missing emission reductions must be covered by international carbon credits up to 2021 and from 2022 onward with emission allowances or internationally transferred mitigation outcomes.	Federal government

Apart from the Environmental Protection Act and the CO_2 Act, there are various other legal provisions that are related to environmental and climate issues. The Energy Act (*Swiss Confederation*, 2016), the Forest Act (*Swiss Confederation*, 1991), the Spatial Planning Act (*Swiss Confederation*, 1979), the Agriculture Act (*Swiss Confederation*, 1998b), the Road Traffic Act (*Swiss Confederation*, 1958), the Heavy Vehicle Charge Act (*Swiss Confederation*, 1997a), the Mineral Oil Tax Act (*Swiss Confederation*, 1996), the Ordinance on Chemical Risk Reduction (*Swiss Confederation*, 2005), the Ordinance on Air Pollution Control (*Swiss Confederation*, 1985), and the Ordinance on the Avoidance and Management of Waste (*Swiss Confederation*, 2015) all have components that contribute to environmental policy goals including emission reductions of greenhouse gases and precursor gases.

To ensure the public availability of information, the website of the Swiss Federal Office for the Environment contains information regarding legislative arrangements, enforcement and administrative procedures.[31] In particular, the Swiss Federal Office for the Environment publishes recommendations on the implementation of the legal provisions in cases where more detailed information is necessary. These recommendations are not legally binding but provide more precise instructions on the application of the legal instruments. For instance, in the context of the second CO_2 Act and the corresponding CO_2 Ordinance, the Swiss Federal Office for the Environment has published recommendations related to the implementation of domestic emission reduction projects in Switzerland[32], the exemption from the CO_2 levy on heating and process fuels for energy intensive companies[33], and the emissions trading scheme[34].

II.A.9.4 Arrangements for the monitoring and evaluation of policies and measures

Article 40 of the second CO_2 Act (section II.D.1.3) obliges the Swiss Federal Council to periodically evaluate the effectiveness of single policies and measures, and to consider the necessity of additional measures. These evaluations, which need to take into account other climate-relevant parameters such as economic development, population growth and

31 https://www.bafu.admin.ch/bafu/en/home/topics/climate.html

32 http://www.bafu.admin.ch/uv-1315-d

33 http://www.bafu.admin.ch/uv-1316-d

34 http://www.bafu.admin.ch/uv-1317-d

the expansion of traffic, have to be reported to the Swiss Parliament. However, apart from some exceptions (see below), the second CO_2 Act does not define the exact dates or periodicity of the assessments. With Article 40 of third CO_2 Act (section II.D.1.4), the Swiss Federal Council continues to be obligated to regularly assess the effectiveness and economic efficiency of the policies and measures. The Swiss Federal Office for the Environment, being responsible for matters relating to climate protection (see section II.A.9.1), is generally also responsible for the monitoring of progress made with greenhouse gas mitigation policies and measures. In addition, the Swiss Federal Audit Office, within the framework of its activities as an independent inspecting authority, regularly inspects the implementation of greenhouse gas mitigation policies and measures. In the following, the most significant monitoring approaches and ex-post evaluations (either completed or performed repeatedly) are presented.

CO_2 levy on heating and process fuels

The Swiss Federal Office for the Environment has undertaken an evaluation of the CO_2 levy on heating and process fuels with the goal to estimate the impact of the CO_2 levy on heating and process fuels on emissions since its introduction using both a modelling approach as well as data collected from a firm-level survey (*FOEN*, 2015b; *FOEN*, 2016b). However, given that the CO_2 Act envisages numerous (and mutually reinforcing) instruments, interdependencies between these instruments are expected. Sorting out the mitigation impact of an individual policy and measure is, thus, very difficult, especially for instruments such as the CO_2 levy on heating and process fuels that have a cross-sectoral impact. In 2017, an update of the model-based estimate was published (*Ecoplan*, 2017), based on a more refined approach that contributed to a more robust assessment of the mitigation impact of the CO_2 levy. Since the last update in 2017, the model-based estimate has not been updated again.[35]

CO_2 emission regulations for newly registered vehicles

The CO_2 emission regulations for newly registered vehicles (section II.D.3.2) are enforced by a sanction mechanism. Accordingly, compliance with the CO_2 emission regulations is monitored and evaluated on a case-by-case basis for small importers (in case the imported vehicle exceeds the CO_2 emission regulations a sanction has to be paid before the vehicle is licensed), or quarterly to annually for large importers. Data on the specific CO_2 emissions of newly registered vehicles are evaluated and published annually by the Swiss Federal Office of Energy.

Further, Article 36 of the CO_2 Ordinance requests that the Swiss Federal Department of Environment, Transport, Energy and Communications reports to the competent commissions of the Council of States and the National Council on the effectiveness of the CO_2 emission regulations for newly registered vehicles every three years. The first report was published in December 2016 (*DETEC*, 2016), followed by a second report in February 2020 (*DETEC*, 2020) and a third report in 2023 (*DETEC*, 2023).

Partial compensation of CO_2 emissions from motor fuel use

According CO_2 Act, fossil fuel importers are bound to offset part of the CO_2 emissions from motor fuels sold in Switzerland (section II.D.3.4). The compensation obligation arises when fossil motor fuels are released for free circulation in accordance with Article 4 of the Mineral Oil Tax Act (*Swiss Confederation*, 1996). The obligation is thus linked to the same taxable event as the mineral oil tax, which is monitored by the Swiss Federal Office for Customs and Border Security.

The Swiss Federal Audit Office evaluated the activities related to the partial compensation of CO_2 emissions from motor fuel use and published the respective report – including a summary in English – in 2016 (*Swiss Federal Audit Office*, 2016). The Swiss Federal Office for the Environment also mandated an evaluation of the partial compensation of the CO_2 emissions from motor fuel use (*evaluanda*, 2016), and is currently undertaking a new evaluation of the instrument (expected to be completed in spring 2025).

National buildings refurbishment programme

Cantons have to report annually on measures implemented within the national buildings refurbishment programme (section II.D.2.4) as well as on the development of corresponding CO_2 emissions from buildings on cantonal territory.[36] By providing a standardised format, the Swiss Federal Office for the Environment facilitates this reporting on CO_2

[35] For the results according to *Ecoplan* (2017), see Fig. 64 of Switzerland's eighth national communication and fifth biennial report.

[36] See https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/buildings/cantonal-reporting.html for more details.

emissions from buildings on cantonal territory, which is due on a biennial basis. So far, reports concerning the effect of climate and energy policies (for buildings at the cantonal level), including CO_2 emissions, are available for the year 2016 (*FOEN and SFOE*, 2018), the year 2018 (*FOEN and SFOE*, 2020), and the years 2016–2020 (*FOEN and SFOE*, 2023).

The annual reports of the national buildings refurbishment programme also present the latest activities and evolutions, including a summary of ex-post evaluations.[37] Further, a report on the first five years of the programme, including the cumulative effects, was published in March 2016 (*Swiss Federal Council*, 2016).

The Swiss Federal Audit Office evaluated the activities related to the national buildings refurbishment programme and published the respective report – including a summary in English – in 2013 (*Swiss Federal Audit Office*, 2013).

Emissions trading scheme

The Swiss Federal Audit Office evaluated the activities related to the emissions trading scheme and published the respective report – including a summary in English – in 2017 (*Swiss Federal Audit Office*, 2017a). The FOEN is currently undertaking a new evaluation of the instrument. It is expected to be completed in spring 2025.

Negotiated reduction commitments (for exemption from the CO_2 levy)

The Swiss Federal Office of Energy mandated an evaluation of the activities related to the negotiated reduction commitments (for exemption from the CO_2 levy; see section II.D.1.8) and published the respective report in 2016 (*Ecoplan*, 2016).

The Swiss Federal Audit Office evaluated the activities related to the negotiated reduction commitments (for exemption from the CO_2 levy) and published the respective report – including a summary in English – in 2023 (*Swiss Federal Audit Office*, 2023).

Energy Act

The Energy Act (*Swiss Confederation*, 2016) sets guidelines for the consumption of energy and electricity as well as for the energy production using renewable sources and hydropower. Monitoring of the respective indicators is part of the Energy Strategy 2050. The fifth monitoring report was published on 1 December 2023.[38] The relevant indicators regarding enhanced energy efficiency and the use of renewable energies evolved satisfactorily, and the intermediate targets prescribed for 2020 (see section II.D.2.1) were met comfortably. In the longer term, however, it appears that further efforts are needed to gradually restructure the energy system and, in particular, to promote the development of renewable energies and energy efficiency.

Technology fund

The Swiss Federal Audit Office evaluated the activities related to the technology fund (see section II.D.10) and published the respective report – including a summary in English – in 2017 (*Swiss Federal Audit Office*, 2017b). Additionally, the management agency of the technology fund produces an annual report on the activities in the past year (see e.g. *Technology Fund*, 2024).

Other monitoring processes

Several other measures require regular reporting of emissions or of compliance with specific commitments. They are therefore closely monitored on a regular basis. For instance, firms participating in the emissions trading scheme and firms with an individual (negotiated) reduction target that are exempt from the CO_2 levy are obliged to monitor their greenhouse gas emissions and to submit an annual report to the Swiss Federal Office for the Environment.

II.A.9.5 Arrangements for the archiving of information

The Act on Archiving (*Swiss Confederation*, 1998a) regulates the archiving of documents of the federal government, ensuring that documents from all federal institutions that are valuable for legal, political, economic, historical, social or

[37] https://www.dasgebaeudeprogramm.ch/de/meta/publikationen-und-fotos/jahresberichte

[38] https://www.bfe.admin.ch/bfe/en/home/supply/statistics-and-geodata/monitoring-energy-strategy-2050.html

cultural reasons are archived by the Swiss Federal Archives.[39] The compulsory archiving of course also covers all information prepared with regard to e.g. the greenhouse gas inventory, the national and international reporting obligations, the legislative process, and the implementation of policies and measures.

II.A.10 Changes in institutional arrangements since previous biennial transparency report

As this is Switzerland's first biennial transparency report, no changes are to be reported. Compared to Switzerland's eight national communication and fifth biennial report, no major changes were implemented.

[39] See *https://www.bar.admin.ch/bar/en/home.html* for more details.

II.B Switzerland's nationally determined contribution

Description of Switzerland's nationally determined contribution under Article 4 of the Paris Agreement, including updates

A general description of Switzerland's first nationally determined contribution covering the years 2021 to 2030 is presented in the box below. Comprehensive information on Switzerland's first nationally determined contribution is included in the appendix to Switzerland's CTF-NDC tables, which are an integral part of Switzerland's first biennial transparency report (see also Tab. 5). To further elaborate on the methodological approaches and to ensure consistency and transparency, Switzerland updated – simultaneously with the preparation of its first biennial transparency report – its information necessary for clarity, transparency and understanding in accordance with decision 1/CP.21 of its first nationally determined contribution. On 13 November 2024, Switzerland submitted the respective document to the UNFCCC secretariat to make it publicly available in the registry.[40]

Tab. 5 > Description of Switzerland's first nationally determined contribution under Article 4 of the Paris Agreement (see also the appendix of the CTF-NDC tables).

Target(s) and description, including target type(s), as applicable	Absolute economy-wide emission reduction target compared with a base year. Emission reduction of at least minus 50 per cent by 2030 compared with 1990 levels, implemented as an emission budget covering 2021–2030, which is equivalent to an average reduction of greenhouse gas emissions of at least 35 per cent over the period 2021–2030.
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	01.01.2021–31.12.2030 Switzerland expresses its first NDC both as single-year (2030) and multi-year target (2021–2030). The single-year target is implemented using an emission budget over the period 2021–2030.
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	Base year: 1990 Emissions in the base year comprise net emissions and net removals from all sectors (including LULUCF) and indirect CO_2. A provisional value for base year emissions, subject to change due to recalculations of the greenhouse gas inventory, is 52.1 million tonnes of CO_2 equivalents (based on the National Inventory Report from April 2024). The value for the final accounting will be defined in the first inventory submission covering data up to 2030. LULUCF will be reported and accounted for on a land-based approach.
Time frame(s) and/or periods for implementation, as applicable	01.01.2021–31.12.2030
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	Gases covered: CO_2 (including indirect CO_2), CH_4, N_2O, HFCs, PFCs, SF_6, NF_3 Sectors covered (as reported in the national inventory report): energy; industrial processes and product use; agriculture; land-use, land-use change and forestry; waste; other. While Switzerland supports the inclusion of international aviation and navigation on the basis of existing and future internationally agreed rules applicable to all Parties, Switzerland's first NDC does not include emissions from international aviation and navigation. In particular, Switzerland's emission reduction targets up to 2030 do not include emissions from international aviation, a part of which are already covered by the Swiss emission trading scheme (ETS) as well as by the Carbon Offsetting and Reduction Scheme CORSIA of the International Civil Aviation Organisation ICAO. However, Switzerland's long-term emissions reduction targets do include emissions from international aviation and navigation.
Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	Switzerland will realize its first NDC mainly domestically and will partly use internationally transferred mitigation outcomes (ITMOs) from cooperation under Article 6. Switzerland will implement the guidance on cooperative approaches referred to in Article 6, paragraph 2 of the Paris Agreement, adopted at COP26, as well as further guidance to be adopted on Article 6, to apply robust rules that avoid any form of double counting, ensure environmental integrity and promote sustainable development, including the protection of human rights, and not to use pre-2020 units towards the achievement of its first NDC. Switzerland already signed bilateral agreements with various countries (see *www.bafu.admin.ch/bilateral-climate-agreements*), creating the necessary frameworks for cooperative approaches under Article 6.2 of the Paris Agreement. The agreements govern the transfers of mitigation outcomes and their use. ITMOs may also be used for other international mitigation purposes, such as e.g. voluntary climate targets by private or sub-state actors. In this case, they would not be counted towards Switzerland's NDC.
Any updates or clarifications of previously reported information, as applicable	As Switzerland consistently uses the values from the most recent greenhouse gas inventory, any recalculations in the greenhouse gas inventory potentially affect the values for the base year (1990) as well as for the years included in the period for implementation. Switzerland's national inventory document annually provides an overview of the most relevant recalculations in chapter 10, while the sectoral chapters document each individual recalculation. The LULUCF sector will be reported and accounted for based on a land-based approach. In order to foster environmental integrity and to reduce uncertainty due to assumptions regarding extrapolated management practices and other parameters influencing the calculation of reference levels, Switzerland decided to use net accounting of emissions and removals in the LULUCF sector from 2021 onwards. This change in the accounting method has also been introduced in the national legislation (CO_2 ordinance).

[40] *https://unfccc.int/NDCREG* (see also *www.bafu.admin.ch/paris-agreement-submissions*)

Box: Switzerland's first nationally determined contribution (2021–2030)

Switzerland is committed to follow the recommendations of science in order to limit warming to 1.5 degrees Celsius. In view of its climate target of net zero greenhouse gas emissions by 2050, Switzerland's first NDC is to reduce its net greenhouse gas emissions by at least 50 per cent by 2030 compared with 1990 levels, corresponding to an average reduction of net greenhouse gas emissions by at least 35 per cent over the period 2021–2030. By 2025, a reduction of net greenhouse gas emissions by at least 35 per cent compared with 1990 levels is anticipated. Internationally transferred mitigation outcomes (ITMOs) from cooperation under Article 6 of the Paris Agreement will partly be used.

Switzerland is currently working on its second nationally determined contribution covering the years 2031 to 2035 and plans to submit it to the UNFCCC secretariat no later than 10 February 2025.

II.C Information necessary to track progress

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

Comprehensive information necessary to track progress is included in Switzerland's CTF-NDC tables, which are an integral part of Switzerland's first biennial transparency report. The sections II.C.1.1 to II.C.1.3 complement the CTF-NDC tables with further information in a narrative format.

II.C.1.1 Accounting approach

CTF-NDC table 3 provides the details with regard to Switzerland's accounting approach. The most relevant points are:

- The accounting approach is based on the national greenhouse gas inventory. By doing so, scope, coverage, data sources, assumptions, methodologies, and metrics are fully consistent between Switzerland's first nationally determined contribution and the greenhouse gas inventory. The methodologies used ensure transparency, accuracy, completeness, consistency and comparability as far as can be achieved and avoid any double-counting of emissions and removals, consistent with decisions 4/CMA.1 and 18/CMA.1;
- The national greenhouse gas inventory is relying on metrics and guidance agreed upon by the CMA and methodologies and good practice guidance from the Intergovernmental Panel on Climate Change in order to provide a sound quantitative framework for accounting of anthropogenic emissions and removals. In order to foster environmental integrity and to reduce uncertainty due to assumptions regarding extrapolated management practices and other parameters influencing the calculation of reference levels, Switzerland decided to use net accounting of emissions and removals in the land use, land-use change, and forestry sector from 2021 onwards. This update of the accounting methodology compared to the methodology used under the Kyoto Protocol is also going to be reflected in the national legislation (CO_2 ordinance);
- Cumulative absolute economy-wide net emissions as reported in the national greenhouse gas inventory over the period 2021–2030 will be compared to the target of the nationally determined contribution (after application of corresponding adjustments involving the use of internationally transferred mitigation outcomes).

With regard to any methodologies associated with any cooperative approaches that involve the use of internationally transferred mitigation outcomes, Switzerland follows the methodologies provided in decision 2/CMA.3.

II.C.1.2 Selected indicator, relation to nationally determined contribution

Given that Switzerland's nationally determined contribution is an absolute economy-wide emission reduction target compared with a base year, Switzerland has selected 'total emissions and removals' as the only relevant indicator needed to track progress towards the implementation and achievement of its nationally determined contribution. As reported in CTF-NDC table 2, the indicator 'total emissions and removals' corresponds total CO_2 equivalent emissions and removals of all gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3, and indirect CO_2) from all sectors (1, 2, 3, 4, 5, and 6) as reported in the national greenhouse gas inventory (see also Tab. 5). Emissions from international aviation and navigation are not covered by Switzerland's first nationally determined contribution and are thus not included in the indicator. With recalculations in the greenhouse gas inventory, total emissions and removals – including those for the base year 1990 –

may be subject to change, and the indicator is therefore regularly updated accordingly. In consistency with Switzerland's most recent greenhouse gas inventory of April 2024, CTF-NDC table 4.1 provides the most recent values for the indicator 'total emissions and removals' for each reporting year during the implementation period of Switzerland's first nationally determined contribution (as far as available yet), and also includes the updated value for total emission and removals in the base year 1990 (see also CTF-NDC table 1).

As reported in CTF-NDC table 1 (see also Tab. 5), Switzerland's absolute economy-wide emission reduction target is implemented as an emission budget covering the years 2021–2030. Accordingly, the relation between the indicator 'total emissions and removals' and Switzerland's first nationally determined contribution results from comparing cumulative absolute economy-wide emissions and removals as reported in the national greenhouse gas inventory over the period 2021–2030 with the target of the nationally determined contribution. In addition, Switzerland participates in cooperative approaches that involve the use of internationally transferred mitigation outcomes.

II.C.1.3 Target assessment and tracking progress

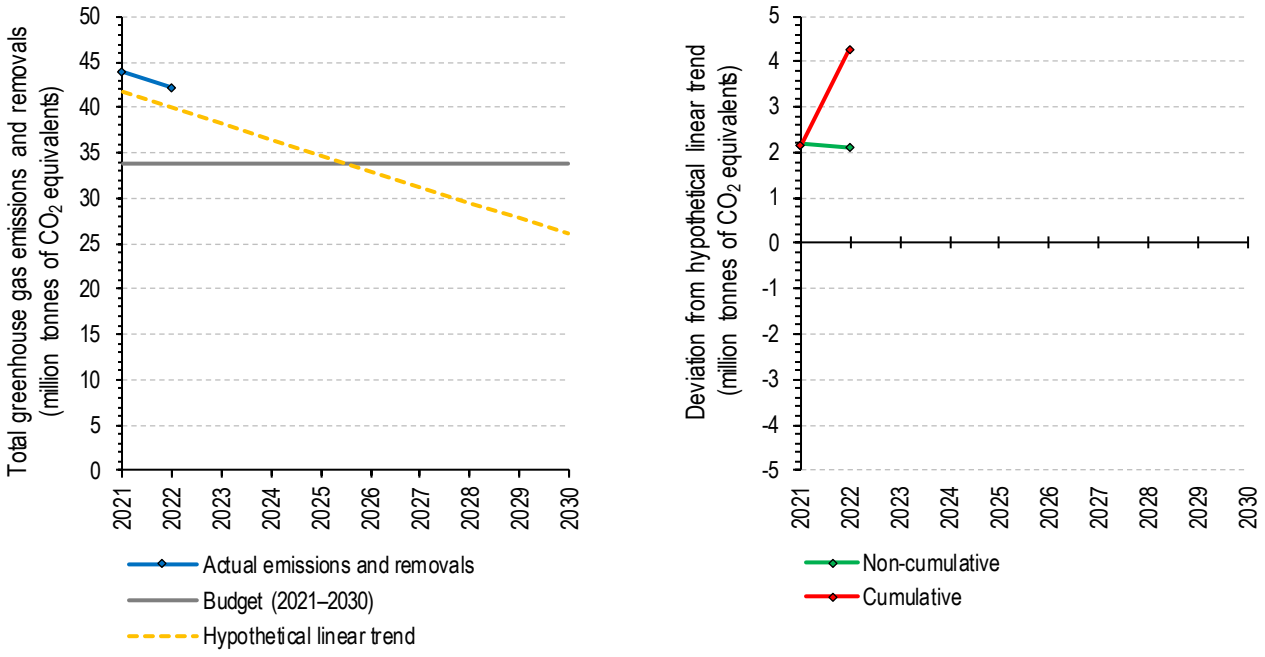
Because Switzerland's absolute economy-wide emission reduction target is implemented as an emission budget covering the years 2021–2030, the final accounting can only take place once the greenhouse gas inventory covers all years up to 2030 (i.e. in the fifth biennial transparency report to be submitted in 2032). Meanwhile, CTF-NDC table 4.1 provides the currently available provisional values (subject to future recalculations in the greenhouse gas inventory), namely:

- Total emissions and removals in the base year 1990: 52,098.58 kilotonnes of CO_2 equivalents;
- The value for the target level, i.e. 65 per cent of ten times total emissions and removals in the base year 1990: 338,640.74 kilotonnes of CO_2 equivalents (corresponding to 33,864.07 kilotonnes of CO_2 equivalents per year);
- Total emissions and removals in the years 2021 and 2022;
- Total quantities of internationally transferred mitigation outcomes (first transferred, authorised for use for other international mitigation purposes, used towards achievement of the nationally determined contribution, net annual quantity, etc.).

For the purpose of tracking progress – while the period for implementation of the first nationally determined contribution is still ongoing – total emissions and removals are compared to a hypothetical linear trend starting at 80 per cent of base year emissions and removals in 2021 and reaching 50 per cent of base year emissions and removals in 2030 (Fig. 50). This hypothetical linear trend is consistent with the emission budget of 65 per cent of base year emissions and removals over the period 2021–2030 and thus allows for a provisional estimate of progress. However, the actual evolution of greenhouse gas emissions and removals will not be linear, e.g. because of variations caused by meteorological conditions impacting heating demand (see section II.A.7) or because of policies and measures that only take full effect over time.

As Fig. 50 illustrates, Switzerland's total emissions and removals in each of the first two years of the implementation period of the first nationally determined contribution were by slightly more than two million tonnes of CO_2 equivalents (about five per cent of total emissions and removals) higher than expected by the hypothetical linear trend that is consistent with the emission budget of the first nationally determined contribution. Expressed cumulatively, Switzerland's emissions as of 2022 are thus about 4.3 million tonnes of CO_2 equivalents above the hypothetical linear trend. Switzerland is committed to continue and strengthen its efforts to further reduce its greenhouse gas emission, and is confident to achieve its first nationally determined contribution, not least also through its participation in cooperative approaches that involve the use of internationally transferred mitigation outcomes. Up to 2022, no internationally transferred mitigation outcomes were used yet towards the achievement of the first nationally determined contribution (see CTF-NDC table 4.1). The policy and measure 'partial compensation of CO_2 emissions from motor fuel use' (see section II.D.3.4) will ensure that Switzerland will dispose of internationally transferred mitigation outcomes to the extent required. In case of need, Article 4, paragraph 5 of the third CO_2 Act authorises the federal government to purchase additional internationally transferred mitigation outcomes to ensure the achievement of targets for the reduction of greenhouse gas emissions.

Fig. 50 > Tracking progress made by Switzerland in implementing its first nationally determined contribution. Left: Total emissions compared to the emission budget (65 per cent of emissions in the base year 1990 over the years 2021–2030) as well as compared to a hypothetical linear trend (starting at 80 per cent of base year emissions in 2021 and reaching 50 per cent of base year emissions in 2030). The emission budget and the hypothetical linear trend are consistent (identical cumulative emissions over the period of implementation). Right: Deviation of total emissions from the hypothetical linear trend (non-cumulative and cumulative over the period of implementation).



II.D Mitigation policies and measures, actions and plans

Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

This chapter describes policies and measures implemented or planned to be implemented in Switzerland in order to achieve the emission reduction commitments agreed on in the national and international context (for Switzerland's national targets for the reduction of greenhouse gas emissions see box below). The sections are organised by sector and present individual mitigation actions as listed in CTF-NDC table 5. Section II.D.1 focuses on policies and measures that are effective across sector boundaries. Section II.D.2 deals with (non-transport) policies and measures related to energy efficiency, reduced energy consumption, and renewable energy. Section II.D.3 encompasses aspects of transport infrastructure, sustainable modes of transport, vehicle emission standards, as well as policies and measures in the aviation sector. This section also describes Switzerland's policies and measures that influence greenhouse gas emissions from international transport (see sections II.D.3.9 to II.D.3.14). The remaining mitigation actions cover the following areas: Industrial processes and product use (section II.D.4), agriculture (section II.D.5), land use, land-use change, and forestry (section II.D.6), and waste (section II.D.7). Information on the costs, non-greenhouse gas mitigation benefits and interactions of Switzerland's policies and measures is provided in section II.D.8. Sections II.D.9 and II.D.10 address policies and measures no longer in place as well as the modification of longer-term trends in greenhouse gas emissions. An assessment of the economic and social impacts of response measures is presented in section II.D.11.

Box: Switzerland's national targets for the reduction of greenhouse gas emissions

Switzerland's nationally determined contribution is presented and discussed in detail in section II.B. In its national legislation, Switzerland translated the international commitment into national targets as follows:

- The second CO_2 Act requires an annual reduction of 1.5 per cent relative to the 1990 level during the years 2021–2024. At least 75 per cent of the reduction of emissions must be achieved with domestic measures, the remainder with measures abroad;
- The third CO_2 Act requires a reduction of total greenhouse gas emissions (relative to 1990) by (i) at least 50 per cent by 2030 and (ii) at least 35 per cent in the mean over the years 2021–2030, primarily with measures in Switzerland, but also allowing for measures abroad (see section II.D.1.4);
- The Climate and Innovation Act requires net-zero greenhouse gas emissions by 2050, with a reduction of total greenhouse gas emissions (relative to 1990) by (i) at least 64 per cent in the mean over the years 2031–2040, (ii) at least 75 per cent by 2040, and (iii) at least 89 per cent in the mean over the years 2041–2050; as far as possible, the targets must be achieved by reducing emissions in Switzerland (see section II.D.1.5);
- The Climate and Innovation Act also sets out the following sectoral targets (reductions relative to 1990):
    - Buildings sector: By at least 82 per cent by 2040 and by 100 per cent by 2050;
    - Transport sector: By at least 57 per cent by 2040 and by 100 per cent by 2050;
    - Industry sector: By at least 50 per cent by 2040 and 90 per cent by 2050;
- With the ongoing revision of the CO_2 Ordinance (to be adopted in spring 2025), the Swiss Federal Council aims at establishing – by agreement with the parties concerned – sectoral targets to be reached by 2030.

Generally, Switzerland's national targets for the reduction of greenhouse gas emissions are identical in scope to Switzerland's nationally determined contribution (see section II.B).

Box: Status of policies and measures as reported in Switzerland's first biennial transparency report

Switzerland drafted its first biennial transparency report in the summer of 2024, so the status of policies and measures reported is as of 1 August 2024. The revision of the CO_2 ordinance, which regulates the implementation of the third CO_2 Act, was ongoing (the Swiss Federal Council opened the consultation on 26 June 2024[41]). Accordingly, Switzerland reports the third CO_2 Act as 'adopted', but reports the measures to be further specified in the corresponding CO_2 Ordinance as 'planned'.

At its meeting on 20 September 2024, the Swiss Federal Council decided which of the relief measures set out in the expenditure and subsidies review should be pursued.[42] Some of the policies and measures reported in Switzerland's first biennial transparency report could be affected by the planned austerity measures and may not be implemented as currently reported. As the consultation process is expected to begin in January 2025, additional information cannot be provided at this stage.

II.D.1 Cross-sectoral policies and measures

II.D.1.1 Overview

While policies and measures addressed in sections II.D.2 to II.D.7 may have side effects beyond their specific policy domain, the policies and measures presented in section II.D.1 are clearly cross-sectoral in nature, i.e. they cannot be assigned to one of the 'classical' policy sectors.

Tab. 6 gives an overview of Switzerland's cross-sectoral policies and measures. The following sections provide more details and background information on each policy and measure.

Tab. 6 > Summary of cross-sectoral climate policies and measures. The sector affected is 'cross-cutting' for all policies and measures presented in this table.

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
First CO_2 Act (1999) *	CO_2	Average reduction of CO_2 emissions from fossil fuel use by 10 per cent over the years 2008–2012 (relative to 1990).	Regulatory	Expired (replaced by second CO_2 Act)	First legal basis of Switzerland's climate policy including the implementation of the first commitment period of the Kyoto Protocol.	2000	FOEN	NA [b]	NA [b]	NA [b]
Second CO_2 Act (2011) *	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Reduction of all greenhouse gas emissions by 20 per cent by 2020, followed by a further annual reduction of 1.5 per cent in the years 2021–2024 (relative to 1990).	Regulatory	Implemented	Current legal basis of Switzerland's climate policy including the implementation of the second commitment period of the Kyoto Protocol, as well as the implementation for the first four years (2021–2024) under the Paris Agreement. The provisions cover mitigation as well as adaptation.	2013	FOEN, SFOE	IE [b]	NA [b]	NA [b]
Third CO_2 Act (2025) *	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Decrease of total greenhouse gas emissions (relative to 1990) by (i) at least 50 per cent by 2030 (including reductions abroad) and (ii) at least 35 per cent in the mean over the years 2021–2030 (including reductions abroad).	Regulatory	Adopted (strengthening planned)	Update of the CO_2 Act providing the legal basis of Switzerland's climate policy consistent with the Paris Agreement. While mostly covering the same policies and measures as the second CO_2 Act, the third CO_2 Act includes several adjustments of the policies and a few new measures in order to reach the more	2025	FOEN, SFOE	NA [b]	IE [b]	IE [b]

41 https://www.bafu.admin.ch/bafu/de/home/themen/klima/mitteilungen.msg-id-101588.html

42 https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-102538.html

					ambitious national and international targets.					
Climate and Innovation Act *	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Net-zero greenhouse gas emissions by 2050, with a reduction of total greenhouse gas emissions (relative to 1990) by (i) at least 64 per cent in the mean over the years 2031–2040, (ii) at least 75 per cent by 2040, and (iii) at least 89 per cent in the mean over the years 2041–2050.	Regulatory	Adopted	Legal basis to guide Switzerland's long-term climate policy in such a way that (i) greenhouse gas emissions are reduced as far as possible, (ii) the effects of remaining greenhouse gas emissions are offset through the use of negative emission technologies, (iii) Switzerland promotes adaptation to and protection against the effects of climate change, and (iv) that financial flows are developed in a low-emission and climate-resilient manner.	2025	FOEN, SFOE	NA [b]	IE [b]	IE [b]
CO_2 levy on heating and process fuels *	CO_2	Promote energy efficiency, less CO_2 intensive energy sources and reduced use of fossil heating and process fuels.	Economic, fiscal	Implemented	Surcharge on fossil heating and process fuels. Two thirds of the revenues are redistributed to households and businesses, up to one third goes into the national buildings refurbishment programme and – to a small extent – to a technology fund granting loan guarantees for the development of new low-emission technologies.	2008	FOEN	2 000	2 250	2 250
Emissions trading scheme *	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Reducing greenhouse gas emissions of emission-intensive industries and aviation using market-based mechanism.	Economic, regulatory	Implemented (strengthening planned)	Emissions trading scheme based on the cap-and-trade principle, enabling the cost-effective achievement of climate-protection targets. Large greenhouse gas-intensive companies are required to participate, medium-sized companies may voluntarily participate. Companies included in the emissions trading scheme are exempt from the CO_2 levy on heating and process fuels. Aviation is included since 2020.	2008	FOEN	600	1 450	2 380
Negotiated reduction commitments (for exemption from the CO_2 levy) *	CO_2	Emission reduction targets agreed with companies exempt from the CO_2 levy on heating and process fuels.	Regulatory	Implemented (strengthening planned)	Binding agreements with eligible small and medium-sized companies. Emission reduction targets take the technological potential and economic viability of measures into account. Targets are calculated from the starting point along a simplified or individual linear reduction trajectory to the endpoint in the year 2020, a linear extrapolation of this reduction trajectory for 2021, followed by a reduction of two per cent per year up to 2024. Alternatively, economically viable measures (measures target) can be determined.	2008	FOEN, SFOE	370	NE [c]	NE [c]
Promotion of innovative technologies and processes *	CO_2, CH_4, N_2O	All companies should achieve net-zero emissions by 2050 at the latest (considering at least the emissions caused by operations as well as those caused by the provision of purchased energy).	Economic	Adopted	Encouraging companies to tackle decarbonisation. First movers are financially supported to implement innovative technologies (total budget of 1.0 billion Swiss francs for the years 2025 to 2030).	2025	FOEN, SFOE	NA [d]	0 [e]	630

Exemplary function of the Swiss Confederation and the cantons	CO_2, CH_4, N_2O	2019: Commitment by the federal government to reduce the CO_2 emissions of the federal administration by 50 per cent in 2030. 2023: Approval of a net-zero target for the federal administration, to be reached by 2040.	Regulatory	Implemented (strengthening planned)	Ensuring that the federal government and cantons set an example in terms of achieving the long-term climate goals. Remaining greenhouse gas emissions must be fully offset.	2020	FOEN	14 [f]	19 [f]	24 [f]

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] The first, second and third CO_2 Acts as well as the Climate and Innovation Act are the legal frameworks for various measures. While the expected mitigation impacts of individual policies and measures are presented along with these policies and measures, the total mitigation impacts of the first, second and third CO_2 Acts as well as the Climate and Innovation Act correspond to the objectives indicated in the third column. Accordingly, the mitigation impacts for the first, second and third CO_2 Acts as well as the Climate and Innovation Act are reported as 'included elsewhere' (or as 'not applicable' in case the law is not in force at that time).

[c] For 2025 and 2030, the mitigation impacts cannot be estimated for the following reasons: (i) the modalities for the time after 2024 are not yet fully defined, and (ii) with the overachievement of their targets in 2020, companies already fulfilled the requested reductions for the years 2021–2024, i.e. it is unclear whether companies will engage in further measures or not in the upcoming years.

[d] The start year is 2025.

[e] The first proposals will be assessed and approved in 2025, with the mitigation impact developing from 2026 onwards.

[f] The offsetting of remaining greenhouse gas emissions through internationally transferred mitigation outcomes (or CERs up to 2021) is not considered in the values provided.

IE, included elsewhere; NA, not applicable; NE, not estimated
FOEN, Swiss Federal Office for the Environment; SFOE, Swiss Federal Office of Energy

II.D.1.2 First CO_2 Act (1999)

The first CO_2 Act (*Swiss Confederation*, 1999b) entered into force in May 2000. It formed the legal framework for the implementation of Switzerland's emissions reduction commitment under the Kyoto Protocol by limiting CO_2 emissions from fossil fuel use for heating and transport to 10 per cent below 1990 levels over the period 2008–2012. The overall target was further divided into a reduction target of 15 per cent on heating and process fuels and eight per cent on motor fuels. These targets were set to assure compliance with the target under the Kyoto Protocol, assuming that the aggregate level of emissions of greenhouse gas other than CO_2 remained unchanged compared to 1990.

The primary instruments to reach the targets for the period 2008–2012 were:

- CO_2 levy on heating and process fuels;
- Emissions trading scheme (cap-and-trade principle);
- National buildings refurbishment programme;
- Voluntary actions in various areas, the 'Climate Cent' (a surcharge on motor fuels) being the most notable example;
- Measures in other policy areas (waste, agriculture, F-gases) that are relevant to climate change mitigation;
- Complementary use of flexible mechanisms under the Kyoto Protocol.

The first CO_2 Act expired at the end of 2012 and has been replaced by the second CO_2 Act (see section II.D.1.3).

Estimate of mitigation impact

The expected mitigation impact of the first CO_2 Act corresponds to its objective, i.e. an average reduction by 10 per cent of CO_2 emissions from fossil fuel use over the years 2008–2012 relative to 1990. As the first CO_2 Act has been replaced by the second CO_2 Act, the mitigation impacts for the years 2020, 2025 and 2030 are indicated as 'not applicable' in Tab. 6 and CTF-NDC table 5.

II.D.1.3 Second CO_2 Act (2011)

The second CO_2 Act (*Swiss Confederation*, 2011) is the current centrepiece of Switzerland's climate policy. Fully revising the first CO_2 Act, it entered into force on 1 January 2013. It was originally supposed to cover the period from 2013–2020. Due to the lengthy debate in the Swiss Parliament on the third CO_2 Act (see section II.D.1.4), it was partially revised and extended by one year until the end of 2021. Following the rejection of the third CO_2 Act in a referendum, the second CO_2 Act was partially revised again and extended until 2024. This second partial revision ensured that the measures that would have expired by the end of 2021 due to the rejection of the third CO_2 Act could be continued until 2024.

Similar to the preceding first CO_2 Act, the second CO_2 Act defines emission reduction targets on the national level (see the discussion of the estimate of the mitigation impact below as well as the description of Switzerland's national targets for the reduction of greenhouse gas emissions in the box at the beginning of chapter II.D). It also forms the foundation for several policies and measures to reach these targets (see sections below). Some policies and measures developed or initiated in the context of the first CO_2 Act – such as the CO_2 levy on heating and process fuels as well as the national buildings refurbishment programme – were continued under the second CO_2 Act. The second CO_2 Act sets incentives for increasing use of renewable energies, improvement of energy efficiency, and development of innovative low-emission technologies. In addition, it gives the Swiss government the responsibility to coordinate measures aimed at adaptation to the impacts of climate change at the national level.

On 1 January 2025, the second CO_2 Act will be replaced by the third CO_2 Act in order to implement the policies and measures from 2025 onwards until 2030 (see section II.D.1.4).

Estimate of mitigation impact

The expected mitigation impact of the second CO_2 Act corresponds to its objectives, i.e. to a reduction of greenhouse gas emissions of 20 per cent by 2020 relative to the 1990 level and an additional annual reduction of 1.5 per cent relative to the 1990 level during the years 2021–2024. At least 75 per cent of the reduction of emissions in the years 2021–2024 must be achieved with domestic measures, the remainder with measures abroad. As the second CO_2 Act forms the legal framework for various measures, the mitigation impact is indicated in Tab. 6 and CTF-NDC table 5 as 'included elsewhere' (i.e. under the policies and measures presented below) or, for years in which the second CO_2 Act will be replaced by the third CO_2 Act, as 'not applicable'.

II.D.1.4 Third CO_2 Act (2025)

A third CO_2 Act that was supposed to replace the second CO_2 Act and to cover the period 2021–2030 was rejected in a popular vote on 13 June 2021 (48.4 per cent voted in favour, 51.6 per cent voted against). Following the rejection, the Swiss Parliament decided to extend the second CO_2 Act until 2024 (see section II.D.1.3). Meanwhile, the third CO_2 Act has been adopted without a referendum, as the new version takes into account – in a balanced way – the concerns that led to the rejection on 13 June 2021. Entering into force on 1 January 2025, the third CO_2 Act covers the period 2025–2030. It translates Switzerland's international commitments under the Paris Agreement into national law and defines national targets for the reduction of greenhouse gas emissions (see the discussion of the estimate of the mitigation impact below as well as the description of Switzerland's national targets for the reduction of greenhouse gas emissions in the box at the beginning of chapter II.D). Within the third CO_2 Act, the following most important proven policies and measures are continued and, in many cases, strengthened:

- CO_2 levy on heating and process fuels (see section II.D.1.6);
- Emissions trading scheme (see section II.D.1.7);
- Negotiated reduction commitments (for exemption from the CO_2 levy) (see section II.D.1.8);
- National buildings refurbishment programme (see section II.D.2.4);
- CO_2 emission regulations for newly registered vehicles (see section II.D.3.2);
- Partial compensation of CO_2 emissions from motor fuel use (see section II.D.3.4);
- Sustainable aviation fuel policy (see section II.D.3.13).

The third CO_2 Act also introduces new polices and measures that mainly focus on targeted promotion and subsidies such as for instance:

- Decarbonisation of installations in the emissions trading scheme (see section II.D.2.8);
- Promotion of electric propulsion technologies in public transport (see section II.D.3.7);
- Operators of aircraft are obliged to state the emissions expected to be caused by the respective flight in CO_2 equivalent in the flight offers (Article 7a of the third CO_2 Act);

- The federal register of buildings and dwellings needs to be updated whenever a system for heating and hot water is installed in a new building or replaced in an existing building (Article 9, paragraph 3 of the third CO_2 Act);
- Public transport companies are to be granted financial aid for the provision of new cross-border long-distance passenger rail services, including night trains, for a limited period until the end of 2030 (Article 37a, paragraph 1a of the third CO_2 Act). Because improved international train connections are an alternative to short-distance flights, the subsidies will be financed, up to 2030, with a maximum of 30 million Swiss francs per year from the auctioning of emission allowances for aviation in the framework of the emissions trading scheme;
- Provision of financial resources to prevent damage to persons or property of considerable value that may arise as a result of increased greenhouse gas concentrations in the atmosphere (Article 37b, paragraph 1a of the third CO_2 Act). The specific use of these financial resources is currently being finalised and Switzerland will be able to report more details in chapter III of its second biennial transparency report.

Some further measures introduced or continued within the third CO_2 Act target the modification of longer-term trends in greenhouse gas emissions and removals and are thus described in section II.D.10: (i) Promotion of renewable energies (Article 34a of the third CO_2 Act), (ii) technology fund (Article 35 of the third CO_2 Act), and (iii) information, training and advisory services (Article 41 of the third CO_2 Act).

Finally, the Unfair Competition Act (*Swiss Confederation*, 1986) has been amended to state in its Article 3 that unfair behaviour is committed by anyone who makes statements about themselves, their goods, works or services in relation to the climate impact caused that cannot be substantiated by objective and verifiable bases.

Planned strengthening

In order to further strengthen Switzerland's climate policies and measures for the period 2031–2040, the Swiss Federal Council has started to prepare a draft for the next revision of the CO_2 Act. The aim is to put Switzerland on track to meet the objective for 2040 as set out in the Climate and Innovation Act (see section II.D.1.5 as well as the description of Switzerland's national targets for the reduction of greenhouse gas emissions in the box at the beginning of chapter II.D). After consultation with the cantons, political parties, associations and other interest groups, the draft will be submitted to the Swiss Parliament for debate approximately in the second or third quarter of 2027. As the legislative process is currently at the very beginning, no further details can be given at this stage.

Estimate of mitigation impact

The expected mitigation impact of the third CO_2 Act corresponds to its objective, i.e. a reduction of total greenhouse gas emissions (relative to 1990) by (i) at least 50 per cent by 2030 and (ii) at least 35 per cent in the mean over the years 2021–2030, primarily with measures in Switzerland, but also allowing for measures abroad. Based on the expected mitigation impacts of the individual policies and measures, the share of domestic reduction will be around 70 per cent. As the third CO_2 Act forms the legal framework of various policies and measures, the mitigation impact is indicated in Tab. 6 and CTF-NDC table 5 as 'included elsewhere' (i.e. under the policies and measures presented below) or, for years in which the third CO_2 Act is not yet in force, as 'not applicable'. The mitigation impact of the planned strengthening should be in line with the objective for 2040, but as the process is currently at an early stage, details are not yet available.

II.D.1.5 Climate and Innovation Act

As an indirect counter proposal to the 'Glacier Initiative' – a popular initiative to enshrine in the Federal Constitution of the Swiss Confederation the target of reducing Switzerland's greenhouse gas emissions to net-zero by 2050, including a ban on the use of fossil fuels – the Swiss Parliament elaborated the Climate and Innovation Act, which was approved by the electorate on 18 June 2023 with 59.1 per cent of the vote. Therewith, Switzerland adopted democratically legitimised long-term reduction targets for greenhouse gas emissions, with the core objective of net-zero by 2050. The Climate and Innovation Act further includes intermediate targets (for single years and specific time periods) as well as sectoral targets for the buildings, transport and industry sectors (see the discussion of the estimate of the mitigation impact below as well as the description of Switzerland's national targets for the reduction of greenhouse gas emissions in the box at the beginning of chapter II.D). It also states that after 2050, the amount of CO_2 removed and stored through the use of negative emission technologies must exceed the remaining greenhouse gas emissions.

The Climate and Innovation Act mandates the Swiss Federal Council to submit proposals to the Swiss Parliament for the implementation of the defined targets in good time (for the periods 2025–2030, 2031–2040, and 2041–2050), after

consulting the parties concerned and taking into account the latest scientific findings. While further policies and measures to achieve the long-term targets are still to be elaborated, the Climate and Innovation Act introduces the following new polices and measures:

- Promotion of innovative technologies and processes (section II.D.1.9);
- Exemplary function of the Swiss Confederation and the cantons (section II.D.1.10);
- Impulse programme for the replacement of heat generation systems and energy efficiency measures (section II.D.2.9);
- Safeguarding against the risks of investments in public infrastructure (section II.D.2.10);
- The Swiss Confederation and the cantons are mandated to ensure that the necessary measures are taken in Switzerland to adapt to and protect against the adverse effects of climate change (Article 8 of the Climate and Innovation Act). Thereby, the main focus is on preventing the increase in climate-related damage to people and property, in particular as a result of (i) the rise in average temperatures and changes in precipitation, (ii) more intense, more frequent and longer-lasting extreme climatic events, and (iii) changes in habitats and species composition. Switzerland will update the respective information in chapter III of its ninth national communication to be submitted in conjunction with the second biennial transparency report;
- The general objective of directing financial flows towards a low-carbon and climate-resilient development is established (Article 1c of the Climate and Innovation Act) and the introduction of measures to mitigate the climate impact of national and international financial flows is enabled (Article 9 of the Climate and Innovation Act). More details are described in section II.D.10.

The Climate and Innovation Act will enter into force on 1 January 2025.[43]

Estimate of mitigation impact

The expected mitigation impact of the Climate and Innovation Act corresponds to its objective, i.e. net-zero greenhouse gas emissions by 2050, with a reduction of total greenhouse gas emissions (relative to 1990) by (i) at least 64 per cent in the mean over the years 2031–2040, (ii) at least 75 per cent by 2040, and (iii) at least 89 per cent in the mean over the years 2041–2050. The reduction targets must be technically feasible and economically viable. As far as possible, they must be achieved by reducing emissions in Switzerland. As the Climate and Innovation Act forms the legal framework for Switzerland's climate policy up to 2050, its mitigation impact is indicated in Tab. 6 and CTF-NDC table 5 as 'included elsewhere' (i.e. under concrete policies and measures – implemented under the Climate and Innovation Act itself or under further legislation such as e.g. the CO_2 Act – presented below) or, for years in which the Climate and Innovation Act is not yet in force, as 'not applicable'. As explained above, the policies and measures currently adopted or planned are not yet sufficient to reach the long-term objectives.

II.D.1.6 CO_2 levy on heating and process fuels

By increasing the price, the CO_2 levy on heating and process fuels sets an incentive to use fossil fuels more efficiently, to invest in low-carbon technologies, and to switch to low-carbon or carbon-free energy sources. The CO_2 levy on heating and process fuels was introduced in January 2008 at an initial rate of 12 Swiss francs per tonne of CO_2. The CO_2 Ordinance foresaw an automatic increase of the rate in case CO_2 emissions from heating and process fuels exceed the intermediate targets shown in Tab. 7. As of 1 January 2022, the maximum rate of 120 Swiss francs per tonne of CO_2 was reached. Since the third CO_2 Act does not include any options for increasing the rate any further, it will remain at 120 Swiss francs per tonne of CO_2 until at least 2030.

One third of the revenues is earmarked for measures mainly in the buildings sector, such as the national buildings refurbishment programme (see section II.D.2.4). Further, a smaller part of the revenues is used to feed the technology fund (see section II.D.10). The partial earmarking of the CO_2 levy on heating and process fuels is also used to finance projects in the field of geothermal energy and – starting with the implementation of the third CO_2 Act – also projects in the field of communal and regional energy planning, the production of renewable gas, and for installations for utilising solar thermal energy for process heat (see section II.D.10). The remaining two thirds of the proceeds from the CO_2 levy

[43] Article 53 paragraph 2 first sentence, 2bis and 3 letter a of the Energy Act (Annex) entered into force on 1 January 2024.

on heating and process fuels are refunded pro-rata to the Swiss population (on a per capita basis) and to the Swiss economy (in proportion to wages paid).

Tab. 7 > Intermediate targets set out in Article 94 of the CO_2 Ordinance to the second CO_2 Act, including corresponding increases of the CO_2 levy in case of non-compliance with the intermediate targets (the intermediate targets set out in Article 3 of the CO_2 Ordinance to the first CO_2 Act are not shown here[44]). The attainment of the targets is evaluated based on the CO_2 statistics which is annually published by the Swiss Federal Office for the Environment at the beginning of July and which contains CO_2 emissions from heating and process fuels from the previous year.[45] The current legislation does not include any options for increasing the rate of the CO_2 levy on heating and process fuels any further.

As of 1 January 2014:
• Increase to 60 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2012 exceed 79 per cent of 1990 emissions.
⇨ The rate of the CO_2 levy on heating and process fuels has increased to 60 Swiss francs per tonne of CO_2.
As of 1 January 2016:
• Increase to 72 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2014 exceed 76 per cent of 1990 emissions;
• Increase to 84 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2014 exceed 78 per cent of 1990 emissions.
⇨ The rate of the CO_2 levy on heating and process fuels has increased to 84 Swiss francs per tonne of CO_2.
As of 1 January 2018:
• Increase to 96 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2016 exceed 73 per cent of 1990 emissions;
• Increase to 120 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2016 exceed 76 per cent of 1990 emissions.
⇨ The rate of the CO_2 levy on heating and process fuels has increased to 96 Swiss francs per tonne of CO_2.
As of 1 January 2022:
• Increase to 120 Swiss francs per tonne of CO_2 if the CO_2 emissions from heating and process fuels in 2020 exceed 67 per cent of 1990 emissions.
⇨ The rate of the CO_2 levy on heating and process fuels has increased to 120 Swiss francs per tonne of CO_2.

Estimate of mitigation impact

The CO_2 levy is estimated to have led to a reduction of about two million tonnes of CO_2 in 2020. This estimate is consistent with the model-based estimate by *Ecoplan* (2009) when transferred to a rate of the CO_2 levy of 96 Swiss francs per tonne of CO_2 in 2020. For the further evolution of the mitigation impact beyond 2020, no analysis is currently available. However, it is estimated that the increase of the rate from 96 to 120 Swiss francs per tonne of CO_2 increases the (unknown) mitigation impact compared to a rate of 96 Swiss francs per tonne of CO_2 by 0.25 million tonnes of CO_2. Accordingly, a value of 2.25 million tonnes of CO_2 is used as a best (but conservative) estimate for the mitigation impact for 2025 and 2030.

II.D.1.7 Emissions trading scheme

Switzerland introduced its emissions trading scheme in 2008 in order to give companies – especially those industries with substantial CO_2 emissions resulting from the use of heating and process fuels as well as from cement production – the opportunity to contribute to CO_2 reduction goals under the same rules as their international competitors (at the same time being exempt from the CO_2 levy on heating and process fuels). The emissions trading scheme is based on the cap-and-trade principle. The cap – i.e. the total quantity of emission allowances available each year within the emissions trading scheme – is reduced annually, thereby ensuring a long-term reduction of total emissions of all companies involved. Some of the emission allowances are allocated free of charge, and some are auctioned off. Each year, participants of the emissions trading scheme must cover their actual greenhouse gas emissions with emission allowances (which are to be surrendered to the federal government). In the case of relatively low emissions, participants may sell surplus emission allowances, in the opposite case they may need to buy additional emission allowances.

The emissions trading schemes of Switzerland and the European Union have been linked since 1 January 2020, after several years of negotiations and after further technical developments to ensure compatibility of the two systems. Notable amendments to the emissions trading schemes of Switzerland included the mandatory nature of the emissions trading scheme for large, greenhouse gas-intensive companies and partial auctioning of emission allowances. Rules for allocation of emission allowances free of charge were harmonised. The linking also required an identical sectoral coverage. Accordingly, Switzerland has included aircraft operators and fossil power plants (such as fossil-thermal power plants and combined heat and power plants) in its emissions trading scheme since 2020.

For industrial installations, the cap was reduced annually by 1.74 per cent of the 2010 baseline between 2010 and 2020 (in 2020, the cap corresponded to around 4.9 million tonnes of CO_2 equivalents). Between 2021 and 2025, the annual

[44] https://www.admin.ch/opc/de/classified-compilation/20070960/201205010000/641.712.pdf

[45] www.bafu.admin.ch/co2-statistics

reduction of the cap is at least 2.2 per cent of the 2010 baseline. For aircraft operators, the cap for 2020 was determined based on transport performance in 2018 (measured in tonne-kilometres) and a benchmark approach as in the European Union. The cap is annually reduced by 2.2 per cent of the 2020 baseline from 2021 to 2023 and by 4.3 per cent for 2024 and 2025. Allocations of emission allowances free of charge to aircraft operators are reduced by 25 and 50 per cent for the years 2024 and 2025, respectively, and completely phased out thereafter. As of 2021, participants of the emissions trading scheme (industrial installations and aircraft operators) are no longer allowed to surrender international carbon credits.

Planned strengthening

The future strengthening of Switzerland's emissions trading scheme is guided by the relevant provisions in the European Union. The planned strengthening in the framework of the CO_2 Ordinance to the third CO_2 Act foresees to further increase the annual rate to lower the cap for industrial installations and aviation to up to 4.4 per cent of the baseline.[46]

Estimate of mitigation impact

Industrial installations covered by the emissions trading scheme reduced their emissions by approximately 600 thousand tonnes of CO_2 equivalents by 2020 (compared to 2013, according to actual emissions documented in the registry). Based on the annual reduction of the cap, emissions are estimated to further decrease by (additional) 650 thousand tonnes of CO_2 equivalents by 2025 and another (additional) 650 thousand tonnes of CO_2 equivalents by 2030. Further, the inclusion of aircraft operators is estimated to contribute a mitigation impact of 200 thousand tonnes of CO_2 equivalents by 2025 and an additional mitigation impact of 280 thousand tonnes of CO_2 equivalents by 2030, resulting from increasing the annual reduction of the aviation cap in several steps (the mitigation impact for 2020 is zero, since aircraft operators were not yet included in the emissions trading scheme). Overall, by 2025, the mitigation impact of the emissions trading scheme is thus estimated at 1,450 thousand tonnes of CO_2 equivalents by 2025 and at 2,380 thousand tonnes of CO_2 equivalents by 2030.

The planned strengthening is estimated to increase the mitigation impact by additional 250 thousand tonnes of CO_2 equivalents by 2025 and by additional 895 thousand tonnes of CO_2 equivalents by 2030.

II.D.1.8 Negotiated reduction commitments (for exemption from the CO_2 levy)

Companies pursuing CO_2 intensive activities listed in Annex 7 of the CO_2 Ordinance may apply for an exemption from the CO_2 levy on heating and process fuels without participation in the emissions trading scheme, provided they commit to lower their onsite greenhouse gas emissions from fossil fuels (negotiated reduction commitment). Thereby, all technically feasible and economically viable measures with a payback period of less than four years for production measures and of less than eight years for building and infrastructure measures have to be implemented. A sanction is incurred if the reduction target is not met at the end of the commitment period.

Up to 2020, the companies' targets were calculated along a linear reduction trajectory from 2013 to 2020. For 2021, these reduction targets were linearly extrapolated. Between 2022 and 2024, greenhouse gas emissions must be reduced by two per cent per year compared to 2021 levels.

Small companies emitting less than 1,500 tonnes of CO_2 equivalents per year do not have to follow a specific emissions path, but can apply for an exemption from the CO_2 levy by taking predefined economically viable measures (measures target). The extension beyond 2020 bases on a simple multiplication of the hitherto measures targets (factor 1.125 for 2021, factor two up to 2024).

Up to 2021, companies outperforming their reduction targets could be issued domestic carbon credits (attestations), which can be sold (e.g. to fossil fuel importers bound to compensate part of the CO_2 emissions from motor fuels, see section II.D.3.4). At no time, however, can attestations be counted towards the own or another companies' negotiated reduction commitment.

[46] The annual rates to lower the cap for industrial installations are planned as follows: 2024: 2.2 per cent, 2025: 6.4 per cent, 2026 and 2027: 4.3 per cent, as of 2028: 4.4 per cent.

Companies that have not reached their negotiated reduction commitment and have not been issued domestic carbon credits (attestations) may take a limited amount of international carbon credits into account towards meeting their negotiated reduction commitments (for details see Articles 75 and 146t of the CO_2 Ordinance).

The elaboration of negotiated reduction commitments and their implementation is assisted by two organisations mandated by the federal government (Swiss Energy Agency of the Economy and Cleantech Agency Switzerland, see section 9.2.2 of Switzerland's eighth national communication and fifth biennial report).

Planned strengthening

Under the third CO_2 Act, the CO_2 ordinance put out to consultation foresees that all companies (with a few exceptions) will be able to establish a negotiated reduction commitment (for exemption from the CO_2 levy) for the period 2025–2040. Compared with the first two commitment periods (2008–2012 and 2013–2024), the CO_2 ordinance foresees to set minimum reduction requirements and proposes a raise of the thresholds for the economic viability (payback period) of the measures. For this third commitment period, companies exempt from the CO_2 levy will also have to draw up decarbonisation plans setting a reduction target until 2040. This target should be geared towards the goal of net-zero emissions by 2050. The decarbonisation plans will have to be updated every three years and will have to demonstrate the planning of the measures needed to achieve the target.

Estimate of mitigation impact

For 2020, the mitigation impact of the negotiated reduction commitments (for exemption from the CO_2 levy) is estimated at 370 thousand tonnes of CO_2 equivalents (Tab. 6 and CTF-NDC table 5). This estimate is derived from the detailed monitoring reports of all exempt companies (reduction trajectory and measures target). The mitigation impact achieved by 2020 substantially exceeded the overall reduction commitments of exempt companies by 70 thousand tonnes of CO_2 equivalents. For 2025 and 2030, the mitigation impacts cannot be estimated and are indicated as 'NE' in Tab. 6 and CTF-NDC table 5 for the following reasons: (i) the modalities for the time beyond 2024 are not yet fully defined, and (ii) with the overachievement of their targets in 2020, companies already fulfilled the requested reductions for the years 2021–2024, i.e. it is unclear whether or not companies will engage in further measures in the coming years.

II.D.1.9 Promotion of innovative technologies and processes

According to Article 5 of the Climate and Innovation Act all companies must achieve net-zero emissions by 2050 at the latest, considering at least the emissions caused by operations (Scope 1 emissions) as well as those caused by the provision of purchased energy (Scope 2 emissions). In order to achieve this goal, companies may draw up roadmaps for achieving net-zero emissions (hereinafter referred to as 'net-zero roadmaps'). From 1 January 2025, companies that have drawn up a net-zero roadmap and are ready to implement decarbonisation measures will be able to apply for financial support from the federal government for the application of innovative technologies or processes such as carbon capture and storage (CCS), carbon capture and utilization (CCU), negative emission technologies (NET) as well as other decarbonisations measures (Article 6 of the Climate and Innovation Act). The aim is to encourage all companies to start thinking about decarbonisation early on and to encourage first movers to implement innovative technologies. Financial support is planned until the end of 2030, with a total budget of about 1.0 billion Swiss francs.

Estimate of mitigation impact

An initial estimate of the impact has been made based on estimates of planned resources and reduction costs per tonne of CO_2 of (i) 175 Swiss francs per tonne of CO_2 for CCS, CCU and NET, and (ii) 75 Swiss francs per tonne of CO_2 for other decarbonisation measures. The total cumulative mitigation impact is estimated at 9,500 kilotonnes of CO_2 (assuming that half of the total budget would be available for CCS, CCU and NET, and the other half for other decarbonisation measures). Assuming a lifetime of the installations of 15 years, an annual reduction of 630 kilotonnes of CO_2 results. This value is used for the year 2030, while no mitigation impact is expected for the starting year as the first proposals will be assessed and approved in 2025, with the mitigation impact developing from 2026 onwards.

II.D.1.10 Exemplary function of the Swiss Confederation and the cantons

On 3 July 2019, the Swiss Federal Council adopted the 'Federal Administration Climate Package'. In doing so, it decided to strengthen the efforts made to date throughout the federal administration by setting ambitious reduction targets for 2030: the department of defence shall reduce its greenhouse gas emissions by 40 per cent and all other administrative units by 50 per cent compared to the base year 2006. At the same time, the remaining greenhouse gas emissions must be

fully offset from 2020 onwards. The required internationally transferred mitigation outcomes (until 2021 CERs could be used) are to be financed through the existing budgets of the individual administrative units. As an example, the building renovation concept includes a ban of fossil-fuelled heating systems for new installations as well as for the replacement of existing systems. In addition, oil-fuelled heating systems should be replaced by systems using renewable energy sources by 2030.

According to Article 10 of the Climate and Innovation Act (see section II.D.1.5), the federal administration must achieve net-zero emissions by 2040 already. In addition to the emissions caused by operations (Scope 1 emissions) and those caused by the provision of purchased energy (Scope 2 emissions), emissions caused by third parties upstream or downstream along the value chain (Scope 3 emissions) should also be taken into account. Paragraph 3 of Article 10 of the Climate and Innovation Act authorises the Swiss Federal Council to provide for exceptions in connection with the security of the country and the protection of the population. The Swiss Federal Council is obliged to define the measures required to achieve net-zero emissions by 2040. The cantonal administrations as well as companies fully or partially owned by the federal government are encouraged to adopt the same target as the federal administration (i.e. net-zero emissions by 2040), but are required to define their own measures.

Planned strengthening

Currently, the measures allowing the federal administration, cantonal administrations as well as companies fully or partially owned by the federal government to achieve net-zero emissions by 2040 are in preparation and will be applied in multiple phases over the years from 2025 to 2030 and beyond.

Estimate of mitigation impact

In the annual reporting on the environmental impacts of the federal administration (see *DETEC*, 2023 for the latest report), the year 2006 serves as the base year, with total greenhouse gas emissions of the federal administration of about 47.5 kilotonnes of CO_2 equivalents. A linear reduction path leading from the emissions in 2006 to 50 per cent of these emissions in 2030 is assumed. This leads to mitigation impacts of 14, 19 and 24 kilotonnes of CO_2 equivalents in 2020, 2025 and 2030, respectively. The offsetting of remaining greenhouse gas emissions through internationally transferred mitigation outcomes (or CERs up to 2021) is not considered in these values. In the years 2020 to 2022, actual emissions of the federal administration were substantially below the linear reduction path, mainly due to the impact of the measures to contain the corona virus pandemic. The mitigation impact of the planned strengthening, i.e. the implementation of measures to achieve net-zero emissions by 2040, cannot yet be included in the estimates.

II.D.2 Energy

II.D.2.1 Overview

In 1990, energy policy was anchored in the Federal Constitution of the Swiss Confederation (*Swiss Confederation*, 1999a), when an energy article was added (Article 89). This article stipulates that the Swiss government and the cantons are obliged to use their competences to ensure an adequate, broad-based, secure, economic and ecological energy supply, and the economical and efficient use of energy This comprehensive list of requirements places high demands on energy policy at the federal and cantonal levels, including the ability to find compromise solutions that meet all criteria.

The energy article in the Federal Constitution of the Swiss Confederation is elaborated further in the Energy Act (*Swiss Confederation*, 2016), the Nuclear Energy Act (*Swiss Confederation*, 2003), and the Electricity Supply Act (*Swiss Confederation*, 2007). In addition to legal instruments and related measures, the energy policies of the Swiss government and the cantons are also based on energy perspectives (i.e. models and scenarios of future energy production and consumption), strategies (i.e. goal-oriented policy packages), implementation programmes focusing on information and promotion, and the periodic evaluation of energy-related measures at the municipal, cantonal and federal level.

Following the nuclear reactor disaster of Fukushima in 2011, the Swiss Federal Council and the Swiss Parliament decided to gradually phase out nuclear energy in Switzerland. This decision, together with further far-reaching changes in the international energy environment, has required an upgrading of the Swiss energy system. For this purpose, the Swiss Federal Council developed the Energy Strategy 2050, which has been in force since January 2018. The strategy addresses the impacts of the country’s decision for a progressive withdrawal from nuclear energy. The existing nuclear power plants will shut down at the end of their technically safe operating life and will not be replaced with new ones. As nuclear energy

currently contributes a large share to Switzerland's electricity generation (see section II.A.6), the generation gap resulting from the decommissioning of nuclear power plants will need to be largely filled by renewable electricity generation, maintaining the high standards of supply security.

On 9 June 2024, the Swiss electorate approved the Swiss Federal Act on a Secure Electricity Supply from Renewable Energy Sources, therewith laying the foundations for a rapid expansion of Switzerland's energy production from renewable sources such as hydropower, solar, wind and biomass (see section II.D.2.2).

Tab. 8 gives an overview of Switzerland's policies and measures in the energy sector. The following sections provide more details and background information on each policy and measure.

Tab. 8 > Summary of policies and measures in the energy sector. The sector affected is 'energy' for all policies and measures presented in this table.

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Implementing entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
Act on a Secure Electricity Supply from Renewable Energy Sources *	CO_2	By 2035 (2050), electricity production from renewable energy sources (excluding hydropower) must reach at least 35 (45) terawatt-hours, while hydropower must additionally contribute at least 37.9 (39.2) terawatt-hours. During winter month, electricity imports should be limited to five terawatt-hours. Average energy consumption per person per year is to be reduced by 43 per cent by 2035 and by 53 per cent by 2050 compared to the level in 2000.	Regulatory, economic	Adopted	Foundations for a rapid expansion of Switzerland's energy production from renewable sources such as hydropower, solar, wind and biomass. Reduction of dependence on energy imports and risk of critical supply situations. Includes funding instruments as well as new regulations for electricity production, transport, storage and consumption. Introduction of a mandatory hydropower reserve.	2025	SFOE	NA [b]	NE [c]	NE [c]
SwissEnergy programme *	CO_2	Promotion of energy efficiency and the increased use of renewables.	Information, education	Implemented	Major policy instrument engaging cantons, municipalities, industry as well as environmental and consumer associations for awareness raising and the promotion of increased energy efficiency and the enhanced use of renewable energy.	2001	SFOE	NE [d]	NE [d]	NE [d]
National buildings refurbishment programme *	CO_2	Refurbishment of existing buildings envelope and incentives for renewable energy, energy recuperation and optimisation of building technology.	Economic	Implemented	The programme increases the energy efficiency of buildings and promotes the use of renewable energies in the buildings sector. Financed by one third of the revenue from the CO_2 levy on heating and process fuels, with additional funds provided by the cantons.	2010	SFOE, FOEN, cantons	1 460	2 810	4 390
Building codes of the cantons *	CO_2	Stringent energy consumption standards for new and existing buildings.	Regulatory	Implemented (strengthening planned)	A set of common energy, 'CO_2' and insulation standards (model provisions) of buildings agreed on by the cantonal energy directors. They aim at reducing energy consumption and CO_2 emissions as well as at increasing production of renewable energy (electricity and heat). Implementation of the latest set of measures was endorsed in 2015, and transposed into cantonal legislation by 24 cantons so far.	1992	Cantons, SFOE	1 760	1 760 [e]	1 760 [e]
Feed-in tariff system and	CO_2	Promotion of renewable electricity production to	Regulatory	Implemented	The feed-in tariff applied to photovoltaics, wind, biomass,	2009	SFOE	420	380	490

floating market premium *		reach targets of the Energy Act.			small hydropower and geothermal plants. The administrative tariffs cover the generation costs based on reference plants over 15 to 25 years. The feed-in tariff phased out at the end of 2022. Starting 2025, a new tariff system (floating market premium) is going to be introduced for photovoltaics, wind, biomass and hydropower. Beneficiaries can apply for investment aids or a new floating market premium.					
Investment aids *	CO_2	Promotion of renewable electricity production to reach targets of the Energy Act.	Regulatory	Implemented	Investment aids apply to photovoltaics, wind, biomass, hydropower and geothermal plants. The contributions depend on the technology and are between 20 and 60 per cent of the investment costs. From 2023, the investment contributions for large photovoltaic installations are awarded through tenders.	2014	SFOE	160	450	590
Decarbonisation of installations in the emissions trading scheme *	CO_2	Support the decarbonisation of installations in the emissions trading scheme.	Economic	Adopted	Subsidy programme exclusively for installations in the emissions trading scheme. Funded by auction revenues from emissions allowances for installations.	2025	FOEN	NA [b]	100	100
Impulse programme for the replacement of heat generation systems and energy efficiency measures *	CO_2	Promote the replacement of fossil-fuelled heating systems and enhance energy efficiency of buildings.	Economic	Adopted	Subsidies of 200 million Swiss francs per year for the replacement of high-output fossil-fuelled heating systems and stationary electric resistance heating systems, alongside energy efficiency measures. The impulse programme complements the national buildings refurbishment programme.	2025	SFOE	NA [b]	60	120
Safeguarding against the risks of investments in public infrastructure *	CO_2	Promoting renewable heating, in particular district heating and seasonal thermal storage.	Economic	Adopted	Insurance against unforeseeable risks of investments in public infrastructure projects that are necessary to achieve the net-zero target.	2025	SFOE	NA [b]	0	48
Negotiated reduction commitment of municipal solid waste incineration plant operators	CO_2	Contribution to emission reduction by municipal solid waste incineration plant operators through energy efficiency measures and metal recuperation.	Regulatory	Implemented	Agreement committing the association of municipal solid waste incineration plant operators to establish a monitoring system and to reduce net CO_2 emissions. Implementation of the agreement exempts municipal solid waste incineration plant operators from participation in the emissions trading scheme.	2014	FOEN	200 [f]	NE [g]	100 [g]

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] Policy and measure not in force.

[c] There is currently no methodology available to link the targets for renewable energy expansion as well as the corresponding measures to actual reduction of greenhouse gas emission. However, increasing renewable energy in Switzerland reduces foreign dependence and is a prerequisite that policies and measures in other areas that rely on electricity supplies, such as e.g. e-mobility, actually deliver the envisaged mitigation impact.

[d] See section II.D.2.3 for more information regarding the mitigation impact.

[e] In the absence of updated studies, the same mitigation impact as for 2020 is also reported for 2025 and 2030, however, the mitigation impact certainly becomes larger as more cantons put into force updated energy acts.

[f] By 2020, the Swiss Association of Municipal Solid Waste Incineration Plants reached its agreed (net) emission reduction commitment of 200 thousand tonnes of CO_2 equivalents below 2010 emissions. The recuperation of metals may lead to (indirect) reductions of greenhouse gas emissions outside Switzerland.

[g] As there is no intermediate target for 2025, the mitigation impact is indicated as 'not estimated'. The target for 2030 is 100 thousand tonnes of CO_2 equivalents (carbon capture and storage). In addition, the commitment in place up to 2020 will be continued.

NA, not applicable; NE, not estimated
FOEN, Swiss Federal Office for the Environment; SFOE, Swiss Federal Office of Energy

II.D.2.2 Act on a Secure Electricity Supply from Renewable Energy Sources

On 18 June 2021, the Swiss Federal Council adopted a draft of the Swiss Federal Act on a Secure Electricity Supply from Renewable Energy Sources, therewith starting the legislative process in the Swiss Parliament. With the newly proposed legislation, the expansion of domestic renewable energies and the security of supply in Switzerland – especially during winter – should be strengthened. In order to achieve the goals of the Energy Strategy 2050 and of Switzerland's long-term climate strategy to 2050 (*Swiss Federal Council*, 2021a), comprehensive electrification is required in the transport and heating sector. To achieve this, domestic electricity generation from renewable energies must be expanded quickly and consistently. The security of the grid and electricity supply must also be strengthened with further specific measures. After the Parliament approved the Act in September 2023, a referendum was filed in which the weakening of nature and landscape conservation was criticised. The Swiss electorate, however, approved the Swiss Federal Act on a Secure Electricity Supply from Renewable Energy Sources in a vote on 9 June 2024. The new legislation introduces changes to the Energy Act and the Electricity Supply Act and will enter into force on 1 January 2025.

The main elements of the Swiss Federal Act on a Secure Electricity Supply from Renewable Energy Sources are:

- **Expansion of solar energy:** The Swiss electorate approved the expansion of the production of electricity from renewable energies in 2017 with the total revision of the Energy Act. The instruments introduced at the time to promote renewable energies are supplemented and extended by five years. As the greatest potential for the entire expansion lies in solar energy on buildings, there are still financial contributions for solar systems on roofs and facades. The new legislation also provides for a minimum tariff for feeding solar power into the grid to be harmonised throughout Switzerland. Local electricity communities can also be formed in order to be able to trade self-produced solar power at the district level;
- **Expansion of hydropower:** The new legislation calls for the expansion of hydroelectric power plants so that enough electricity can be stored in winter. It contains a list of 16 projects that are particularly suitable for this purpose. If these facilities are built, additional measures for the benefit of biodiversity and the landscape must be implemented in each individual case;
- **Energy efficiency:** The more efficiently electricity is consumed, the fewer additional power plants need to be built. Accordingly, new measures to increase energy efficiency are introduced, for example by obliging electricity suppliers to make an effective contribution;
- **Winter reserve:** Finally, the new legislation provides for energy reserves for the winter. These are intended to help ensure that there are no electricity shortages. As the focus is on the hydropower reserves in reservoirs, operators of larger hydroelectric power plants are obliged and compensated for retaining enough water in the reservoirs for electricity production during the cold winter months.

Estimate of mitigation impact

Currently, no methodology is available to estimate the mitigation impact of the Act on a Secure Electricity Supply from Renewable Energy Sources. While targets for the expansion of electricity production from renewable energies as well as consumption targets are defined (see 'objective' in Tab. 8), it is not possible to convert these targets and hence the corresponding measures to reductions of greenhouse gas emissions in a meaningful way. Expanding Switzerland's energy supply from renewable energy sources helps to reduce dependence on foreign countries and ensures that measures in other areas that rely on electricity supplies – such as e.g. e-mobility – actually deliver the envisaged mitigation impact. For these reasons, the mitigation impact of the Act on a Secure Electricity Supply from Renewable Energy Sources is indicated in Tab. 8 and CTF-NDC table 5 as 'not estimated' or, for years in which the Act on a Secure Electricity Supply from Renewable Energy Sources is not yet in force, as 'not applicable'.

II.D.2.3 SwissEnergy programme

In 2001, the Swiss Federal Council launched the SwissEnergy programme, in line with the Energy Act and the CO_2 Act. The aim is to reduce fossil fuel use and CO_2 emissions as required by the CO_2 Act and to fulfil the targets for electricity generation from renewable sources as required by the Energy Act. The SwissEnergy programme represents a major policy instrument for awareness raising and promoting an increase in energy efficiency and the enhanced use of renewable energy (see section 9.2.2 of Switzerland's eighth national communication and fifth biennial report). Measures are mostly

voluntary in nature, supporting the effect of regulatory measures. In 2018, the Swiss Federal Council mandated the continuation of the programme for a third decade until 2030.

The SwissEnergy programme is managed by the Swiss Federal Office of Energy. Projects are usually run in close cooperation with cantons, municipalities, industry as well as environmental and consumer associations. Programme results are subject to detailed monitoring and verification. To support the Energy Strategy 2050, the SwissEnergy programme's annual budget has been increased from about 30 million Swiss francs in 2012 to around 44 million Swiss francs up to 2030.

The previous focal points of the SwissEnergy programme have been replaced by priority fields of action. This corresponds to the current needs regarding flexibility and prioritisation of the SwissEnergy programme. The three priority fields of action are:

- Building efficiency and renewable energies for private households;
- Mobility of private households and companies;
- Facilities and processes in industry and services.

These three fields of action cover a total of 74 per cent of Switzerland's final energy consumption. Accordingly, at least three quarters of the total budget of the SwissEnergy programme should be used for measures in these three fields of action.

The priority fields of action are supplemented by further fields of action, including large-scale renewable energy facilities as well as grids and storage. The fields of action are supported by cross-cutting themes. These include education and training, cities, municipalities, neighbourhoods and regions, communication, cooperation with the climate programme managed by the Swiss Federal Office for the Environment, digitalisation and innovation. The cross-cutting themes are central to addressing the priority fields of action.

Many minimum efficiency performance standards – previously introduced in the form of voluntary agreements (cars, some appliances) or codes of conduct (some energy-using products) – are now legally mandated and aligned with the standards of the European Union. Hence, the role of the SwissEnergy programme is shifting towards one as a facilitator for the above-mentioned regulations and laws.

Estimate of mitigation impact

The SwissEnergy programme covers a number of fields, each of which requires the use of very different – and very specific – instruments and means of communication. The focus of the programme is on soft measures (information, consulting, training and continuing education, quality assurance), for which there is no methodology to quantify the mitigation impact. In addition, the SwissEnergy programme provides advice about implementation of regulations and promotional programmes and is primarily responsible for ensuring that enough trained people are available and that measures are publicised. These are necessary activities, but their mitigation impact cannot be looked at in isolation from the measures being applied. For all these reasons, the mitigation impact of the SwissEnergy programme is reported as 'not estimated' in Tab. 8 and CTF-NDC table 5.

II.D.2.4 National buildings refurbishment programme

In order to increase the refurbishment rate of buildings and to promote the use of renewable energies in the buildings sector, a third of the revenues from the CO_2 levy on heating and process fuels, but no more than 300 million francs per year, were earmarked for this purpose in the first CO_2 Act. Based on the revised Energy Act (*Swiss Confederation*, 2016), more funding has been available since 1 January 2018 as the maximum amount earmarked was increased from 300 million to 450 million Swiss francs per year. With the rate of the CO_2 levy rising to 120 Swiss francs per tonne of CO_2 as of 2022, revenues allow for the first time to tap the full legally possible amount. Due to the mitigation impact of the measure, the consumption of fossil fuels is decreasing and therefore the revenue from the CO_2 levy on heating and process fuels is constantly falling; 377 million Swiss francs were available in 2024.

In 2009, the Swiss Parliament adopted the national buildings refurbishment programme (operational since 1 January 2010). Its measures are aimed at the long-term reduction of CO_2 emissions from buildings, including the reduction of

electricity consumption during the winter months. Also taken into account is the CO_2 balance of the building materials that are used (Article 34 of the CO_2 Act). The programme was collectively developed by the cantons, represented by the Conference of Cantonal Energy Directors, and the Swiss federal administration (Swiss Federal Office of Energy, Swiss Federal Office for the Environment). The cantons are responsible for its implementation. The duration of the programme is unlimited. A mid-term evaluation was submitted to the Swiss Parliament in 2016. Some numbers on the programme taken from the most recent annual reporting (*SFOE*, 2023f) are given below.

3.6 billion Swiss francs have been paid out as part of the national building refurbishment programme since 2010. In 2023, disbursements amounted to 528 million Swiss francs. Most of this was paid out for replacements of fossil heating systems. The thermal insulation of individual components comes second. The contributions to system renovations and indirect measures such as training and education have increased as well in 2023. From 2010 to 2023, the average abatement cost per tonne of CO_2 amounted to 149 Swiss francs (combined funds from the federal and the cantonal level). Beyond the national buildings refurbishment programme, the Swiss federal administration and several cantons fund measures such as promotion of photovoltaics and consulting of building owners. However, there is no systematic overarching evaluation of the quantitative effect of these measures on CO_2 emissions.

The impulse programme for the replacement of heat generation systems and energy efficiency measures – introduced by the Climate and Innovation Act as of 2025 – will provide additional funding in areas where the national buildings refurbishment programme is not effective enough (see section II.D.2.9). The well-established framework of the national buildings refurbishment programme will be used to implement this new impulse programme.

Estimate of mitigation impact

A model assigning a CO_2 effect to each measure implemented (e.g., per square metre of insulation) was previously used to calculate the mitigation impact of the national buildings refurbishment programme. Based on the model results and taking into account the availabe and expected funds, the following mitigation impacts are estimated for the different years: (i) 1,460 thousand tonnes of CO_2 equivalents in 2020, (ii) 2,810 thousand tonnes of CO_2 equivalents in 2025, and (iii) 4,390 thousand tonnes of CO_2 equivalents in 2030 (Tab. 8 and CTF-NDC table 5).

II.D.2.5 Building codes of the cantons

The cantons are responsible to decree any regulations in the buildings sector. Under the CO_2 Act they are required to define standards for the continuous reduction of CO_2 emissions in new and existing buildings (Article 9). In order to harmonise the building codes throughout Switzerland, the cantons, under the guidance of the Conference of Cantonal Energy Directors, agreed on model provisions. A first set was established in 1992 and thereafter updated periodically (i.e. in 2000, 2008, and 2014, see *EnDK*, 2014). These standard regulations need to be implemented by means of cantonal energy acts, which – in each canton – are subject to an optional referendum (allowing citizens to veto the decisions made). As of July 2024, 24 cantons already implement (or have adopted the implementation) of the standard regulations, while the remaining two cantons are currently in the parliamentary phase (*EnDK*, 2024). Thereby, some cantons stand somewhat behind the requirements of the model provisions, while others are frontrunners and completely ban the installation and replacement of fossil heating systems. More detailed information is available in the annually published report summarising the state of energy and climate policy in the cantons (*EnDK/SFOE/FOEN*, 2024).

Planned strengthening

The implementation of the model provisions in cantonal legislation is an ongoing process, leading to a continuous strengthening. The cantons are currently working on a revision of the model provisions, planned to be introduced by 2025. Under the title ‘energy hub buildings’, the further development should take into account that buildings are increasingly becoming the central control point for the consumption, production and storage of energy (see also *EnDK*, 2021).

Estimate of mitigation impact

The mitigation impact of the building codes of the cantons on greenhouse gas emissions mainly results from insulation requirements for building refurbishment and for new constructions, as well as prescriptions with regard to heating systems. For 2020, the mitigation impact is estimated at 1,760 thousand tonnes of CO_2 equivalents, based on assumptions about the energy reference area, rate of refurbishment, heat consumption before and after renovation, and heat consumption of new buildings (*EPFL and Infras*, 2016; *EPFL*, 2017). In the absence of updated studies, the same mitigation impact as for 2020 is also reported for 2025 and 2030 in Tab. 8 and CRF Table 5. However, the mitigation

impact is expected to increase over time as more cantons put into force updated energy acts. In the long term, the building codes of the cantons are going to contribute to making the buildings sector fossil-free.

II.D.2.6 Feed-in tariff system and floating market premium

The feed-in tariff system, which entered into force in 2009 with a revision of the Energy Act, aimed at increasing the renewable power production according to the targets of the Energy Act (Article 2). The promotion system applied to photovoltaics, wind, biomass, small hydropower and geothermal plants. The administrative tariffs covered the generation costs based on reference plants over 15 to 25 years. In 2018, with the first package of measures of the Energy Strategy 2050, the feed-in tariff system was replaced by feed-in premiums to entice producers to sell their electricity when demand is high, giving them an incentive to sell electricity when it is in short supply and thus to fetch higher prices. The promotion system faced out at the end of 2022. Beneficiaries are going to receive the contracted tariff until the end of their remuneration period, but no new plants are included anymore. Instead, new plant investors have the choice between a contract-for-differences for 20 years (see just below) or investment aids (see section II.D.2.7).

A two-way contract-for-differences scheme – so-called floating market premium (Article 29 of the Energy Act) – is adopted and will enter into force on 1 January 2025 and phase out by the end of 2035, so that no new contracts can be granted after that date. The beneficiaries are owners of wind, hydropower (without pumping plants) and biomass power plants as well as photovoltaic installations (from 150 kilowatts without self-consumption). The beneficiaries receive a market premium for the power fed into the grid and they are responsible for selling themselves the production on the market. The market premium results from the difference between the tariff and the power market price, which is calculated on a monthly basis and is technology-specific based on the technology production profile.

The promotion systems are financed by a network surcharge, which is paid by all consumers of electricity. Only energy intensive firms can apply for a refund under certain conditions (e.g. a commitment to increase energy efficiency).

Estimate of mitigation impact

In 2023, power plants supported by the feed-in tariff system generated 3,203 gigawatt-hours of electricity. As this energy amount substitutes imported electricity or power generated by other sources, the mitigation impact achieved through the feed-in tariff system is calculated based on greenhouse gas emissions resulting from the average consumer mix (125 grams of CO_2 equivalents per kilowatt-hour of electricity), corrected by greenhouse gas emissions resulting from the average renewable energy mix (16 grams of CO_2 equivalents per kilowatt-hour of electricity). For 2020, the mitigation impact was estimated at about 420 thousand tonnes of CO_2 equivalents. By 2025, the expected power generation from the feed-in tariff system is about 3,500 gigawatt-hours, which is slightly less than 2020. Accordingly, a mitigation impact of about 380 thousand tonnes of CO_2 equivalents results. The mitigation impact did not increase over time because the feed-in tariff phased out and because of the high market prices some large plants left the subsidy scheme and now sell their electricity directly on the market. Thanks to the new contract-for-differences scheme the promoted electricity production should increase to 4,500 gigawatt-hours by 2030 with a mitigation impact of about 490 thousand tonnes of CO_2 equivalents. As Switzerland trades electricity with its neighbouring countries on a fairly large scale, the mitigation impact as presented here may – to a large extent – develop outside Switzerland, in particular because Switzerland's domestic electricity production is mostly based on hydro and nuclear power (see section II.A.6.1).

II.D.2.7 Investment aids

Investment aids were first introduced in 2014 for small photovoltaic installations through a parliamentary initiative. In 2018 and 2023, other amendments to the Energy Act (first package of measures of the Energy Strategy 2050 and a parliamentary initiative) extended the so-called 'one-off investment grants' for small photovoltaic installations to new beneficiaries for electricity generation, i.e. large photovoltaic installations, hydropower plants, biomass plants, geothermal plants as well contributions for 'seek and find' for geothermal plants. A new amendment that is adopted and will enter into force on 1 January 2025 enlarges the scope of the investment grants also to wind power plants and some storage hydropower plants. The possible contribution depends on the technology and ranges between 20 and 60 per cent of the total investment costs. Thanks to the investment aids – and starting 2025 also thanks to the option to choose between investment aids and a floating market premium (see section II.D.2.6) – the renewable power production targets for 2035 according to Article 2 of the Energy Act can be achieved. These targets follow the path needed to achieve the goals of the Energy Strategy 2050 and the climate strategy, i.e. 100 per cent renewable energy production and net-zero emissions by 2050. Like the feed-in tariff system (section II.D.2.6) the investment aids are financed by a network surcharge, which is paid by all consumers of electricity. Only energy intensive firms can apply for a refund under certain conditions (e.g. a

commitment to increase energy efficiency). Renewable plants for electricity generation are eligible for investment aids until the end of 2035.

In addition to the investment aids, contributions for the running costs for biomass plants have been guaranteed since 2023 to prevent these plants to stop operation, since their production costs are very high.

Estimate of mitigation impact

Between 2014 and 2023, power plants supported with an investment aid generated about 3,700 gigawatt-hours of electricity. As this energy amount substitutes imported electricity or power generated by other sources, the mitigation impact achieved through the investment aids is calculated based on greenhouse gas emissions resulting from the average consumer mix (125 grams of CO_2 equivalents per kilowatt-hour of electricity), corrected by greenhouse gas emissions resulting from the average renewable energy mix (16 grams of CO_2 equivalents per kilowatt-hour of electricity). For 2020, the mitigation impact is estimated at 160 thousand tonnes of CO_2 equivalents. By 2025, the power generation from plants with an investment aid is expected to increase to 4,100 gigawatt-hours with a mitigation impact of about 450 thousand tonnes of CO_2 equivalents. By 2030 the promoted electricity production should increase to 5,400 gigawatt-hours with a mitigation impact of about 590 thousand tonnes of CO_2 equivalents. As Switzerland trades electricity with its neighbouring countries on a fairly large scale, the mitigation impact as presented here may – to a large extent – develop outside Switzerland, in particular because Switzerland's domestic electricity production is mostly based on hydro and nuclear power (see section II.A.6.1).

II.D.2.8 Decarbonisation of installations in the emissions trading scheme

The third CO_2 Act introduces a new subsidy scheme for installations in the emissions trading scheme. According to Article 37b of the third CO_2 Act, the revenues from the auctions of emissions allowances for installations shall be partly used for the decarbonisation of installations in the emissions trading scheme. In contrast to the subsidy scheme under Article 6 of the Climate and Innovation Act, this programme explicitly targets installations in the emissions trading scheme. It will enter into force on 1 January 2025. The details will be set out in the CO_2 Ordinance. The other part of the revenues from the auctions of emissions allowances for installations shall be used for measures to prevent damage to persons or property of considerable value (see also section II.D.1.4).

Estimate of mitigation impact

This instrument contributes to the reduction of fossil fuel use in industries. The mitigation impact depends on the revenues that will be available. Current estimates point to revenues of 15 to 20 million Swiss francs per year, allowing for a mitigation impact of around 100 thousand tonnes of CO_2 equivalents (assuming mitigation costs as recently observed). This estimate is reported for the years 2025 and 2030 in Tab. 8 and CRF Table 5.

II.D.2.9 Impulse programme for the replacement of heat generation systems and energy efficiency measures

The impulse programme for the replacement of heat generation systems and energy efficiency measures was adopted as part of the Climate and Innovation Act and will become operative as of 1 January 2025. In accordance with Article 50a of the Energy Act, the federal government is promoting the replacement of fossil-fuelled heating systems in the higher output range, stationary electric resistance heating systems as well as measures in the area of energy efficiency. The available subsidies average 200 million Swiss francs per year. The impulse programme – limited for a period of ten years from the start of 2025 to the end of 2034 – provides incentives where the existing national buildings refurbishment programme (see section II.D.2.4) is not effective enough. It is implemented by the cantons within the framework of the existing structures of the national buildings refurbishment programme. The Swiss government pays the funds to the cantons in the form of a basic contribution per inhabitant.

Estimate of mitigation impact

EBP (2023) analysed the current stock of the various heating types. Based on the study, it is estimated that between 1,250 and 1,800 heating systems can be replaced each year thanks to the impulse programme, corresponding to around 460 to 670 gigawatt-hours of heat. If the energy source is based on the current stock (61 per cent heating oil, 27 per cent gas and 12 per cent electric heating), this heat corresponds to between 100 and 145 kilotonnes of CO_2 per year. In 2025, the year in which the measure comes into force, the effect cannot yet fully unfold (phase-in), so a mitigation impact of 60 kilotonnes is assumed. For 2030, a mitigation impact of 120 kilotonnes of CO_2 is assumed.

II.D.2.10 Safeguarding against the risks of investments in public infrastructure

Under Article 7 of the Climate and Innovation Act, the Swiss Confederation insures the risk of investments in public infrastructure projects that are necessary to achieve the net-zero target. From 1 January 2025, this new incentive programme will be introduced, in particular for district heating and seasonal thermal storage, to cover some specific, unforeseeable risks such as the failure of the heat source or the loss of consumers. The instrument will remain in force until the end of 2030.

Estimate of mitigation impact

It is assumed that with this instrument an additional dissemination of 50 district heating networks can be achieved by 2030 (no additional network in the start year 2025), substituting mainly individual fossil heating systems. Based on the observed average heat production of district heating networks in Switzerland (about 12 gigawatt-hours) and the assumption that district heating networks are operated with a share of 10 per cent fossil energy carriers, it is estimated that the mitigation impact of the instrument starts from zero in 2025 and reaches 48 thousand tonnes of CO_2 by 2030.

II.D.2.11 Negotiated reduction commitment of municipal solid waste incineration plant operators

Switzerland's 29 waste incineration plants emit around four million tonnes of CO_2 per year. About 50 per cent of these emissions are biogenic, and 50 per cent are fossil. In 2014, the Swiss Federal Department of Environment, Transport, Energy and Communications concluded an agreement with the Swiss Association of Municipal Solid Waste Incineration Plants. In this agreement the association committed to reduce net CO_2 emissions by 200 thousand tonnes by 2020, compared to 2010 levels, and to reduce cumulative net emissions over the period 2010–2020 by one million tonnes. Additionally, the association was obliged to establish a monitoring system to track progress towards these targets, and it had to annually report progress to the Swiss Federal Office for the Environment. Since the potential for direct emission reductions at the incineration plants is limited, improvements in the efficiency of the use of the heat generated and avoided emissions (mostly occurring outside Switzerland) through the recuperation of metals were taken into account (bottom ash of the municipal solid waste incineration plants contains on average about 10 per cent scrap iron and significant amounts of non-iron metals such as aluminium, copper, brass etc.). Thanks to the implementation of the agreement, municipal solid waste incineration plant operators were exempt from participation in the emissions trading scheme.

As documented in the monitoring report for the year 2020, the Swiss Association of Municipal Solid Waste Incineration Plants met the targets of its commitment if the impacts of the variability of winter temperatures on heat demand is considered. To extend the agreement that expired at the end of 2021, the Swiss Federal Department of Environment, Transport, Energy and Communications and the Swiss Association of Municipal Solid Waste Incineration Plants concluded a follow-up agreement covering the period until 2030. The new agreement calls the Swiss Association of Municipal Solid Waste Incineration Plants for equipping at least one plant with a unit for carbon capture and storage with a capacity of 100 thousand tonnes of CO_2 by 2030. Additionally, the Swiss Association of municipal solid waste incineration plants also commits to further reduce its net CO_2 emissions as defined in the previous agreement (but without a quantitative target). Notably, the agreement does not include a reduction target for the (direct) emissions from waste incineration plants, implying that these emissions might still increase.

Estimate of mitigation impact

By 2020, the Swiss Association of Municipal Solid Waste Incineration Plants reached its agreed (net) emission reduction commitment of 200 thousand tonnes of CO_2 equivalents below 2010 emissions[47]. For 2030, the expected mitigation impact of the agreement corresponds to its objectives, i.e. 100 thousand tonnes of CO_2 equivalents (carbon capture and storage). As there is no intermediate target for 2025, the mitigation impact of the negotiated reduction commitment of municipal solid waste incineration plant operators is indicated as 'not estimated' in Tab. 8 and CTF-NDC table 5 for the respective year.

[47] The recuperation of metals may lead to (indirect) reductions of greenhouse gas emissions outside Switzerland.

II.D.3 Transport

II.D.3.1 Overview

Over the years, Switzerland has developed an integral transport policy, seeking better coordination between transport modes, spatial planning, and taking into account environmental and sustainability concerns. While several strategies aim at reducing specific energy consumption or domestic CO_2 emissions from the transport sector – such as the road map 2025 for e-mobility in Switzerland (target by 2025: 50 per cent of newly registered cars shall be electric cars and 20,000 public charging stations shall be available country-wide)[48] – many are part of the general transport policy approach that involves reducing unnecessary motorised mobility through closely coordinated transport infrastructure and land-use planning, shifting traffic from road to more environmentally friendly modes, and improving intermodal transport chains and interconnectivity. The guidelines for this more comprehensive national transport concept have been laid down in the 1980s by the Swiss Coordinated Transport Policy Bill.[49] Recently, they have been broadened and amended by the Programme Part of the Strategic Plan for Transport (*DETEC*, 2021).

The latest projections for passenger and freight transport (*ARE*, 2021) still show substantial growth rates for the coming decades. Sustainable management of this growth represents a major challenge. Spatial development and infrastructure planning are key factors influencing future emissions from the transport sector. The coordination of spatial planning and transport infrastructure development by concentrating population and transport growth in areas where non-motorised and public transport offer comparative advantages is a viable option to curb transport growth and urban sprawl. Switzerland has therefore adjusted its spatial planning tools on the federal and cantonal level by developing the Agglomeration Programme (see below). For over 20 years, the coordination of pedestrian and hiking networks has been laid down in the Federal Constitution of the Swiss Confederation. Since January 2023, the Bicycle Routes Act has been in force to promote cycle networks in a similar way, further strengthening non-motorised transport.

Switzerland has an excellent and very dense rail infrastructure that is permanently maintained, modernised, and improved. The first phase of a major expansion of rail transport capacity, RAIL 2000, was opened on 12 December 2004. It has marked a milestone for Swiss public passenger transport, as rail service levels have increased by 12 per cent from one day to the next (more trains and faster connections between Swiss cities). As a follow-up of RAIL 2000, the Swiss Federal Act on the Future Development of Rail Infrastructure (*Swiss Confederation*, 2009) was enacted in 2009 to further modernise and expand the Swiss rail network. With the opening of several base tunnels (Lötschberg in 2007, Gotthard in 2016 and Monte Ceneri in 2020), the project New Rail Links through the Alps was completed, enhancing capacity and reducing travel time for freight and passenger transport. Furthermore, there are other projects under way for expanding rail capacity by 2025 for passenger and freight transport in the country. By also improving connections to the European high-speed rail network and night trains, Swiss transport policy encourages the modal shift of short-distance international passenger traffic from air to rail.

In the past, financing of the major rail infrastructure projects was secured on the basis of the temporary 'FinÖV', a public transport fund, which drew revenues from the heavy vehicle charge. As of 1 January 2016, operation, maintenance, and extension of rail infrastructure have been financed through a single, open-ended 'Rail Infrastructure Fund' (in 2023, the fund's income totalled around 640 Swiss francs per inhabitant of Switzerland).

From 2007 to 2017, funding for development and maintenance of road infrastructure was provided through the 'Infrastructure Fund for Agglomeration Transport, the National Highway Network and Major Roads in Mountain Areas and Peripheral Regions'. In 2018, this fund was replaced by the time-unlimited 'Fund for the National Road Motorway Network and the Agglomeration Traffic' (in 2023, the fund's income totalled around 310 Swiss francs per inhabitant of Switzerland). Out of this fund, Switzerland runs an agglomeration programme aimed at providing financial resources for infrastructure projects promoting public and non-motorised transport in sub-urban regions and agglomerations.

The two-lane Gotthard road tunnel connecting northern Switzerland to the Ticino and Italy opened in 1980. After more than forty years of operation, it needs major refurbishment. The Swiss Federal Council and the Swiss Parliament proposed

[48] Roadmap Elektromobilität 2022: *https://roadmap-elektromobilitaet.ch*. The progress made so far is illustrated on the following website: *https://www.uvek-gis.admin.ch/BFE/storymaps/MO_Kennzahlen_Fahrzeuge/Ladeinfrastruktur_Elektromobilitaet/?lang=en*.

[49] Gesamtverkehrskonzeption (1977). Stab GVF. Online: *https://www.alptransit-portal.ch/de/ereignisse/ereignis/die-gesamtverkehrskonzeption/?no_cache=1&cHash=ea54b930f67a615ddf8bf179ba7ae582*.

to construct a second tunnel. This would allow for closing of the first tunnel during refurbishment works without lengthy interruption of this important traffic link. In addition, two tunnels would lead to safer operating conditions in the future. A referendum on this proposal was held in 2016 and approved. The referendum was motivated by concerns that the two tunnels will be opened to four-lane traffic once refurbishment of the first tunnel is completed – leading to a conflict with the intention of Article 84 of the Federal Constitution of the Swiss Confederation stating that the capacity of the transit routes in the alpine region may not be increased (section II.D.3.5). The construction of the second road tunnel started in 2021 and the opening is scheduled for 2029.

In view of the importance of road transportation with regard to Switzerland's greenhouse gas emissions, policies and measures targeting those emissions have been introduced as part of the CO_2 Act. Most important are the CO_2 emission regulations for newly registered vehicles as well as the partial compensation of CO_2 emissions from motor fuel use.

Switzerland has excellent international flight connections, with many direct flights to and from economically important destinations. As the share of emissions from Switzerland's domestic aviation is very small, Switzerland's aviation policy is focused on international aviation, and, thus, mainly targets bunker fuels. Switzerland is engaged in the environmental expert groups of the International Civil Aviation Organisation and the European Civil Aviation Conference in order to support harmonisation and further development of international environmental aviation standards and measures. Switzerland directly applies environmental standards of the International Civil Aviation Organisation and their revisions in its national aviation legislation. This includes environmental technical standards for aircraft registered in Switzerland (such as the CO_2 emissions standard for aircraft, NO_x and non-volatile particulate matter emission regulations for aircraft engines) and market-based policies and measures like the carbon offsetting and reduction scheme for international civil aviation (CORSIA). The international orientation of Switzerland's aviation policy is reflected in the policies and measures presented in the sections II.D.3.9 to II.D.3.13. Since the linking of the emissions trading schemes of Switzerland and the European Union as of 1 January 2020, Switzerland has included aircraft operators in its emissions trading scheme. The respective information with regard to aviation is thus included under the cross-sectoral policies and measures (see section II.D.1.7) and is therefore not listed in the table below. International aviation and navigation is outside the scope of Switzerland's first nationally determined contribution. Therefore, the mitigation impact of policies and measures in this area will be in addition to the mitigation policies and measures covered by Switzerland's first nationally determined contribution.

Tab. 9 gives an overview of Switzerland's policies and measures in the transport sector. The following sections provide more details and background information on each policy and measure.

Tab. 9 > Summary of policies and measures in the transport sector. The sector affected is 'transport' for all policies and measures presented in this table. Aircraft operators are included in the emissions trading scheme (see section II.D.1.7).

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
CO_2 emission regulations for newly registered vehicles *	CO_2	Reduction of average fuel consumption and CO_2 emissions from new passenger cars and light commercial vehicles, as well as heavy-duty vehicles from 2025. Promotion of electric road transport.	Regulatory	Implement ed (streng-thening adopted)	CO_2 emission targets for newly registered vehicles in line with regulations of the European Union. The target by 2020 for passenger cars (fleet average) has been set at 95 grams of CO_2 per kilometre, for light commercial vehicles at 147 grams of CO_2 per kilometre. Vehicle importers have to pay a penalty if the individually specified target is not met.	2012	SFOE, FEDRO	210	550	900
Energy label for new motor vehicles *	CO_2	Promote visibility of cars with low average fuel consumption, low CO_2 emissions and high energy efficiency. Raise awareness of car and light commercial vehicle buyers and ensure transparent customer information.	Information, regulatory	Implement ed (streng-thening adopted)	Mandatory label for cars displayed at the point of sale, in online configurators and in advertisements providing information on the fuel consumption (litres per 100 kilometre), CO_2 emissions (in grams of CO_2 per kilometre) and energy efficiency class of every passenger car.	2003	SFOE	IE [b]	IE [b]	IE [b]

Partial compensation of CO_2 emissions from motor fuel use *	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Mitigation projects as compensatory measure (instead of a CO_2 levy on motor fuels).	Regulatory	Implemented (strengthening planned)	Obligation for importers to offset part of the CO_2 emissions from motor fuel use through investments in domestic and international emission reduction projects. Financed by a surcharge paid by the consumer on imported fuels not exceeding 0.05 Swiss francs per litre of fuel. The share of CO_2 emissions to be offset gradually increases (from two per cent in 2014 to 23 per cent as of 2024).	2013	FOEN, KliK	1 300	NE [c]	NE [c]
Heavy vehicle charge *	CO_2	Reduction of transalpine road traffic, increase of transport rates on rail, limit increase in heavy vehicles on the road.	Fiscal	Implemented (strengthening/adjustment planned)	Charges applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight, aiming at a shift of transalpine transport from road to rail. The level of the charge depends on the distance driven, the maximum weight, and emissions standards of the individual vehicle.	2001	FOCBS, FOT	110	120	110
Mineral oil tax reduction on biofuels and natural gas *	CO_2	Promotion of low-carbon or carbon-free motor fuels.	Fiscal	Implemented	Tax reduction of 0.4 Swiss francs per litre of gasoline equivalent for natural gas and liquefied petroleum gas (LPG). Complete tax exemption for biogas and other renewable fuels used in combustion engines if certain ecological and social criteria are met. Tax revenue losses are compensated by increasing tax rates on liquid fossil motor fuels.	2008	FOCBS, FOEN, SECO	IE [d]	IE [d]	IE [d]
Promotion of electric propulsion technologies *	CO_2	Support and accelerate the transition from buses and ships powered by diesel oil to electric propulsion technologies in Swiss public transport, reducing fossil fuel dependence and associated CO_2 emissions.	Economic	Adopted	Financial support (47 million Swiss francs annually, from 2025 to 2030) available to all concessionary transport companies to cover the additional costs of electric buses and ships compared to diesel oil alternatives.	2025	FOT	NA [e]	200	200
International exhaust gas regulations (NMVOC) *	Indirect CO_2	Improvement of air quality through O_3 abatement.	Regulatory	Implemented	Limits for NMVOC emissions of motor vehicles, also leading to a reduction of indirect CO_2 emissions.	1974	FEDRO	200	200	200
CO_2 emissions standard for aircraft *	CO_2	Reduction of average fuel consumption and CO_2 emissions from new and in-production aircraft.	Regulatory	Implemented	CO_2 emission targets for new aircraft designs from 2020, for in-production aircraft from 2023 and production cut-off from 2028.	2020	FOCA	NA [e]	330	360
Carbon offsetting and reduction scheme for international civil aviation (CORSIA)	CO_2	Carbon neutral growth of international civil aviation.	Regulatory	Implemented	Emissions from international civil aviation above predefined levels will have to be offset by operators. Applicable standards and recommended practices are currently being developed by the International Civil Aviation Organisation.	2020	FOCA, FOEN	NA [e]	NE [f]	NE [f]
Non-volatile particulate matter emission regulation for aircraft engines	Non-CO_2	Reduction of the number of emitted soot particles for new engine designs.	Regulatory	Adopted	Coated soot particle emissions are directly connected to ice particle generation, cloud formation and the optical properties of clouds. Emission reductions positively affect the non-CO_2 impact of aviation.	2023	FOCA	NA [e]	NE [g]	NE [g]
NO_x emission regulation for aircraft engines	Non-CO_2	More stringent NO_x standard, better control of NO_x emissions in cruise	Regulatory	Planned	Proposal for increased stringency of LTO NO_x regulation. Finalisation of a cruise NO_x metric.	2025	FOCA	NA [e]	NE [h]	NE [h]

Sustainable aviation fuel policy *	CO_2, non-CO_2	Production and use of low fossil carbon aviation fuels.	Regulatory, economic	Adopted	Introduction of sustainable aviation fuel with blending mandate for fuel suppliers, support for production upscaling and research to improve technologies, especially for renewable synthetic fuels.	2025	FOCA, FOEN	NA [e]	NA [i]	425

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] The mitigation impact of the energy label for new motor vehicles is included in the mitigation impact of the CO_2 emission regulations for newly registered vehicles.

[c] For 2025 and 2030, the mitigation impact cannot yet be estimated, because the share of CO_2 emissions from motor fuels to be offset by fuel importers of motor fuels remains to be defined in the CO_2 ordinance to the third CO_2 Act. However, it is planned that the share will increase to 25 per cent in 2025 and 50 per cent in 2030 (to be reached by means of emission reduction projects within Switzerland and abroad).

[d] The mitigation impact of the mineral oil tax reduction on biofuels and natural gas is included under the partial compensation of CO_2 emissions from motor fuel use. For 2020, domestic emission reduction projects that bring biofuels on the market achieved an estimated mitigation impact of about 500 thousand tonnes of CO_2.

[e] The mitigation impact of these policies and measures will develop after 2020.

[f] The mitigation impact of the carbon offsetting and reduction scheme for international civil aviation (CORSIA) has been overruled by a much stronger impact resulting from the corona virus pandemic. In 2020, CO_2 emissions from international aviation departing from Switzerland fell by 64 per cent. Due to the difficulties in estimating the future short-term to medium-term evolution of international civil aviation, no mitigation impact is currently available for 2025 and 2030.

[g] Non-volatile particulate matter emissions are expected to stabilise by 2025 in absolute terms and decline afterwards. However, the cruise emissions of a particular substance as well as the atmospheric conditions at exact location and time during the flights are currently not known well enough to quantify the mitigation impact of specific policies and measures that target non-CO_2 emissions.

[h] As NO_x reductions trade with CO_2 emissions, a precautionary target of NO_x stabilisation instead of reduction is envisaged for the time being. However, the cruise emissions of a particular substance as well as the atmospheric conditions at exact location and time during the flights are currently not known well enough to quantify the mitigation impact of specific policies and measures that target non-CO_2 emissions.

[i] At this time, the starting date of the blending mandate is subject to discussions.

IE, included elsewhere; NA, not applicable
FOCBS, Swiss Federal Office for Customs and Border Security; FEDRO, Swiss Federal Roads Office; FOCA, Swiss Federal Office of Civil Aviation; FOEN, Swiss Federal Office for the Environment; FOT: Swiss Federal Office of Transport; KliK: Foundation for Climate Protection and Carbon Offset; SECO, Swiss State Secretariat for Economic Affairs; SFOE, Swiss Federal Office of Energy

II.D.3.2 CO_2 emission regulations for newly registered vehicles

Because a voluntary agreement signed in 2002 by the Association of Swiss Automobile Importers to reduce the specific fuel consumption of first-time registration cars was insufficient, the Swiss Parliament amended the CO_2 Act in 2011 to include CO_2 emission regulations for newly registered vehicles. The prescriptions came into force in July 2012 and are based on those in the European Union. In the first phase from 2012 through 2019, a fleet average target for newly registered passenger cars was set at 130 grams of CO_2 per kilometre. In consequence, the fleet average emission of newly registered passenger cars decreased from 155 grams of CO_2 per kilometre in 2011 to 138 grams of CO_2 per kilometre in 2019. As of 1 January 2020, targets of 95 grams of CO_2 per kilometre for newly registered passenger cars and of 147 grams of CO_2 per kilometre for newly registered light commercial vehicles have entered into effect as part of the Energy Strategy 2050 (section II.D.2.1). From 2021 onward, these targets were translated to account for the change to the new Worldwide Harmonised Light Vehicle Test Procedure (118 grams of CO_2 per kilometre for passenger cars, 186 grams of CO_2 per kilometre for light commercial vehicles). With the third CO_2 Act, strengthened emission reduction targets for newly registered cars, vans and heavy-duty vehicles in line with the regulation of the European Union were adopted (referring to the Worldwide Harmonised Light Vehicle Test Procedure). For newly registered passenger cars, the targets will be 93.6 grams of CO_2 per kilometre from 2025 onward and 49.5 grams of CO_2 per kilometre from 2030 onward. For newly registered vans, the targets will be 153.9 grams of CO_2 per kilometre from 2025 onward and 90.6 grams of CO_2 per kilometre from 2030 onward. For newly registered heavy-duty vehicles, the third CO_2 Act introduces CO_2 emission reduction targets, defined as a percentage reduction from the baseline[50] provided in the regulation of the European Union: A 15 per cent reduction from 2025 onward and a 30 per cent reduction from 2030 onward.

In 2023, the CO_2 emissions stood at 113 grams of CO_2 per kilometre for newly registered passenger cars and at 186 grams of CO_2 per kilometre for newly registered light commercial vehicles. Most vehicle importers reached their individual targets. The CO_2 emission regulations for newly registered vehicles are enforced by a sanction mechanism (see also section II.A.9.3). Sanctions paid by those importers with excess emissions amounted to 6.2 million Swiss francs for both vehicle categories in 2023.

[50] The baseline corresponds to average CO_2 emissions of new registered heavy-duty vehicles registered from 1 July 2019 to 30 June 2020.

Estimate of mitigation impact

The mitigation impact was estimated ex ante at 210 thousand tonnes of CO_2 equivalents per year in 2020, 550 thousand tonnes of CO_2 equivalents per year in 2025, and 900 thousand tonnes of CO_2 equivalents in 2030 (Tab. 9 and CTF-NDC table 5, see also *SFOE*, 2017 and *FOEN*, 2023b). This mitigation impact is calculated by comparing a scenario where the new vehicle fleets attain the implemented targets with only little delay to a scenario where only autonomous technological progress leads to a slower decrease of specific CO_2 emissions. Due to ongoing fleet turnover, the mitigation impact increases with time. For 2030, the mitigation impact of the heavy-duty vehicle targets adds to those of the car and van regulation.

II.D.3.3 Energy label for new motor vehicles

Since 2003, the compulsory energy label for newly sold cars has informed customers at the point of sale about fuel consumption, specific CO_2 emissions and energy efficiency. The energy label ensures transparency when buying a car and allows the different drive technologies to be compared It also serves as the basis for calculating motor vehicle tax in certain cantons. It classifies cars into one of seven energy efficiency classes from A to G using well-to-wheel energy consumption. Evaluation criteria are adapted at yearly intervals to follow technological development in the automotive sector. The label as well as the customer information regulations have been strengthened from 1 January 2020 onward. Curb mass of new vehicles is not considered any more for energy efficiency classification, while new car advertisements and online configurators have to display the colour band efficiency rating. The customer information regulations have been extended to light commercial vehicles (excluding the energy label). A further strengthening of the energy label was introduced on 1 January 2023 in that the category limits are now determined on the basis of the targets set out by the CO_2 emission regulations for newly registered vehicles (see section II.D.3.2) and that the classification process now takes into account the uneven distribution of the vehicle range across the different drive technologies. As of 1 January 2025, the adopted strengthening of the targets set out by the CO_2 emission regulations for newly registered vehicles will automatically lead to a strengthening of the energy efficiency categories for passenger cars. The classification will become more ambitious for all technologies and it is expected that only the most efficient models will be in category A from 2025 onward.

Estimate of mitigation impact

The energy label for new motor vehicles is a purely informative measure for car buyers. An estimate from 2005 found a positive impact on energy efficiency. However, there is no recent quantitative estimate. Surveys demonstrate that energy efficiency and low fuel consumption are important criteria for the purchase of new cars and the energy label is known among a majority of car buyers. A positive overall impact on energy efficiency is expected. The energy label for new motor vehicles supports the efforts with regard to the CO_2 emission regulations for newly registered vehicles (section II.D.3.2). Accordingly, the mitigation impact of the energy label for new motor vehicles is included in the mitigation impact of the CO_2 emission regulations for newly registered vehicles, and is therefore reported as ‘included elsewhere’ in Tab. 9 and CTF-NDC table 5.

II.D.3.4 Partial compensation of CO_2 emissions from motor fuel use

The partial compensation of CO_2 emissions from motor fuel use obliges importers to offset part of the CO_2 emissions from motor fuels sold in Switzerland through investments in domestic and international emission reduction projects. It is the follow-up policy and measure to the ‘Climate Cent’, which levied a surcharge of 0.015 Swiss francs per litre on motor fuels from October 2005 to August 2012 (for more details see section 4.4.4 of Switzerland’s eight national communication and fifth biennial report).

Under the partial compensation of CO_2 emissions from motor fuel use the offset is financed by a surcharge paid by the consumer on imported fuels which shall not exceed 0.05 Swiss francs per litre of fuel. The Swiss Federal Council determined the share of CO_2 emissions from motor fuels to be offset by fuel importers within Switzerland as follows:

- Two per cent in 2014–2015;
- Five per cent in 2016–2017;
- Eight per cent in 2018–2019;
- Ten per cent in 2020;

- 12 per cent in 2021.

As of 2022, the share of CO_2 emissions from motor fuels to be offset by fuel importers within Switzerland shall be at least 15 per cent. The total share, to be reached by means of emission reduction projects within Switzerland and abroad, shall be:

- 17 per cent in 2022;
- 20 per cent in 2023;
- 23 per cent as of 2024.

From 2025 onward, the third CO_2 Act stipulates that the share of CO_2 emissions from motor fuels to be offset by fuel importers shall be at least five per cent and at most 90 per cent. As before, the surcharge paid by the consumer on imported fuels shall not exceed 0.05 Swiss francs per litre of fuel. The Swiss Federal Council is mandated to decree the details of implementation, such as the actual shares to be compensated within Switzerland and abroad (as of summer 2024, the respective revision of the CO_2 ordinance was ongoing, see planned strengthening below). Most fuel importers are members of the Foundation for Climate Protection and Carbon Offset (KliK), the follow-up organisation to the Climate Cent Foundation, which manages the revenues and climate change abatement measures. Switzerland will use internationally transferred mitigation outcomes related to the implementation of the partial compensation of CO_2 emissions from motor fuel use towards the achievement of its nationally determined contribution.

For emission reduction projects used for the mandatory compensation of CO_2 emissions from motor fuel use, the Swiss Federal Office for the Environment issues tradable attestations if conditions are met: (i) Emission reduction projects must take place in Switzerland or in a country with which Switzerland has signed a bilateral agreement under Article 6 of the Paris Agreement, (ii) be registered in advance, and (iii) the emission reductions achieved must be accounted for annually in a monitoring report. Attestations can only be issued for measures that go beyond legal requirements and that are not already supported otherwise. Emission reduction projects cover a variety of different technological areas such as energy efficiency on the supply and demand side, renewable energy, fuel switch, avoidance of emissions of CH_4, N_2O and F-gases, and biological sequestration. A detailed list of emission reduction projects in these various technological areas is available on the website of the Swiss Federal Office for the Environment[51], where the expected and actual emission reductions from currently registered emission reduction projects are presented as well.

Planned strengthening

The planned strengthening in the framework of the CO_2 Ordinance to the third CO_2 Act foresees that the share of CO_2 emissions from motor fuels to be offset by fuel importers within Switzerland shall be at least 12 per cent. The total share, to be reached by means of emission reduction projects within Switzerland and abroad, shall be 25 per cent in 2025 and increase by five percentage points each year to finally reach 50 per cent in 2030.

Estimate of mitigation impact

For 2020, the Swiss Federal Office for the Environment issued attestations corresponding to about 1,300 thousand tonnes of CO_2 equivalents, consistent with the share of 10 per cent of total CO_2 emissions from motor fuels that needed to be compensated.[52] Three quarters of this mitigation impact comes from three projects that either increase carbon fixation in long-living harvested wood products or promote the use of biogenic fuels. For 2025 and 2030, the mitigation impact cannot yet be estimated, because the final decision on the share of CO_2 emissions from motor fuels to be offset by importers of motor fuels for the years beyond 2024 is still pending. Accordingly, in Tab. 9 and in CTF-NDC table 5, the mitigation impact of the partial compensation of CO_2 emissions from motor fuel use is indicated as 1,300 thousand tonnes of CO_2 equivalents for 2020 and as 'not estimated' for 2025 and 2030. However, the planned strengthening suggests that the mitigation impact will substantially increase in future years, as it is planned to increase the share of CO_2 emissions from motor fuels to be offset to 25 per cent in 2025 and 50 per cent in 2030 (with a substantial share achieved abroad). The emission reductions abroad are achieved through cooperative approaches under Article 6 of the Paris Agreement.

51 https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/compensation.html

52 The ongoing mitigation impact of the 'Climate Cent' after 2012 is included as well.

II.D.3.5 Heavy vehicle charge

Switzerland's freight transport policy is based on Article 84 of the Federal Constitution of the Swiss Confederation (as amended in 1994) which requires transalpine freight transport to be shifted from road to rail. This goal is to be reached by the so-called heavy vehicle charge, in combination with measures to improve competitiveness of international rail transport (see section II.D.3.1). Since 2001, passenger and freight transport vehicles of more than 3.5 tonnes of total weight have been charged a fee, calculated according to three criteria: (i) kilometres travelled on Swiss customs territory, (ii) permissible maximum laden mass according to the vehicle registration certificate, and (iii) emission standard according to EURO classes. The heavy vehicle charge was implemented in three stages between 2001 and 2008, accompanied by increasing permissible maximum weight for trucks (40 tonnes instead of 28 tonnes). As of July 2021, the charge is set according to the vehicle class as follows: (i) EURO 1 to EURO 5 currently at 3.10 Swiss francs per hundred tonne kilometres and (ii) EURO 6/VI currently at 2.28 Swiss francs per hundred tonne kilometres[53]. Heavy vehicles with battery-electric or fuel cell drives are currently exempt from the charge. One third of the net revenue goes to the cantons which use their allocation mainly to meet their share of the uncovered road transport costs. Two thirds of the net revenue go to the federal government, which mainly uses its share to finance the 'Rail Infrastructure Fund'.

Planned strengthening/adjustment

The current heavy vehicle charge is reaching its limits due to technical developments: 90 per cent of vehicles subject to the heavy vehicle charge are now in the most favourable tax category. In addition, an increasing number of heavy goods vehicles are powered by batteries and hydrogen-electric drives, which are exempt from the heavy vehicle charge. This development could lead to a loss of revenue of several billion Swiss francs in the coming decades and thus jeopardise the target of promoting freight transport by rail. Accordingly, the heavy vehicle charge is currently further developed. During spring 2024, the Swiss Federal Council submitted a draft revision of the relevant legislation for public consultation. It is planned to make heavy good vehicles powered by batteries and hydrogen-electric drives subject to the heavy vehicle charge; however, in order not to slow down the transition to electric heavy goods vehicle, the Swiss Federal Council will also propose appropriate measures in its dispatch.

Estimate of mitigation impact

The heavy vehicle charge has prompted a significant renewal of the heavy goods vehicles fleet in the year before its introduction. This was due to the fact that the charge depends on the maximum weight and on emissions standards of the individual vehicle. The heavy vehicle charge results in a positive overall environmental balance, in particular thanks to reduced emissions of air pollutants and greenhouse gases from road freight transport. According to model calculations for the year 2005 (*ARE*, 2007), air quality has improved by 10 per cent (particle emissions) and 14 per cent (nitrogen oxides), respectively. CO_2 emissions have decreased by six per cent compared to a scenario without the introduction of the heavy vehicle charge (and with a weight limit of 28 tonnes). In the absence of more recent estimates, it is assumed that the heavy vehicle charge has persistently led – and will continue to lead – to a reduction of CO_2 emissions from road freight transport by six per cent compared to a scenario without its introduction. Application of this assumption to the (reported or projected) emissions of road freight transport suggests a mitigation impact of the heavy vehicle charge of about 110 thousand tonnes of CO_2 in 2020, of about 120 thousand tonnes of CO_2 in 2025, and of about 110 thousand tonnes of CO_2 in 2030 (Tab. 9 and CTF-NDC table 5).

II.D.3.6 Mineral oil tax reduction on biofuels and natural gas

A mineral oil tax is usually levied on sales of mineral oils (see section II.A.6). On 1 July 2008, an amendment to the Mineral Oil Tax Act entered into force, providing tax incentives for low-carbon or carbon-free fuels. A tax reduction of 0.4 Swiss francs per litre of gasoline equivalent has been granted for natural gas and liquefied petroleum gas. Complete tax exemptions for biogas and other renewable fuels used in combustion engines have been granted, if ecological and social criteria are met. In March 2014, the Swiss Parliament decided to tighten these criteria by amending the Mineral Oil Tax Act as well as the Environment Protection Act. Since then, the ecological criteria have been: (i) a minimum of 40 per cent greenhouse gas reduction based on life cycle analysis (LCA), (ii) a net environmental burden lower than or not significantly exceeding the one of fossil fuels, and (iii) the cultivation of biofuels must not endanger biodiversity, in particular rainforests. Minimum requirements for socially acceptable production conditions have been: (i) social legislation applicable at the production location of raw materials and fuels is respected, (ii) at least the fundamental

[53] https://www.ezv.admin.ch/ezv/de/home/information-firmen/transport--reisedokument--strassenabgaben/schwerverkehrsabgaben--lsva-und-psva-/lsva---allgemeines---tarife.html

conventions of the International Labour Organisation (ILO) are complied with, and (iii) cultivation of biofuels has to be realised on legally acquired soils. Tax revenue losses need to be counterbalanced by increasing tax rates on liquid fossil motor fuels. In contrast to other countries, Switzerland has no quotas for biofuels. In the framework of the third CO_2 Act, an extension until 2030 of the mineral oil tax reduction on biofuels and natural gas was adopted.

Estimate of mitigation impact

In Switzerland, the largest share of activities that bring biofuels on the market are registered as domestic emission reduction projects (see also sections II.D.3.4). Based on the corresponding monitoring reports[54], the mitigation impact is estimated at about 500 thousand tonnes of CO_2, corresponding to about four per cent of the emissions of the transport sector (values for 2020). However, because this mitigation impact is already included under the partial compensation of CO_2 emissions from motor fuel use (section II.D.3.4), the mitigation impact of the mineral oil tax reduction on biofuels and natural gas is reported as 'included elsewhere' in Tab. 9 and CTF-NDC table 5 for all years, 2020, 2025 and 2030.

II.D.3.7 Promotion of electric propulsion technologies in public transport

Based on Article 41a of the third CO_2 Act, the Swiss Confederation intends to support the conversion of buses and ships powered by diesel oil to fossil-free electric drives and thus accelerate the efforts already being made by the cantons and municipalities. To incentivise investments, the Swiss Confederation will contribute 47 million Swiss francs per year towards the additional costs of buses and ships with electric engines compared to combustion engines. The subsidies should be paid out between 2025 and 2030 and will be available to all concessionary transport companies. Part of the subsidies will be counter-financed by the abrogation of the mineral oil tax reliefs for local public transport as of 1 January 2026.

Estimate of mitigation impact

The combination of increasing the cost of fossil energy and reducing the additional cost for electric propulsion technologies should accelerate the shift away from buses and ships powered by diesel oil. Given the ongoing trend towards the purchase of electric buses instead of buses powered by diesel oil, it is questionable whether the support will have much of an incentive effect or whether it will mainly shift costs from the cantons and municipalities to the Swiss Confederation. Further, in the case of subsidised public transport, a large part of the additional costs resulting from the abrogation of the mineral oil tax reliefs will be paid by the Swiss Confederation, the cantons and the municipalities. Experience in Germany shows that vehicle manufacturers tend to raise the prices for electric propulsion technologies by about the amount that is provided through subsidies by the government. The subsidies may therefore delay the cost reduction for electric buses in Switzerland. Nevertheless, the promotion of electric propulsion technologies is expected to have a mitigation impact of 200 thousand tonnes of CO_2 in 2025 and 2030.

II.D.3.8 International exhaust gas regulations (NMVOC)

At the beginning of the 1970s, the first exhaust gas regulations have been introduced in Switzerland. With the goal of limiting emissions of air pollutants (such as CO, NMVOC, NO_x, etc.) from vehicles and machineries, numerous subsequent regulations have followed. Since 1995, Switzerland has harmonised its standards with those of the European Union, replacing national regulations with the corresponding directives of the European Union and adopting the dates for their entry into force.[55] The regulations have led to strongly decreasing emissions of air pollutants, e. g. thanks to the implementation of the three-way catalytic converter. Indirect CO_2 emissions have decreased in concert.

Estimate of mitigation impact

In 1990, the emissions of NMVOC of road traffic amounted to about 100 thousand tonnes. In 2020, emissions of NMVOC of road traffic have dropped to below 10 thousand tonnes of NMVOC, and the trend is projected to level off up to 2030 and beyond. Without measures since 1990, it is assumed that the emission factors would have remained constant, resulting in emissions of around 70 thousand tonnes of NMVOC in 2020 to 2030. Lowering emissions of NMVOC by 60 thousand tonnes results in corresponding lower emissions of indirect CO_2. By 2020, 2025 and 2030, the estimated greenhouse gas mitigation impact is about 200 thousand tonnes of CO_2 (Tab. 9 and CTF-NDC table 5), based on a carbon content of

[54] See projects listed under https://www.bafu.admin.ch/bafu/de/home/themen/klima/fachinformationen/verminderungsmassnahmen/kompensation/inland/registrierte-projekte/5-2.html.

[55] See the following website for more details about the regulations in place: https://www.bafu.admin.ch/bafu/de/home/themen/luft/fachinformationen/massnahmen-zur-luftreinhaltung/massnahmen-zur-luftreinhaltung-beim-strassenverkehr.html.

NMVOC of 90 per cent for emissions from combustion engines (diesel oil and gasoline mostly contain hydrocarbons and have a very low content of oxygen, sulphur, nitrogen etc.).[56]

II.D.3.9 CO_2 emissions standard for aircraft

Switzerland helped in the process for the adoption of the first CO_2 emissions standard for civil aircraft by the International Civil Aviation Organisation, which is the world's first global design certification standard governing CO_2 emissions. The standard applies to new relevant aircraft type designs registered in Switzerland from 2020. As of 2023, it also applies to relevant aircraft type designs already in production. Those in-production aircraft which by 2028 do not meet the standard will no longer be able to be produced unless their designs are sufficiently modified. Switzerland is currently engaged in analysis and negotiations for stringency increase of the CO_2 emissions standard at the International Civil Aviation Organisation.

Estimate of mitigation impact

Because the CO_2 emissions standard for aircraft will develop its mitigation impact after 2020, the mitigation impact for 2020 is reported as 'not applicable' in Tab. 9 and CTF-NDC table 5. Based on *ICAO* (2022), the CO_2 emissions standard for aircraft may contribute a reduction of CO_2 emissions of about five per cent. For 2025 and 2030, the mitigation impact is thus estimated at about 330 and 360 thousand tonnes of CO_2. The mitigation impact will strongly depend on accelerated phase-out of older aircraft, restructuring and the rate of recovery from the corona virus pandemic. The mitigation impact is mostly related to international aviation, i.e. the respective emissions are not covered by Switzerland's first nationally determined contribution.

II.D.3.10 Carbon offsetting and reduction scheme for international civil aviation (CORSIA)

In 2017, the assembly of the International Civil Aviation Organisation decided to introduce the so-called carbon offsetting and reduction scheme for international civil aviation (CORSIA). CORSIA is a global market-based measure and designed to offset international aviation CO_2 emissions in order to stabilise the levels of such emissions from 2020 onwards. Already in 2017, Switzerland has announced its willingness to participate in the scheme together with the 43 other member states of the European Civil Aviation Conference. Applicable standards and recommended practices for the scheme are in force, which includes the standards for eligible CO_2 compensation projects and eligible renewable fuels (sustainable aviation fuels with fossil carbon reduction based on life-cycle emissions standards). CORSIA is structured in a pilot phase (2021–2023), first phase (2024–2026) and second phase (2027–2035). In 2024 the first phase with 126 participating countries including Switzerland has started.

Estimate of mitigation impact

In 2020, the CO_2 emissions for international flights departing Switzerland fell by 64 per cent due to the corona virus pandemic. In consequence, no CO_2 emissions were offset in the pilot phase and therefore the mitigation impact of this measure for 2020 is reported, as 'not applicable' in Tab. 9 and CTF-NDC table 5. Taking into account the drastic drop of aviation activities in 2020, the Council of the International Civil Aviation Organisation agreed on using 2019 emissions for the CORSIA baseline only for the pilot phase and using 85 per cent of 2019 emissions after the pilot phase (2024–2035). Slowly, aviation activities are approaching 2019 levels again and the measure will probably soon lead to offsetting requirements for the aviation industry. Due to the difficulties in estimating the future short-term to medium-term evolution of international civil aviation, no mitigation impact is currently available for 2025 and 2030 (Tab. 9 and CTF-NDC table 5 thus indicate 'not estimated').

II.D.3.11 Non-volatile particulate matter emission regulation for aircraft engines

Switzerland played a key role in the development of the first global regulation for ultrafine particle emissions from aircraft engines, which has been applicable worldwide since 2020. The regulation was introduced not only with a view to address health impacts, but also to substantially reduce ultrafine soot emissions during cruise. These emissions are an important trigger for aviation non-CO_2 climate impacts. From 2023, new engine types have to meet regulatory limits, which are approximately 30 per cent more stringent than for previous in-production engines. Combustion improvements can reduce non-volatile particulate matter emissions in cruise without compromising fuel efficiency. Recently, Switzerland provided

[56] In the greenhouse gas inventory, the oxidation factors used to calculate CO_2 emissions from road traffic are assumed to be 100 per cent. Accordingly, indirect CO_2 emissions resulting from the atmospheric oxidation of NMVOCs are already included under direct CO_2 emissions in this case. The values related to indirect CO_2 emissions provided in the greenhouse gas inventory as well as Switzerland's projections (see section II.F.4.6) strictly avoid double counting.

technical substantiation to the International Civil Aviation Organisation for the introduction of additional reporting requirements relevant to the future control of non-volatile particulate matter emissions from aircraft cruising at high altitude. A decision by the Council of the International Civil Aviation Organisation on their inclusion in global aviation emission standards is expected in 2025.

Estimate of mitigation impact

With this measure, it is anticipated that non-volatile particle emissions will reduce with the introduction of more modern engines and with increased use of sustainable aviation fuels. Emissions reduction potentials depend on fleet renewal but roughly, a 20 per cent reduction in the number of emitted particles by 2025 seems to be possible relative to fuel consumption. In absolute terms, a stabilisation is anticipated in 2025, followed by a decline. Based on application of the precautionary principle, a reduction of the warming potential of contrails from this measure can be assumed. However, the climate impact of non-CO_2 emissions (e.g. water vapour, nitrogen oxides, soot) depends on the quantity of these emissions (and therefore also on aircraft movements) as well as on numerous other factors such as the aircraft fleet (technology), the flight operation (e.g. flight altitude and speed), the ambient conditions (temperature, relative humidity, background concentration of air pollutants) or the observation period (hours, days, years), as the various substances remain in the air for different lengths of time. Because the cruise emissions of a particular substance as well as the atmospheric conditions at exact location and time during the flights are currently not known well enough, it is not possible to individually quantify the mitigation impact of specific policies and measures that target non-CO_2 emissions. Accordingly, the mitigation impact of the non-volatile particulate matter emission regulation for aircraft engines is indicated as 'not estimated' in Tab. 9 and CTF-NDC table 5 (or as 'not applicable' in case the policy and measure is not in force at that time).

II.D.3.12 NO_x emission regulation for aircraft engines

Historically, aircraft engine NO_x regulation is based on an airport-related landing and take-off standard. In the past, this standard has also controlled cruise NO_x emissions. However, Switzerland's expertise in aircraft engine emissions contributed to an insight that modern engine cruise NO_x performance can differ from what is regulated in the landing and take-off standard. Additionally, a number of countries, including Switzerland, reported an increase in aviation NO_x emissions from modern fleets, although they have become more fuel efficient (producing less CO_2 but more NO_x). As a result, an International Civil Aviation Organisation work programme was agreed in 2022 to improve the existing landing and take-off NO_x regulation and to develop a cruise NO_x metric to better account for cruise NO_x emissions performance of engines. Meanwhile, technical improvements to the landing and take-off standard to make it more stringent and a new cruise NO_x metric concept have been developed and are proposed for future work in the International Civil Aviation Organisation. The council of International Civil Aviation Organisation is expected to decide on this future work in spring 2025.

Estimate of mitigation impact

NO_x regulation of aircraft engines suffers from the technical fact that NO_x reduction has a fuel burn trade-off. The simplest example is a slightly heavier engine due to a more complex combustion system. For an aircraft, the fuel burn of the installed engine is relevant: If the engine is heavier, the aircraft will need additional fuel for the increased weight and thus total CO_2 emissions increase. As the impact of reduced NOx emissions is temporary and highly uncertain, mitigation measures should prioritise CO_2. Therefore, the regulatory activities target stabilisation of NO_x emissions and identifying those engines that produce less cruise NO_x at similar fuel consumption. If successfully implemented, the new regulation should trigger more focus on optimisation for low cruise NO_x for new engine types, while highest fuel efficiency is maintained. As for non-volatile particulate matter emissions, the mitigation impact cannot be properly assessed at this time and is indicated as 'not estimated' in Tab. 9 and CTF-NDC table 5 (or as 'not applicable' in case the policy and measure is not in force at that time).

II.D.3.13 Sustainable aviation fuel policy

In December 2022, Switzerland published its report on fostering the development and uptake of sustainable aviation fuels (*FOCA*, 2022). Following this report and in the framework of the third CO_2 Act (Articles 28f and 28g), the legal basis for a sustainable aviation fuel blending mandate for aviation fuel suppliers has been adopted, in coordination with the ReFuelEU programme in the European Union. The availability of sustainable aviation fuels is currently limited, reaching 0.5 per cent of aviation fuel use globally in 2025 (technically, up to 50 per cent of sustainable aviation fuel blend is possible to be used with the current aircraft fleet). According to the ReFuelEU aviation regulation, the aviation fuel made

available in the European Union should contain two per cent of sustainable aviation fuel starting in 2025, with this share increasing to six per cent by 2030. According to the CO_2 Act, the blending mandate is to be adopted by way of the bilateral Air Transport Agreement between Switzerland and the European Union. At this time, the starting date of the blending mandate is subject to discussions. Furthermore, the new regulation supports research for technology improvements and especially upscaling technologies, which produce the most environmentally sustainable aviation fuels in the longer term (Article 37a, paragraph 1b, Article 28g, paragraph 8 of the third CO_2 Act and Article 103b of the Aviation Act). The overall analysis about how to reach the long-term target of CO_2-neutral Swiss aviation by 2050 has been published in *FOCA* (2024).

Estimate of mitigation impact

According to the projections (see section II.F.4.7), the minimum sustainable aviation fuel blending mandated by the law corresponds to a mitigation impact of about 425 thousand tonnes of CO_2 in 2030 (see Tab. 9 and CTF-NDC table 5; the mitigation impact for 2020 and 2025 is indicated as 'not applicable' because the policy and measure is either not yet in force or the share of sustainable aviation fuel blend is not yet defined at that time).

II.D.3.14 Further relevant measures

This section provides a brief overview of further measures with limited direct impact on greenhouse gas emission levels, e.g. measures that may indirectly contribute to climate policy goals (e.g. by reducing precursor gas emissions) and measures focusing on non-greenhouse gas emissions that may have favourable side effects on climate change mitigation.

Further measures to promote rail transport

With the opening of the Ceneri Base Tunnel and the commissioning of the four-metre corridor, the project New Rail Links through the Alps has been completed in 2020. However, a ramp-up phase is still needed before the new infrastructure is fully operational and the new productivity and modal shift potential can be exploited fully. The modernisation of the access routes in neighbouring countries is behind schedule, so that favourable production conditions for rail freight transport are not yet available along the entire north-south rail corridor. By building three base tunnels and by upgrading the access routes, Switzerland has managed to bring the north and south of the country – as well as Europe – closer together. Journey times between north and south are reduced by up to one hour for passengers, whilst the flat link increases rail's environmentally-friendly credentials for freight traffic.

Various accompanying measures on the road and rail side are applied at different points in the value chain of freight transport. Without the central instruments (the heavy vehicle charge and the project New Rail Links through the Alps) and the accompanying measures, an additional 800,000 heavy goods vehicles would cross the Alps in Switzerland every year.

The land transport agreement between Switzerland and the European Union secures the Swiss policy and the modal shift efforts in the European context. The European Union respects the Swiss policy objectives and the necessary measures taken (in particular the heavy vehicle charge).

Switzerland is strongly committed to further simplify and strengthen cross-border rail transport. This goal is pursued by reducing obstacles and dismantling existing national requirements. The work to implement the technical pillar of the 4th European Union railway package has been launched. Switzerland is involved in the Netherlands' initiative to promote international passenger rail transport within the framework of a European platform created for this purpose. The Swiss focus lies on improving customer-friendly international ticketing and contributing its experience in the planning of supply-oriented interval timetables and instruments of train path protection.

Greenhouse gas emissions from marine bunker fuels

As a landlocked country, Switzerland operates only a small fleet of ships at the international level. Consequently, greenhouse gas emissions from marine bunker fuels are negligible (see section II.E, Tab. 14) and only include emissions from fuel sold within the borders of Switzerland for international transport on border lakes (such as the Lake Geneva and the Lake Constance) as well as on the Rhine. Nevertheless, within the framework of its membership to the International Maritime Organisation (IMO), Switzerland supports the introduction and further strengthening of obligations to reduce greenhouse gas emissions from international navigation. Switzerland ratifies, as a basic principle, all environmentally relevant international agreements related to international navigation and implements them, as required, in domestic

legislation. On the basis of Article 9 of the Navigation Act (*Swiss Confederation*, 1953), compliance with international agreements and domestic legislation is enforced through inspections by the Swiss Maritime Navigation Office or by its recognised organisations.

Air pollution control measures at cantonal and communal level

The cantons are in charge of the implementation of the Ordinance on Air Pollution Control. Within the transport sector, the most important measures include speed reduction in city areas, parking space management and programmes for renewing bus fleets (installation of particle filters). The annual cantonal motor vehicle tax depends on different parameters such as vehicle weight and engine capacity, which provides an incentive to buy and use cars that are more fuel efficient. Moreover, many cantons have adopted rebate and feebate regimes for cars, based on criteria such as the energy label category, fuel or drive type, and specific CO_2 emissions.

Gothenburg Protocol

In 2005, Switzerland ratified the Gothenburg Protocol to abate acidification, eutrophication and ground-level ozone (under the Geneva Convention on Long-range Transboundary Air Pollution within the framework of the United Nations Economic Commission for Europe). The implementation of this protocol and compliance with the prescribed national emission ceilings contributes to the reduction of ozone and secondary particulate precursors. It also contributes to avoiding emissions of indirect greenhouse gases. Up to the present, Switzerland fulfilled the different commitments which are included. The Gothenburg Protocol was revised in 2012 and the amended protocol has been in force since 2019. The revised version also addresses particulate matter (PM2.5) and black carbon. It contains national emission reduction commitments for sulphur dioxide, nitrogen oxides, ammonia, volatile organic compounds and particulate matter for 2020 and to be maintained beyond. The obligations of the Gothenburg Protocol include the application of best available techniques and emission limits for various industrial and mobile sources, as well as for combustion installations and agriculture. The implementation of the Gothenburg Protocol creates benefits for human health, ecosystems (air, water, soils, vegetation) and materials. According to the 2024 submission of the emission data, Switzerland achieved the national emission reduction commitments.

II.D.4 Industrial processes and product use

II.D.4.1 Overview

Most greenhouse gas reduction policies and measures in the industry sector are implemented under the CO_2 Act and target CO_2 emissions from fossil fuel use. These policies and measures are presented together with the cross-sectoral policies and measures (section II.D.1). The main instruments affecting greenhouse gas emissions from industry are (i) the CO_2 levy on heating and process fuels (section II.D.1.6), (ii) the emissions trading scheme (section II.D.1.7), and (iii) the negotiated reduction commitments (for exemption from the CO_2 levy) (section II.D.1.8).

However, emissions of F-gases and precursor gases – such as NMVOCs – are not tackled by the CO_2 Act. Instead, specific policies and measures have been developed on the basis of the Environmental Protection Act and specified in the Ordinance on Chemical Risk Reduction (*Swiss Confederation*, 2005), the Ordinance on Air Pollution Control (*Swiss Confederation*, 1985), as well as in the Ordinance on the Incentive Tax on Volatile Organic Compounds (*Swiss Confederation*, 1997b). NMVOCs are used as solvents in numerous industries, are contained in many products such as paints, varnishes and various cleaning solutions, and are emitted by industrial processes, product use and by incomplete fuel combustion. If these compounds become airborne, they contribute (together with nitrogen dioxide) to the excessive formation of ground-level ozone (summer smog). In addition, NMVOCs oxidise in the atmosphere within days and are, thus, a source of indirect CO_2 emissions. In order to reduce NMVOC emissions, Switzerland has three policies and measures in place: (i) the international exhaust gas regulations for motor vehicles, which are fully implemented in Swiss regulations and where Switzerland is highly involved in the development (reported under the transport sector, see section II.D.3.8), (ii) the Ordinance on Air Pollution Control for stationary sources (section II.D.4.3), and (iii) the NMVOC incentive fee to reduce diffuse emissions of NMVOCs (section II.D.4.4). Regarding the reduction of F-gas emissions, provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, and NF_3) are in place (section II.D.4.2).

Tab. 10 gives an overview of Switzerland's policies and measures in the industry sector. The following sections provide more details and background information on each policy and measure.

Tab. 10 > Summary of policies and measures in the industry sector. The sector affected is 'industrial processes and product use' for all policies and measures presented in this table.

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
Provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, NF_3) *	All F-gases	Reduction in consumption and emissions of F-gases. The reduction in consumption aims to meet the phase-down schedule for Switzerland under the Kigali-Amendment of the Montreal Protocol.	Regulatory	Implemented (strengthening planned)	Regulations relating to, inter alia, refrigerants, aerosol dispensers, plastic foams, solvents containing PFCs, HFCs or HFEs, extinguishing agents, and SF_6 in electrical distribution equipment.	2003	FOEN, cantons	991 [b]	1 421 [b]	1 940 [b]
Ordinance on Air Pollution Control *	Indirect CO_2	Improvement of air quality through O_3 abatement.	Regulatory	Implemented	Limits for NMVOC emissions of stationary installations, also leading to a reduction of indirect CO_2 emissions.	1986	FOEN, cantons	IE [c]	IE [c]	IE [c]
NMVOC incentive fee *	Indirect CO_2	Improvement of air quality through O_3 abatement.	Economic	Implemented	Market-based instrument to reduce NMVOC emissions, also leading to a reduction of indirect CO_2 emissions.	2000	FOCBS	300	300	300
Obligations in relation to chemical conversion processes (N_2O) *	N_2O	Reduction of N_2O emissions as by-product in the manufacture of chemical substances.	Regulatory	Implemented	N_2O generated as a by-product must be converted in accordance with the state of the art provided this is technically and operationally feasible and economically viable.	2022	FOEN	NA	500	500

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] Values by gas:
2020: HFCs ➔ 965 kt CO_2eq, PFCs ➔ about 0 kt CO_2eq, SF_6 and NF_3 ➔ 27 kt CO_2eq
2025: HFCs ➔ 1,269 kt CO_2eq, PFCs ➔ 13 kt CO_2eq, SF_6 and NF_3 ➔ 139 kt CO_2eq
2030: HFCs ➔ 1,762 kt CO_2eq, PFCs ➔ 17 kt CO_2eq, SF_6 and NF_3 ➔ 162 kt CO_2eq

[c] The estimate of mitigation impact is included under the 'NMVOC incentive fee'.

IE, included elsewhere
FOCBS, Swiss Federal Office for Customs and Border Security; FOEN, Swiss Federal Office for the Environment

II.D.4.2 Provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, NF_3)

The three main lines of action in the area of F-gases are: (i) to limit the use of these substances to those applications where there is no alternative at the current state of technology, (ii) when such substances are used, to reduce emissions as far as possible, and (iii) where feasible, to engage in voluntary binding agreements with industry.

F-gases are regulated in the Ordinance on Chemical Risk Reduction under the name of 'substances stable in the atmosphere', including fluorinated substances, such as HFCs, PFCs, SF_6, NF_3 and HFEs (*Swiss Confederation*, 2005). In particular, Annex 1.5 of the Ordinance on Chemical Risk Reduction contains general provisions to control their use and emissions, labelling requirements for containers and switchgear, and a licensing scheme for the import and export of HFCs (to fulfil Switzerland's obligations under the Kigali Amendment to the Montreal Protocol). Further provisions on specific uses of F-gases are covered in other annexes of the Ordinance on Chemical Risk Reduction (see below).

Refrigerants

Emissions of refrigerants from stationary equipment dominate total F-gas emissions. Therefore, the regulations in Annex 2.10 of the Ordinance on Chemical Risk Reduction most importantly aim at reducing emissions from such stationary equipment. Further provisions are in place to regulate appliances working with F-gases as refrigerants.

Refrigerants containing F-gases have been regulated since 2003. In 2004, the selling of stationary equipment containing more than three kilograms of F-gases has been subjected to a permit, being contingent on the conditions that no alternative at the current state of technology was available and emissions were reduced as far as possible. In 2012, provisions were added that limit refrigerant charges in certain types of equipment. In 2013, a partial ban has replaced the permit mentioned above. This ban applies to the placing on the market of certain types of stationary equipment containing F-gases, depending on the cooling capacity, the global warming potential of the refrigerant, and the sector of use. The ban has been tightened twice, in 2015 and 2019, respectively. In 2019, a restriction to the servicing of stationary equipment with refrigerants with a high global warming potential has been introduced, along with additional bans on certain types of

appliances operating with F-gases where alternatives are available. The state of technology is published and updated regularly after consulting with the sectors concerned. To ensure the transparency and proportionality of the relatively complex system, several technical guidelines relating to the relevant technology and to the implementation of the various measures to improve confinement have been developed in collaboration with cantonal authorities and the sectors concerned.

Aerosol dispensers

In the area of aerosol dispensers, emissions of F-gases (mainly HFCs) are limited by restrictions on use in Annex 2.12 of the Ordinance on Chemical Risk Reduction. Applications for which exemptions are inevitable are medical and pharmaceutical applications, in particular metered dose inhalers. For other applications where these substances may be required, e.g. for safety reasons, the state of technology is changing rapidly, and it seems more appropriate to use the option of granting temporary exemptions based on individual technically justified requests.

Plastic foams

The measures currently implemented in Switzerland with regard to plastic foams (such as restrictions on their use in Annex 2.9 of the Ordinance on Chemical Risk Reduction and further provisions for their disposal by incineration and recycling) limit emissions of F-gases from those foams. F-gases (mainly HFCs) may only be used in plastic insulating foams and under severe restraints: (i) if they offer significant advantages in thermal insulating efficiency in case of spatial constraints and (ii) where non-flammability is required, in agreement with the current state of technology. Rapidly advancing technology requires that the state of technology and application criteria need to be clarified in guidelines developed and updated in collaboration with the producers and professional users, as well as with the cantonal enforcement authorities.

Solvents containing HFCs, PFCs or HFEs

The use of solvents containing HFCs, PFCs or HFEs is currently restricted in Annex 2.3 of the Ordinance on Chemical Risk Reduction to surface treatment installations with specific technical characteristics to reduce emissions. Exemptions can be given to further uses (in practice almost exclusively within the electronic and precision industry), in cases where sound alternative technology is not available. To reduce emissions, consumer goods containing such solvents have been banned.

Extinguishing agents

Since 1996, the supply and import of extinguishing agents made of F-gases and of appliances or stationary equipment containing such agents are banned (Annex 2.11 of the Ordinance on Chemical Risk Reduction). However, temporary exemptions are granted in cases where no viable alternatives are available.

SF_6 in electrical distribution equipment

The use of SF_6 is only authorised in particle accelerators and electrical equipment that operates at more than one kilovolt, whose gas compartment is hermetically sealed or constantly monitored. The emissions of SF_6 from this sector are governed by a voluntary agreement established in 2002 by the high-voltage industry, which was updated in 2014 and 2020.[57] The maximum amount of annual emissions agreed was 4.5 tonnes until 2012, decreasing to 3.65 tonnes in 2020 and to 1.35 tonnes thereafter. Further, recovery of SF_6 from decommissioned equipment must be guaranteed.

Other application sectors

The use of PFCs and SF_6 in tyres, insulating windows and sport shoes has been banned since 2003. SF_6 as protecting gas in magnesium and aluminium smelting was banned as of 31 December 2016. Other uses can be authorised temporarily upon request if it is shown that there is no environmentally superior alternative and that emission levels are kept to a minimum according to the best available techniques.

[57] https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/reduction-measures/sector-agreements/agreement-sf6.html

Furthermore, under Annex I of the Ordinance concerning Lists Regarding the Movement of Waste, waste containing HFCs counts as special waste. Thus, the movement of such waste is controlled, and it must be treated by licensed enterprises in an environmentally sound manner.

Planned strengthening

In order to fulfil Switzerland's obligations under the Montreal Protocol and its Kigali Amendment (in particular the phase down of HFC consumption to 15 per cent of its baseline until the year 2036), the Ordinance on Chemical Risk Reduction is expected to be revised regularly with a view to further restricting the uses of HFC, where the evolving state of technology provides new alternatives. Further details of the planned strengthening are provided in section II.F.4.2 (Tab. 27, description of assumptions under the WAM scenario).

Estimate of mitigation impact

For estimating the mitigation impact, emission scenarios were calculated with and without existing policies and measures (see section II.F.4.2; *Carbotech*, 2024). The emission scenarios cover metal production, electrical equipment, refrigerants, solvents, aerosols, foam blowing, electrical equipment, and others. The dominating sector is refrigeration, contributing roughly 80 per cent in total CO_2 equivalent emissions of substances stable in the atmosphere. Input data for projecting the development of this key sector are the statistics available on currently installed stationary equipment, as well as assumptions on future market growth and leakage rates during operation and disposal. As shown in Tab. 10 and CTF-NDC table 5, the emission modelling suggests a total mitigation impact of 991 thousand tonnes of CO_2 equivalents by 2020, 1,421 thousand tonnes of CO_2 equivalents by 2025, and 1,940 thousand tonnes of CO_2 equivalents by 2030 (see also Tab. 22 and Fig. 53, difference between the WOM and WEM scenarios).

II.D.4.3 Ordinance on Air Pollution Control

The Ordinance on Air Pollution Control is based on the Environmental Protection Act and has been in force since 1986. It contains – beside other prescriptions – emission limits for NMVOCs for stationary installations. It also prescribes that emissions shall be captured as fully and as close to the source as possible and shall be removed in such a way as to prevent excessive ambient air pollution levels. Furthermore, it gives the possibility to the authorities to limit emissions preventively as far as technically and operationally feasible and economically acceptable.

Estimate of mitigation impact

The estimate of mitigation impact is included under the NMVOC incentive fee (section II.D.4.4), and, thus, reported as 'included elsewhere' in Tab. 10 and CTF-NDC table 5.

II.D.4.4 NMVOC incentive fee

The NMVOC incentive fee is defined in the Ordinance on the Incentive Tax of Volatile Organic Compounds, which is based on the Environmental Protection Act, and which has been in force since 1997. The incentive fee has been levied since 1 January 2000, amounting to two Swiss francs per kilogram of NMVOC emitted into the air. Since 2003, the fee has been three Swiss francs per kilogram of NMVOC. As a market-based instrument in the field of environmental protection, it creates a financial incentive to further reduce NMVOC emissions.

Estimate of mitigation impact

As in Switzerland's last submission, the mitigation impact is estimated based on a hypothetical scenario using real activity data and keeping the emission factors constant from 1990 onwards. The determined reduction of about 140 thousand tonnes of (anthropogenic) NMVOC emissions results from the combined impact of the Ordinance on Air Pollution Control (II.D.4.3) and the NMVOC incentive fee. Using a carbon content of NMVOC of 60 per cent, the greenhouse gas mitigation impact – due to the reduction of indirect CO_2 emissions[58] – is about 300 thousand tonnes of CO_2 equivalents in 2020, 2025 and 2030.

[58] This estimate includes fossil and biogenic NMVOC emissions. In contrast to the estimates presented here, the values related to indirect CO_2 emissions provided in the chapter on projections (see section II.F.4.6) only consider fossil carbon and strictly avoid double counting. However, in 1990 almost 80 per cent of NMVOC emissions resulted from the use of solvents anyway.

II.D.4.5 Obligations in relation to chemical conversion processes (N_2O)

Since 1 January 2022, N_2O has been regulated under the Ordinance on Chemical Risk Reduction (*Swiss Confederation*, 2005). This means that companies in the chemical industry have to avoid their N_2O emissions by technical means. According to Annex 1.5 (Number 9, paragraph 2) of the Ordinance on Chemical Risk Reduction, any facility that produces chemical substances such as nitric acid, caprolactam, nicotinic acid (niacin) etc. with N_2O as by-product must convert it in accordance with the state of the art provided this is technically and operationally feasible and economically viable. This amendment to the Ordinance on Chemical Risk Reduction is the political and legislative response to the discovery of a previously unknown source of N_2O from the niacin production process at a specific chemical plant.

Estimate of mitigation impact

With the catalyst installed at the respective chemical plant in the course of autumn 2021 about 99 per cent of N_2O emissions can be avoided (based on monitoring reports in the framework of the emissions trading scheme), corresponding to about 500 thousand tonnes of CO_2 equivalents per year. Accordingly, in Tab. 10 and in CTF-NDC table 5, the mitigation impact of the obligation in relation to chemical conversion processes (N_2O) is indicated as 500 thousand tonnes of CO_2 equivalents for 2025 and 2030 and as 'not applicable' for 2020 (as the policy and measure was implemented after 2020).

II.D.5 Agriculture

II.D.5.1 Overview

Articles 104 and 104a of the Federal Constitution of the Swiss Confederation form the basis for agricultural policy in Switzerland. They mention sustainability as one of the guiding principles. The Agriculture Act, which came into force in 1999, provides a framework for sustainable development in the agriculture sector. In its Article 2, as amended in 2014, it stipulates that the federal government shall, inter alia, take measures to promote the sustainable use of natural resources as well as animal-friendly and climate-friendly production.

Greenhouse gas emissions in agriculture strongly depend on the portfolio of activities chosen by farmers. An important parameter influencing this decision is the relative economic profit achievable by the different activities. Their attractiveness depends on the price level of agricultural goods and services as well as on the mode and level of agricultural subsidies. Agricultural policy, as it is designed in Switzerland, influences both, prices of agricultural products and subsidies and is therefore an important factor determining the amount of greenhouse gas emissions.

Tab. 11 gives an overview of Switzerland's policies and measures in the agriculture sector. The following sections provide more details and background information on each policy and measure.

Tab. 11 > Summary of policies and measures in the agriculture sector. The sector affected is 'agriculture' for all policies and measures presented in this table (however, some policies and measures may also influence the greenhouse gas balance of agricultural soil as reported in the land use, land-use change and forestry sector).

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
Reduction pathway on nutrients *	CH_4, N_2O, CO_2	Legal reduction targets for nitrogen surpluses.	Regulatory, voluntary	Implemented	Aim to reduce nutrient losses of nitrogen by 15 per cent and phosphorus by 20 per cent by 2030 compared to the 2014–2016 average, with additional voluntary target agreements by the sector.	2023	FOAG	NA [b]	IE [b]	IE [b]
Direct payments *	CH_4, N_2O, CO_2	More targeted direct payments.	Economic	Implemented	Abolition of unspecific direct payments (livestock subsidies, general acreage payments). Additional funds for environmentally-friendly production systems and for the efficient use of resources, e.g. increase in nutrient efficiency and ecological set-aside areas, reduction of ammonia emissions.	2014	FOAG	300	350	400

Proof of ecological performance to receive direct payments *	CH_4, N_2O, CO_2	Ecological requirements for direct payments.	Regulatory	Implemented	Direct payments are contingent on appropriate soil nutrient balance, suitable proportion of ecological compensation areas, crop rotation system, soil protection, selective application of crop protection agents, and animal husbandry in line with legal provisions.	Early 1990s	FOAG	700	750	800
Resource programme (subsidies for a more efficient use of natural resources)	CH_4, N_2O, CO_2	Promotion of efficient use of natural resources.	Economic	Implemented	Subsidising measures for more efficient use of natural resources such as nitrogen, phosphorous and energy, protection and sustainable use of soils, and biodiversity. To qualify for subsidies, measures must go beyond legal requirements or the criteria for other funding programmes.	2008	FOAG	NE [c]	100	100
Structural improvement measures *	CH_4, N_2O, CO_2	Promotion of sustainable agricultural structures.	Economic	Implemented (strengthening planned)	Support of measures in civil engineering, building construction and farm development with non-repayable contributions or repayable interest-free investment loans.	2008	FOAG	NE [d]	NE [d]	NE [d]
Notification requirement for the trade in nutrients	CH_4, N_2O, CO_2	Reporting obligation for sellers of fertilisers and concentrated feed.	Regulatory	Adopted	Notification requirement for nitrogenous and phosphorus fertilisers and concentrated feed in addition to farmyard and recycled fertilizers, and recording in a web application.	2025	FOAG	NA [e]	NA [e]	NA [e]
Climate strategy for agriculture and food *	CH_4, N_2O, CO_2	Long-term mitigation and adaptation in the sector.	Information, planning	Implemented (strengthening planned)	Declaration of intent to reduce greenhouse gas emissions of agriculture by at least 40 per cent by 2050 compared to 1990 and greenhouse gas footprint of food per capita by at least two third by 2050 compared to 2020. Framework for the development, testing and implementation of specific future measures in mitigation and adaptation.	2011	FOAG, FOEN, FSVO	IE [f]	IE [f]	IE [f]

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] As most of the mitigation impact is provided by specific measures that are implemented under the direct payments and the proof of ecological performance to receive direct payments, the mitigation impact for the reduction pathway on nutrients is reported as 'included elsewhere' (or as 'not applicable' in case the policy and measure is not in force at that time).

[c] In 2020, the projects on the mitigation of greenhouse gas emissions only targeted a small number of pilot farms. The mitigation impact was not estimated, but it is expected to be negligible.

[d] As there is only limited evidence concerning the environmental impact of the supported projects, the mitigation impact is indicated as 'not estimated'.

[e] As the policy and measure increases transparency and controllability, however, with no direct effect on greenhouse gas emissions, the mitigation impact is reported as 'not applicable' (in 2020, the policy and measure was not yet in force).

[f] As the climate strategy for agriculture and food sets the framework for further polices and measures that are already in place or will need to be implemented in the future, the mitigation impact is reported as 'included elsewhere'.

IE, included elsewhere; NA, not applicable; NE, not estimated
FOAG, Swiss Federal Office for Agriculture
FOEN, Swiss Federal Office for the Environment
FSVO, Swiss Federal Food Safety and Veterinary Office

II.D.5.2 Reduction pathway on nutrients

The nutrient balance of Swiss agriculture shows a surplus of nitrogen and phosphorus. This surplus has remained more or less constant for years. In the case of nitrogen, the surplus largely corresponds to the losses to the environment. In order to reduce these negative effects, the Swiss Federal Council adopted the nutrient reduction pathway in 2022 as part of a parliamentary initiative (19.475). The aim is to reduce nutrient losses of nitrogen by 15 per cent and phosphorus by 20 per cent by 2030 compared to the 2014–2016 average (in accordance with the Ordinance on the Assessment of

Sustainability in Agriculture). The federal government uses the methods of the Convention for the Protection of the Marine Environment of the North-East Atlantic to estimate the nutrient surpluses in agriculture throughout Switzerland. This method corresponds to a farm gate or input-output balance. The entire agricultural sector in Switzerland is considered as one farm and the nutrient input is compared with the nutrient output from agriculture.

The nutrient reduction pathway should lead to more efficient and sustainable agriculture in terms of nutrients. In addition to measures adopted in the direct payments and the strengthening of the proof of ecological performance to receive direct payments (see sections II.D.6.3 and II.D.6.4), the sector should take self-determined measures that support the reduction path. To this end, organisations can conclude target agreements with the Swiss Federal Office for Agriculture on a voluntary basis. These set out the targets and measures and define the reporting. Committed organisations regularly report to the Swiss Confederation on their measures and the progress they have made. These organisations are explicitly listed on the website and in the agricultural report of the Swiss Federal Office for Agriculture.[59] By the end of 2023, six organisations have concluded a target agreement, covering the production of fruits, potatoes, sugar beet, pig, poultry and eggs.

Estimate of mitigation impact

With regard to the reduction pathway on nutrients, most of the mitigation impact is provided by specific measures that are implemented under the direct payments (see section II.D.5.3) and the proof of ecological performance to receive direct payments (see section II.D.5.4). Therefore, the mitigation impact for the reduction pathway on nutrients is reported as 'included elsewhere' in Tab. 10 and CTF-NDC table 5 (or as 'not applicable' in case the policy and measure is not in force at that time). The mitigation impact of the self-determined measures by the sector and the translation in reductions of greenhouse gases cannot currently be quantified, but is estimated to be small.

II.D.5.3 Direct payments

In 2013, the Swiss Parliament adopted the agricultural policy 2014–2017. The key element of this quadrennial programme for agriculture was the further development of the direct payments system. Measures with unspecified aims have been replaced by specific tools. Subsidies for livestock have been converted to subsidies for ensuring food security, dependent on land use. The funds freed by the abolishment of the general acreage subsidy have been used, inter alia, for new direct payment types for environmentally-friendly production systems and for the efficient use of resources. Concretely, payments have been made for e.g. organic farming, grassland-based ruminant production, conservative soil cultivation, as well as for precise application of fertiliser and plant protection agents. The legal framework of the agricultural policy 2014–2017 has been designed in a way that has enabled the inclusion of further elements under the new direct payment types by adjusting the corresponding ordinance. In 2017, the Swiss Parliament has adopted the continuation of the agricultural policy, setting the financial framework for the period 2018–2021. Further, with the payments for differentiated feeding of pigs according to age and nutritional needs (phase feeding with protein-reduced feed (NPr)), another element has been introduced.

In its session of spring 2021, the Swiss Parliament decided to suspend the agricultural policy from 2022 (AP22+) and only approved the payment framework for the period 2022–2025 on 3 June 2021. At the same time, Parliament approved legal changes as part of the parliamentary initiative 'Reducing the risk of pesticide use' (19.475, *Swiss Confederation*, 2019). On 13 April 2022, the Swiss Federal Council adopted the first package of ordinances for clean drinking water and more sustainable agriculture, which implements the main part of the above-mentioned parliamentary initiative. Thanks to the new provisions, the environment will be better protected from the effects of plant protection products and nutrient surpluses. Further production system contributions were introduced: (i) for adequate land cover, the efficient use of nitrogen (since 2023), and (ii) the longer useful life of cows (since 2024). Parliament also resumed discussions on AP22+ in 2022 and adopted it in its session of summer 2023.

Estimate of mitigation impact

In a simplified way it can be assumed that, for 2020, the mitigation impact of the direct payments corresponds to the difference between the WEM and the WOM scenarios (see section II.F.4.3), i.e. about 300 thousand tonnes of CO_2 equivalents. The adjustments in the direct payments system made with the parliamentary initiative are expected to lead to an additional reduction of emissions by 100 thousand tonnes of CO_2 equivalents as of 2030. Accordingly, the mitigation

[59] See https://www.agrarbericht.ch and www.blw.admin.ch/blw/en/home.html.

impact is reported as 300, 350 and 400 thousand tonnes of CO_2 equivalents for the years 2020, 2025 and 2030 respectively in Tab. 11 and CTF-NDC table 5.

II.D.5.4 Proof of ecological performance to receive direct payments

Direct payments (see section II.D.5.3) are tied to ecological standards, i.e. farmers are eligible for payments only if they fulfil the so-called proof of ecological performance. This is the case when the nutrient balance is maintained, a suitable proportion of farmland is managed as ecological compensation area, a crop rotation system is in place, soil protection is given due consideration, crop protection agents are chosen and applied selectively, and livestock is kept in accordance with legal regulations and animal welfare requirements. Since direct payments are an essential part of the income for most farmers, the proof of ecological performance is widespread. Around 90 per cent of all farms receive direct payments and are thus managed according to the guidelines of the proof of ecological performance.

The nutrient balance is calculated using the 'Suisse-Bilanz' method, whereby the permitted amount of phosphorus and nitrogen is based on plant requirements and the farm's management potential. Until 2023, error ranges of plus 10 per cent could be applied. Together with the adoption of the reduction pathway on nutrients (see section II.D.6.2), this requirement was tightened. The error ranges of plus 10 per cent for nitrogen and phosphorus were removed. The nutrient balance may therefore be completed at a maximum of 100 per cent since 2024. A further requirement was introduced with the revision of the Ordinance on Air Pollution Control. Accordingly, air pollution caused by the storage and spreading of liquid farmyard manure must be limited. Since 2022, liquid farmyard manure must be stored with low emissions, i.e. open slurry and digestate tanks require a cover. Remediation periods of six to eight years are granted for situations requiring structural adjustments. Since 2024, liquid farmyard manure must be applied in a low-emission way.

Estimate of mitigation impact

It is assumed that the introduction of the proof of ecological performance was the main driver for the reductions in agricultural greenhouse gas emissions in the 1990s and early 2000s (about 700 thousand tonnes of CO_2 equivalents). The impact of the introduction of the proof of ecological performance to receive direct payments is clearly reflected in substantial decreases of the main drivers of agricultural greenhouse gas emissions during this time period. Indeed, total cattle decreased by 14 per cent from 1990 to 2000, while total commercial fertiliser decreased by 24 per cent over the same time period (see also Fig. 60). However, other factors like increased production efficiency and price signals certainly also have contributed to these trends. Therefore, the estimate may represent an upper limit. It is estimated that the tightening of the proof of ecological performance in the early 2020s will contribute to further emission reductions of around 100 thousand tonnes of CO_2 equivalents until 2030. Accordingly, the mitigation impact is reported as 700, 750 and 800 thousand tonnes of CO_2 equivalents for the years 2020, 2025 and 2030, respectively, in Tab. 11 and CTF-NDC table 5.

II.D.5.5 Resource programme (subsidies for a more efficient use of natural resources)

On the basis of an amendment to the Agriculture Act in 2008, a new instrument called resource programme was introduced. Through this programme, the federal government is subsidising the implementation of technical, organisational and structural innovations for the more efficient use of natural resources in agriculture within a region or a sector. Target areas are resources such as nitrogen, phosphorous and energy, protection and sustainable use of soils, and biodiversity. To qualify for subsidies, measures must go beyond legal requirements or the criteria for other funding programmes. Support is given to measures that need financial support in an introductory phase, but that will run without further payments afterwards. Therefore, payments are restricted to six years. The requirements for projects eligible under the resource programme have been revised in 2014. More emphasis has been given to innovation and accompanying research. With that, the variety of projects has been enhanced and the transfer of know-how beyond the project has been improved. The knowledge and experience gained in the projects is used to further develop agriculture and agricultural policy with regard to sustainability.

By the end of 2023, a total of 53 projects were launched. A total of 27 of these projects have been completed, including two in the area of reducing greenhouse gas emissions. One project focused on regular greenhouse gas balancing of the participating farms. Based on this, farmers were advised and supported in the implementation of reduction measures. In the other project, a catalogue of measures with a score system in which one point corresponded to one tonne of CO_2 equivalents reduced was tested on pilot farms. The score system was then implemented on all label farms. Other projects in relation to greenhouse gas emissions are focusing on nitrogen use efficiency, agroforestry and use of organic soils.

Two projects with a focus on reduction of greenhouse gas emissions from milk production and soil carbon sequestration started in 2022 and 2024 respectively.[60]

Estimate of mitigation impact

The specified targets and measures, as well as the spatial dimension and the participation of farms can vary considerably between different projects. However, since most of the projects work with a small pilot group only, the direct impact of the resource programme is limited. In the projects with a focus on the mitigation of greenhouse gas emissions, the mitigation impacts were calculated at farm level using tools that follow a life-cycle analysis and that are therefore not consistent with the territorial principle of the greenhouse gas inventory. The mitigation impact of projects focusing on related aspects cannot be estimated due to a lack of specific information.

In the project focusing on regular greenhouse gas balancing, greenhouse gas emissions of the participating 21 farms amounted to around six thousand tonnes of CO_2 equivalents in the initial situation. Within six years, a reduction of five per cent was achieved after adjusting for growth effects. In the second project, a catalogue of measures with a score system could be developed on 33 farms. Towards the end of the respective project, the score system was extended to all about 9,000 label farms. As of March 2022, around 5,303 farms have provided plausible data that indicate an overall reduction of greenhouse gas emissions of around 113 thousand tonnes of CO_2 equivalents compared to 2016. In the third project that focuses on the reduction of greenhouse gas emissions in milk production, greenhouse gas emissions are to be reduced by 20 per cent by 2027 on the 232 participating farms. In the initial situation, a total of 62 thousand tonnes of CO_2 equivalents was calculated across all farms. If the target is achieved, the savings will amount to a good 12 thousand tonnes of CO_2 equivalents. All in all, assuming that the projects achieve their targets, but that the life-cycle analysis leads to an overestimation of the impact and that part of the impact is due to deadweight effects of the other measures, a reduction effect of roughly 100 thousand tonnes of CO_2 equivalents can be expected for the years 2025 and 2030. For 2020, however, the projects on the mitigation of greenhouse gas emissions only targeted a small number of pilot farms. The mitigation impact was not estimated, but is expected to be negligible.

Accordingly, the mitigation impact is reported as ‘not estimated’ for the year 2020 and as 100 thousand tonnes of CO_2 equivalents for the years 2025 and 2030 in Tab. 11 and CTF-NDC table 5. Due to methodological constraints, this impact is not modelled in the projections.

II.D.5.6 Structural improvement measures

In addition to strengthening rural and mountain areas, the structural improvement measures of the Swiss Confederation and the cantons aim to (i) improve the operational competitiveness of farms as well as living and working conditions on farms, (ii) maintain and strengthen agricultural production capacities in a targeted manner, and (iii) promote food production that respects the environment and animal welfare. In particular, measures in civil engineering and measures in building construction and farm development are supported with non-repayable contributions or repayable, mostly interest-free investment loans. Measures have been added over time. Buildings, installations and facilities for the production of sustainable energy that are not supported by other federal funding programmes and which are mainly used for self-supply can be supported with investment aid since 2008. Construction measures that lead to a reduction in ammonia emissions can be supported since 2018.

Planned strengthening

Another amendment to the Ordinance on Structural Improvements is planned to come into force in 2025. The purchase of field robots and electric motorised mowers and agricultural tractors without fossil fuels is promoted on this basis.

Estimate of mitigation impact

To date, there is only limited evidence concerning the environmental impact of the supported projects. Therefore, the mitigation impact for the structural improvement measures is reported as ‘not estimated’ in Tab. 10 and CTF-NDC table 5.

[60] For background information on the resource programme, see the following website: https://www.blw.admin.ch/blw/de/home/instrumente/ressourcen--und-gewaesserschutzprogramm/ressourcenprogramm.html.

II.D.5.7 Notification requirement for the trade in nutrients

In 2021, Parliament passed a notification requirement for the trade in and use of plant protection products and the trade in nutrients. This was triggered by the popular initiatives for clean drinking water and healthy food ('Drinking Water Initiative') and for a Switzerland without synthetic pesticides ('Pesticides Initiative'), which have since been rejected by the population. The Swiss Federal Office for Agriculture is developing the digiFLUX web application in close consultation with future users to implement the notification requirement. The notification requirement will apply to nitrogenous and phosphorus fertilisers and concentrated feed in addition to farmyard and recycled fertilizers. In the case of concentrated feed, the takeover of feed grain from another farm, for example, or its return, e.g. by feed manufacturers, is also subject to notification.

DigiFLUX will be introduced in several stages. From January 2025, retailers, agricultural businesses, contractors, green space and infrastructure operators will be able to test digiFLUX and record deliveries of plant protection products at their own request. From January 2026, the reporting obligation will apply to trade in plant protection products, fertilisers and concentrated feed.

Estimate of mitigation impact

The notification requirement applies to key inputs that are related to agricultural greenhouse gas emissions. The policy and measure increase transparency and controllability, however, it has no direct effect on greenhouse gas emissions. Accordingly, the mitigation impact is reported as 'not applicable' in Tab. 11 and CTF-NDC table 5.

II.D.5.8 Climate strategy for agriculture and food

Switzerland's climate strategy for agriculture and food was published in fall 2023 (*FOAG, FOEN, FSVO*, 2023). It replaces the strategy of 2011 (*FOAG*, 2011). The new strategy considers the entire food system from agriculture to food consumption. It's about reducing emissions of greenhouse gases and adapting to climate change. The strategy was developed by three federal offices: the Swiss Federal Office for Agriculture, the Swiss Federal Food Safety and Veterinary Office and the Swiss Federal Office for the Environment. The strategy consists of two parts: (i) part one sets out principles, objectives and direction, and (ii) part two describes measures in the horizon to 2030. In the horizon to 2050, Switzerland is pursuing three overall objectives for the food system that are consistent with Switzerland's climate strategy for agriculture and food (see *FOAG, FOEN, FSVO*, 2023):

- (1) Domestic agricultural production is adapted to the climate and location. It takes into account the production potential of the location and the carrying capacity of the ecosystems. The degree of self-sufficiency is to be kept stable at 50 per cent despite increasing population growth;
- (2a) The population eats a healthy, balanced diet that corresponds to the recommendations of the Swiss food pyramid and the greenhouse gas footprint per capita is reduced by at least two thirds compared to 2020;
- (2b) Greenhouse gas emissions from domestic agricultural production are reduced by at least 40 per cent compared to 1990.

The overall goals are to be achieved via eight sub-goals. Corresponding measures were developed for these sub-goals in the second part of the strategy. The sub-goals cover the following areas: consumption patterns, food waste, trade relations, production portfolio, nutrients, water, soil and energy. The action plan contains 42 measures. The plan serves as a guideline for the administration and policymakers. The measures are specified by the responsible federal office within the framework of the respective sectoral policy and implemented in projects. Some of the measures can be implemented using existing legislation, while others require amendments to ordinances or laws. In the case of the latter, the Swiss Federal Council and Parliament will ultimately decide whether and how they are to be implemented.

Estimate of mitigation impact

The climate strategy for agriculture and food is a declaration of intent to guide agriculture and food production in Switzerland in the efforts to reduce greenhouse gas emissions and to adapt to a changing climate. It does not have a direct and immediate mitigation impact, but sets the framework for further polices and measures that are already in place or will need to be implemented in the future. Accordingly, the mitigation impact is reported as 'included elsewhere' in Tab. 11 and CTF-NDC table 5.

II.D.6 Land use, land-use change and forestry

II.D.6.1 Overview

There is a long tradition of forest protection in Switzerland. The first Forest Act came into force in 1876. It covered the alpine region and its aim was to put a halt to deforestation, to secure the remaining forest area, to manage it in a sustainable way, and to promote afforestation. The Forest Act of 1902 covered the whole country. The forest acts have resulted in an increase of the forested area in Switzerland from 0.7 million hectares in the mid-19th century to over 1.3 million hectares today (*Brändli et al.*, 2020). Switzerland's total forest area continues to increase, although the changes in forest area vary significantly from region to region. The strongest increase in forest area can be observed in the Alps and in the Southern Alps. The forest area in the Central Plateau is relatively stable.

Due to the age structure, large fractions of the Swiss forest are mature for harvesting. Consequently, the levels of harvesting should rise in the near future. On one hand, this contributes to avoiding episodic large quantities of greenhouse gas emissions originating from decay, should an excessive accumulation of carbon stocks be disturbed by drought, fires, storms, or insect attacks. On the other hand, as the forest, its products and services could be broadly affected by climate change, there is a need to support forests to adapt to climate change. Adaptation processes in forests are best induced through regeneration.

In Switzerland, the climate-related goals of forest policy are to adapt forests by increasing resilience to climate change and – taking into account the high growing stock – to reduce CO_2 emissions by substituting other materials or fossil fuels rather than enhancing the forest sink capacity. The highest possible substitution effect can be achieved through the principle of cascaded use of wood. With the planned step-by-step phase-out of nuclear energy, renewable energy sources will play a crucial role for the nationwide energy supply (see Energy Strategy 2050 as addressed in section II.D.2.1). This development is likely to lead to a more intensive use of energy wood and an increase in timber harvesting.

The most recent changes in the Federal Act on Forest (in force since 1 January 2017) pursue the above-mentioned goals and strengthen the measures concerning adaptation to and mitigation of climate change. Furthermore, new instruments for the prevention and abatement of harmful organisms have been defined in the latest revision.

Among others, mitigation of climate change is a major objective of the Forest Act and the Forest Policy, which form both part of the legislative arrangements and administrative procedures. At the same time, by applying sustainable forest management practices in Swiss forests, complete use of the wood harvesting potential and conservation of biodiversity are envisaged. The objective of mitigating climate change includes the optimisation of the climate protection services of Swiss forest (*FOEN*, 2021b). These climate protection services comprise (i) the sequestration of carbon in the forest ecosystem, (ii) the carbon fixation in long-living harvested wood products, and (iii) the substitution of fossil fuels by using fuel wood or by replacing energy-intensive construction materials like steel by wood (material substitution). The climate protection services ensure sustainable use of the natural resource 'wood'.

Tab. 12 gives an overview of Switzerland's policies and measures in the land use, land-use change and forestry sector.[61] The following sections provide more details and background information on each policy and measure.

Tab. 12 > Summary of policies and measures regarding land use, land-use change and forestry sector. The sector affected is 'forestry/LULUCF' for all policies and measures presented in this table.

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
Forest Act (sustainable forest management and forest area conservation) *	CO_2	Limiting harvest to size of growth increment in forests, obligation to compensate for any deforestation.	Regulatory	Implemented	Ban on clearcutting, no deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity.	1876 [b]	FOEN, cantons	NE [c]	NE [c]	NE [c]

[61] Many sectoral policies and measures influence land use in Switzerland in different ways. None of them was primarily designed as a climate protection measure in the land use, land-use change and forestry sector, and their effects on greenhouse gas fluxes are generally difficult to allocate, sometimes contradictory and hardly quantifiable on a national scale. For this reason, only policies and measures addressing the forest and timber sector are presented.

Wood Action Plan (implementation of Swiss Wood Resource Policy) *	CO_2	Ecologically and economically effective use of wood.	Information, education, research	Implemented	Policy package implementing Forest Policy in the area of better use of the wood harvest potential. Primary fields of action are 'Swiss wood value added' and 'climate-appropriate buildings', and the cross-cutting themes communication and innovation.	2009	FOEN	IE [d]	IE [d]	IE [d]
Measures within Forest Policy (objectives and implementation) *	CO_2	Promote the use of wood and the substitution of carbon-intensive resources.	Information	Implemented	Improvement of conditions for an efficient and innovative forestry and wood industry. Targets for the consumption of sawn timber and timber products and for CO_2 emission reductions through enhanced use of wood. Long-term target of a CO_2 balance between forest sink, wood use and wood substitution effects. Given the current age structure of Swiss forests, this implies aiming at increased harvesting rates over the coming years.	2011	FOEN, cantons	1 200	1 200	1 200
Forest Act (changes due to revision 2017) *	CO_2	Promote the use of wood and the substitution of carbon-intensive resources. Precautionary measures against climate change.	Regulatory, Information	Implemented	New legal base for Wood Action Plan (see above) and new legal instrument to promote the use of sustainably produced timber for the construction of federal buildings. Adaptation measures with the aim to increase the adaptive capacity of Switzerland's forests and combating invasive species.	2017	FOEN, cantons	NE [e]	NE [e]	NE [e]

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] First implemented in 1876, main revisions and extensions in 1902 and 1993.

[c] See section II.D.6.2 for a qualitative discussion of the mitigation impact.

[d] The respective effects are included under the measures within Forest Policy (objectives and implementation). Reductions result from substitution of other materials or fossil fuels (and thus impact emissions outside the land use, land-use change and forestry sector). While these indirect reductions are not included in the modelling of emissions (see section II.F.4.4), the value of 1,200 thousand tonnes of CO_2 equivalents only includes the substitution effect and does not reflect the corresponding reduction of carbon storage by the forest.

[e] See section II.D.6.5 for a qualitative discussion of the mitigation impact.

IE, included elsewhere; NE, not estimated
FOEN, Swiss Federal Office for the Environment

II.D.6.2 Forest Act (sustainable forest management and forest area conservation)

The Forest Act, as revised in 1993, reaffirms the long-standing Swiss tradition of preserving both forest area and forests as natural ecosystems. It prescribes sustainable forest management, prohibits clearcutting, and bans deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. At an average increment of 10.8 million cubic metres per year and an average of cut and mortality of 9.2 million cubic metres per year, 1.6 million cubic metres remain unlogged annually (values for survey periods of NFI3/2004–2006 and NFI4/2009–2017; *Brändli et al.*, 2020) – mainly in forests that are difficult to access and in forest reserves. The federal authorities would like to increase Switzerland's annual wood harvest since the forests' sustainable potential for supplying domestic construction and energy wood is not being exploited completely. Specific measures aiming, inter alia, at the better exploitation of the existing potential of wood as a renewable resource are described below (sections II.D.6.3 to II.D.6.5).

Estimate of mitigation impact

There are no quantitative estimates available, but the impact is assumed to be positive (see qualitative evaluation in sections II.D.6.3 and II.D.6.5). It is difficult or nearly impossible to define scenarios including elements like 'avoiding natural disturbances' or 'adaptation of forests' because such scenarios would include a lot of speculative assumptions. Moreover, while the mitigation impacts of these elements are quite important for forest ecosystem functioning, they are

only of minor importance for Switzerland's current national CO_2 budget. Therefore, no quantitative information is provided. Clearcutting is prohibited, unless in special cases where it can be proven that important reasons exist for the deforestation that outweigh the interests of forest conservation. This very restrictive approach limits deforestation in Switzerland to an absolute minimum. Further, the deforested area must be replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. Therefore, deforestations do not significantly contribute to the CO_2 balance of Swiss forests. The active promotion of wood will have a positive impact on the pool of harvested wood products (more carbon stored), but will have a reverse impact on the carbon stored in the forest.

II.D.6.3 Wood Action Plan (implementation of Swiss Wood Resource Policy)

The Swiss Wood Resource Policy (first initiated in 2008, updated in 2014, 2017 and 2021; see e.g. *FOEN/SFOE/SECO*, 2021) supports Switzerland's sustainable development strategy. It makes significant contributions to forest, climate, energy and regional policy and other sectoral policies, and also to the sustainable development goals of the United Nations. The Swiss Federal Office for the Environment is the lead agency for this policy. It is implemented with relevant partners mainly by the Wood Action Plan with its two priority areas: (i) 'Swiss wood value added' (i.e. to revitalise and develop Swiss forestry and timber value added networks as well as the market for wood from Switzerland's forests) and 'climate-appropriate buildings', and (ii) the cross-cutting themes 'communication and innovation'. In 2021, a new programme phase of the Wood Action Plan has started (2021–2026).

Estimate of mitigation impact

There are no quantitative estimates available, but the overall mitigation impact of the Wood Action Plan is assumed to be positive. The promotion of 'climate-appropriate buildings' increases the carbon stored in the pool of harvested wood products. It is a challenge to define and model a scenario including the goal 'climate-appropriate buildings' because this would include a lot of speculative assumptions. Therefore, only a descriptive and not a quantitative estimate is provided. With the aim of using wood for material purposes and afterwards for energetic purposes, the carbon stored in long-living harvested wood products will increase and therefore the overall mitigation impact is estimated to be positive. Only mitigation impacts of harvested wood products can be accounted for in the land use, land-use change and forestry sector. The mitigation impact of substitution effects is reflected indirectly in the energy sector.

II.D.6.4 Measures within Forest Policy (objectives and implementation)

The Forest Policy 2020, which was approved by the Swiss Federal Council in 2011, is a strategic document built on the Forest Act of 1993 and the Forest Ordinance of 1992 and designed to trigger improvements to it. Consequently, the Forest Act and Forest Ordinance have been updated in 2017 (see section II.D.6.5) based on an intermediate evaluation of the Forest Policy 2020. For the period after 2020, the Forest Policy was continued with updated and complemented measures for the period 2021–2024 and defined as 'Forest Policy: objectives and measures 2021–2024' (*FOEN*, 2021b).

The Forest Policy ensures sustainable forest management while creating favourable conditions for an efficient and innovative forestry and wood industry. The policy sets out eleven strategic objectives. It identifies five objectives that pose the greatest challenges: (i) exploiting the potential sustainable wood supply, (ii) contributing to mitigation of, and enhancing resilience to, climate change, (iii) maintaining the protective forest services, (iv) increasing biodiversity by conserving forests as near-natural ecosystems, and (v) conservation of the forest area in its spatial distribution.

The Forest Policy contains a comprehensive set of strategic and specific measures, indicators and target values that go with every objective. Some examples related to mitigation are (i) under the Forest Policy, the consumption of sawn timber and timber products should be increased by 20 per cent by 2030 compared to 2008 levels, (ii) at the same time, the substitution effect through enhanced use of wood should be increased by 1.2 million tonnes of CO_2 equivalents per year compared to 1990 (*FOEN*, 2007), and (iii) in the long term, a sustainable equilibrium between forest sink, wood use and wood substitution effects is sought.

In 2022, the Swiss Federal Council has commissioned the Swiss Federal Office for the Environment to develop an integral strategy, based on the current policies 'Forest Policy: objectives and measures 2021–2024' (*FOEN*, 2021b) and 'Wood Resource Policy 2030'. This 'Integral forest and timber strategy 2050' will merge the current policies and replace them from 2025 onwards. The development and implementation of this strategy is based on the principle of a joint task with the Swiss Confederation and the cantons, but also with the relevant players in the forest and timber sector. The new strategy aims to achieve a balance between protection and utilisation aspects, taking into account relevant sectoral policies

(climate, energy, biodiversity, spatial planning, regional economy, agriculture, circular economy, security, bioeconomy, etc.).

Estimate of mitigation impact

According to the Forest Policy, the mitigation impact by substitution is estimated at 1.2 million tonnes of CO_2 equivalents (see page 48 in *FOEN*, 2021b; value based on *FOEN*, 2007). For a qualitative evaluation see sections II.D.6.3 and II.D.6.5. The estimated mitigation impact of 1.2 million tonnes of CO_2 equivalents results from the use of wood for materials and energy and includes the mitigation impacts achieved in other sectors, e.g. when wood replaces fossil fuels or CO_2-intense materials (such as cement and steel) in energy industry, building and housing, industrial processes, etc. This may thus lead to some overlap with the individual estimates of the mitigation impacts for policies and measures affecting these other sectors, however, double counting is carefully avoided for the projections (as the mitigation impact resulting from substitution of materials and fossil fuels is not accounted for in the WEM and WAM scenarios of the land use, land-use change and forestry sector). The envisaged increase of the consumption of sawn timber and timber products will result in a decrease of carbon stored in the forest, but will in exchange increase the amount of carbon stored in long-living harvested wood products. Due to the lack of further information, the mitigation impact of 1.2 million tonnes of CO_2 equivalents according to *FOEN* (2007) is reported for 2020, 2025 and 2030.

II.D.6.5 Forest Act (changes due to revision 2017)

In 2017, a revised version of the Forest Act entered into force. The revised Forest Act foresees measures to promote timber which was produced sustainably and in close-to-nature silvicultural systems. A goal of these measures to promote timber is reducing CO_2 emissions through the use of harvested wood products. Since 2017, the Swiss government has been required, if suitable, to use domestic wood in its own building projects that complies with the above-mentioned criteria. Further, Article 28a of the revised Forest Act – entitled 'precautionary measures against climate change' – is the first legal provision in a federal sector law that explicitly addresses the issue of forest adaptation to climate change. With the revised Forest Act the Swiss government financially supports adaptation measures with the aim to increase the adaptive capacity of Switzerland's forests (see also section 6.3.8 of Switzerland's eighth national communication and fifth biennial report). Further, the revised Forest Act allows for taking measures to combat invasive species outside of protective forests. Non-native pests – such as the Asian longhorn beetle, whose numbers have recently increased – will be controlled.

Estimate of mitigation impact

There are no quantitative estimates available, but the overall mitigation impact of the Forest Act (changes due to revision 2017) is assumed to be positive:

- In the medium to long term, climate change mitigation efforts cannot be sustained without adaptation. Adaptive forest management in Switzerland aims to avoid major emissions from collapsing forest stands that are not adapted to climate change. The Forest Act prescribes to prepare Swiss forests for future climate conditions by adaptation measures. In pursuing this objective, increased short-term emissions from forest management are to be expected, but in the long term, removals should compensate for them. Swiss forests are often characterised by high carbon stocks. To convert these old forests into more stable younger forests, a decrease in biomass is necessary and net emissions can be reduced or postponed by increasing the share of harvested biomass being transformed into harvested wood products. Further, specific forest stand types might need a change in species composition because of changing climate and corresponding changing stand characteristics. This exchange in tree species composition is typically spread over decennia. CO_2 emissions from all the measures mentioned in this section are expected to be moderate or small;
- By combating invasive species, CO_2 emissions from tree mortality caused by insect diseases can be minimised;
- The more active promotion of wood use (e.g., the commitment for the construction of federal buildings) has a positive mitigation impact because the further development of the pool of harvested wood products is strengthened.

II.D.7 Waste

II.D.7.1 Overview

The aim of Swiss waste policy is to close the material cycle and to treat the waste that cannot be recycled in such a way that it becomes a material suitable for final disposal. In principle, all waste should be recycled or incinerated. If this is not technically possible or economically acceptable, the waste and incineration residues are landfilled after suitable treatment. Since 2000, the landfilling of untreated combustible waste has been prohibited and the capacity of municipal solid waste incineration plants has been increased accordingly.

The most important strategy to reduce emissions from waste incineration is to increase recycling. Well-developed recycling systems exist for many types of waste. In 2022, 52 per cent of the total amount of municipal waste was collected separately and recycled (see section II.A.6.4, Tab. 2). The corresponding figure for the year 2000 was 45 per cent. The recycling rates are particularly high (more than 80 per cent) for glass, aluminium packaging, PET bottles as well as paper and cardboard (see section II.A.6.4, Fig. 35).

In general, waste disposal in Switzerland is financed according to the polluter-pays principle, i.e. those who produce more waste must also pay more for its disposal. About 95 per cent of the Swiss population finance their waste disposal entirely or partially through volume-based charges, and the remaining five per cent through taxes or a flat-rate fee.

Tab. 13 gives an overview of Switzerland's policies and measures in the waste sector. The following sections provide more details and background information on each policy and measure. The negotiated reduction commitment of municipal solid waste incineration plant operators – an agreement between the Swiss Federal Department of Environment, Transport, Energy and Communications and the Swiss Association of Municipal Solid Waste Incineration Plants – aims at effectively reducing fossil CO_2 emissions from waste incineration and to accelerate the deployment of carbon capture and storage (CCS). It is presented in detail in section II.D.2.11, as the emissions from municipal solid waste incineration plants are attributed to the energy sector.

Tab. 13 > Summary of policies and measures regarding waste management. The negotiated reduction commitment of municipal solid waste incineration plant operators is presented together with the policies and measures of the energy sector (section II.D.2.11). The sector affected is 'waste management' for all policies and measures presented in this table.

Name of policy or measure [a]	Green-house gas(es) affected	Objective and/or activity affected	Type of instrument	Status	Brief description	Start year	Imple-menting entity	Estimate of mitigation impact (not cumulative, in kt CO_2eq)		
								2020	2025	2030
Ban on landfilling of combustible waste *	CH_4	Avoid emissions from solid waste disposal sites, use waste as an energy source.	Regulatory	Implemented	Prohibition on landfilling of combustible waste.	2000 [b]	FOEN	194	163	135
Ordinance on the Avoidance and Management of Waste *	CO_2	Optimisation of energy recovery by municipal solid waste incineration plants.	Regulatory	Implemented	Mandatory minimal energy recovery rate.	2016	FOEN	28	28	28

[a] Policies and measures marked with an asterisk (*) are included in the 'with measures' projection.

[b] Regulations regarding the installation of technical equipment for the collection and removal of landfill gas were already established in the 1990s.

FOEN, Swiss Federal Office for the Environment

II.D.7.2 Ban on landfilling of combustible waste

Since 2000, disposal of combustible solid wastes on landfills has been banned. All Swiss waste incineration plants use the combustion heat they produce to generate electricity or to supply district heating networks and industrial facilities. Today, Swiss waste incineration plants supply around two per cent of Switzerland's total energy consumption. As a consequence of the ban on landfilling, CH_4 emissions from solid waste disposal sites have declined substantially. In addition, regulations regarding landfilling established in the 1990s led to the installation of technical equipment for the collection and removal of landfill gas (*Consaba*, 2016).

Estimate of mitigation impact

The mitigation impact of the ban on landfilling of combustible waste is estimated by comparing the 'with existing measures' (WEM) and 'without measures' (WOM) scenarios as used for Switzerland's projections of greenhouse gas emissions (for methodological details see section II.F.4.5). Accordingly, it is assumed that the mitigation impact of the

ban on landfilling of combustible waste corresponds to 194 thousand tonnes of CO_2 equivalents in the year 2020, 163 thousand tonnes of CO_2 equivalents in the year 2025 and 135 thousand tonnes of CO_2 equivalents in the year 2030 (these estimates do not include the different evolutions of biogas production which lead to further differences between the two scenarios for the waste sector).

II.D.7.3 Ordinance on the Avoidance and Management of Waste

In Switzerland, the disposal of waste is regulated by the Ordinance on the Avoidance and Management of Waste (*Swiss Confederation*, 2015). This ordinance has replaced the former Technical Ordinance on Waste since 1 January 2016. The new ordinance aims in particular at the sustainable use of renewable and non-renewable raw materials, among other things by promoting closed material cycles. At the same time, the reduction of environmental pollution is to be further improved through the separation and proper treatment of hazardous substances and the proper disposal of waste of all kinds. The reliability of the entire waste disposal system is to be strengthened by ensuring adequate structures for the collection, transport and treatment of the various types of waste.

The most important objective of the Ordinance on the Avoidance and Management of Waste with a direct impact on greenhouse gas emissions is to optimise the energy recovery of municipal waste in incineration plants. This is done by specifying a minimum energy recovery rate of 55 per cent of the energy content of the incinerated waste (binding as of 1 January 2026). All 29 Swiss municipal waste incineration plants supply energy either in the form of electricity or heat for district heating. While many waste incineration plants have recovery rates that are well above the minimum legal requirements, there are a few plants that need further technical investment to achieve the minimum recovery rate. The revision of the Ordinance on the Avoidance and Management of Waste of April 2022 has introduced an article according to which the construction of new plants or the expansion of the capacity of existing ones must be planned in such a way that at least 80 per cent of the energy content is used outside the installation. This high energy efficiency requirement can be achieved, for example, through increased use of district heating or CO_2 capture (which is also explicitly considered as use outside the installation).

Estimate of mitigation impact

Municipal solid waste incineration plants with an insufficient recovery rate have to raise their energy efficiency in order to meet the mandatory requirements. Applied to the actual situation in 2016, an additional minimal recovery of 107 gigawatt-hours is needed that all municipal solid waste incineration plants fulfil the legal requirements. Assumed that this additional energy is supplied as heat for district heating and, therefore, replaces fossil heating fuels, a reduction of 28 thousand tonnes of CO_2 can be obtained. This may be a conservative assumption, because an energetic optimisation of a municipal solid waste incineration plant will usually aim at higher energy recovery rate than required by the Ordinance on the Avoidance and Management of Waste. However, there is a transition period until 2026, i.e. the full mitigation impact may develop after 2020. To account for these effects, the value of 28 thousand tonnes of CO_2 is provided as the best estimate for the mitigation impact for both year, 2020 and 2025, in Tab. 13. The short-term mitigation impact of the additional increase of the minimum energy efficiency to 80 per cent is difficult to estimate quantitatively, but it will certainly lead to a further positive mitigation impact in the long-term. In the absence of a more comprehensive methodology, the mitigation impact for 2030 is also estimated at 28 thousand tonnes of CO_2 equivalents.

II.D.8 Costs, non-greenhouse gas mitigation benefits and interactions of policies and measures

The UNFCCC reporting guidelines encourage Parties to report on costs, non-greenhouse gas mitigation benefits and interactions of policies and measures. It turned out that gaining this information is very challenging and Switzerland is therefore not in a position to comprehensively report this information for every single policy and measure. However, information for selected policies and measures as well as a discussion of the challenges regarding the reporting of this information is provided in the following.

Costs of policies and measures

Evaluation of the costs of policies and measures is particularly challenging, e.g. because the definition of costs is ambiguous and because many policies and measures are closely interlinked. Accordingly, Switzerland does not evaluate its policies and measures regarding costs on a regular basis, and no consistent methodology to estimate costs of all individual policies and measures exists. However, the social costs and benefits of the policies and measures are expected to be moderate. In 2017, the Swiss Federal Office for the Environment published a synthesis report focusing on the economic assessment of climate policy measures after 2020 (*FOEN*, 2017). A similar analysis is likely to take place again

in preparation for the revision of the third CO_2 Act for the period after 2030 (see planned strengthening in section II.D.1.4). The following information allows for a good understanding of the potential costs and economic impacts of policies and measures enforced to mitigate climate change in Switzerland:

- The economy-wide cost of the CO_2 levy, the most relevant policy and measure in this context, has been analysed in detail. Since 2018, the federal government has set the rate of the CO_2 levy to 96 Swiss francs per tonne of CO_2, and has increased it to 120 Swiss francs per tonne of CO_2 as of 1 January 2022. This currently results in annual revenues of about 1.2 billion Swiss francs. A third of the revenues (at most 450 million Swiss francs) flows into the national buildings refurbishment programme, allowing the federal government and the cantons to support energy-efficient renovations. Another 25 million Swiss francs is transferred to the technology fund. Around two thirds of the revenues are available annually for redistribution. The federal government distributes the funds between the population and the Swiss economy in proportion to the CO_2 levy paid. Currently, the redistribution to the population is 64.20 Swiss francs per capita (including the redistribution of revenues from the NMVOC incentive fee) and the redistribution to the Swiss economy is 70.70 Swiss francs per 100,000 Swiss francs settled old-age and survivor's insurance payroll of employees. Households living in poorly isolated buildings that still rely on fossil heating systems are affected relatively strongly. However, the redistribution of the CO_2 levy on a per capita basis significantly moderates these negative effects and counteracts the regressive nature that carbon taxes generally have;
- Before the implementation of the linking of the emissions trading schemes of Switzerland and the European Union, it was estimated that Switzerland's gross domestic product would increase by approximately 0.04 per cent in 2030, compared to a scenario where the two emissions trading schemes are operated separately. It was further estimated that the inclusion of aircraft operators in the emissions trading scheme would slightly reduce the growth rate of value added of the aviation sector, but this effect would most probably not fully counteract the overall positive impact of the linking. Starting in 2026, full auctioning of aviation allowances will take place;
- For aviation, the introduction of a sustainable aviation fuel blending mandate will have a cost effect on aircraft operators due to the high cost of sustainable aviation fuel compared to fossil kerosene fuels. The initial sustainable aviation fuel blending of two per cent is moderate in order to meet availability of sustainable aviation fuel. However, together with the cost increase of the emissions trading scheme, direct operation cost of aircraft operators will increase considerably;
- The feed-in tariff system (see section II.D.2.6), which is financed by the network surcharge with a cap of 2.3 cent per kilowatt-hour, disposes of about 1.3 billion Swiss francs per year. Since the feed-in tariff system pays operators of electricity generation plants from wind and geothermal energy as well as from biomass the difference between the production costs and the electricity prices, the final direct costs depend on the level of the electricity prices and vary from year to year. An overall economic cost evaluation is not available;
- The cost of policies and measures focusing on subsidies are well-defined. In the following, a few examples are provided (list is not exhaustive): (i) under the promotion of innovative technologies and processes (section II.D.1.9), financial support totalling 1.0 billion Swiss francs until the end of 2030 is planned, (ii) in the framework of the decarbonisation of installations in the emissions trading scheme (section II.D.2.8), 15 million to 20 million Swiss francs per year should be available from auctions of emissions allowances for installations, (iii) with regard to the impulse programme for the replacement of heat generation systems and energy efficiency measures (section II.D.2.9), the available subsidies average 200 million Swiss francs per year, and (iv) for the promotion of electric propulsion technologies in public transport, the Swiss Confederation will contribute 47 million Swiss francs per year.

Overall, most of the policies and measures are expected to have only a minor or even negligible impact on the overall economy. Additionally, possible secondary benefits of the reduction of emissions (such as lower health costs, lower dependency on fossil fuels, impacts on innovation etc.) are difficult to quantify and are generally not taken into account. It is likely that the overall economic impact of the policies and measures would be positive if their benefits were also considered.

Administrative costs of policies and measures

Because market-based policies and measures such as the CO_2 levy and the emissions trading scheme play a dominant role in Switzerland's climate policy, the administrative costs are generally moderate. For the CO_2 levy, the compensation for

implementation expenses is defined in the CO_2 Ordinance (Article 132) and amounts to 1.85 per cent of the receipts (this percentage may be reduced if receipts increase).

Non-market-based polices and measures such as the CO_2 emission regulations for newly registered vehicles or the negotiated reduction commitments (for exemption from the CO_2 levy) require more personal and financial resources. From 2025, the number of companies with a negotiated reduction commitment (for exemption from the CO_2 levy, see section II.D.1.8) is expected to increase significantly, as all companies (with a few exceptions) will be granted access, leading to a substantial increase in the administrative costs.

Non-greenhouse gas mitigation benefits of policies and measures

Non-greenhouse gas mitigation benefits of policies and measures are generally difficult to estimate. The main benefits come from the reduction of other air pollutants and the corresponding decrease of health and damage costs. Until 2020, these benefits (mainly due to the CO_2 levy on heating and process fuels) are estimated to be 100 million to 200 million Swiss francs per year (*Econcept*, 2008). Policies and measures that increase energy efficiency contribute to energy security and reduce the potential costs of shortages in energy supply. The same holds for policies and measures that lower the demand for fossil fuels. These policies and measures reduce the dependency on fossil energy imports. For any other secondary benefits, no robust quantifications are available.

Interactions of policies and measures

The use of fossil fuel accounts for around three quarters of Switzerland's greenhouse gas emissions. Energy and climate policy are therefore closely linked. The main objective of the Energy Strategy 2050 (increasing energy efficiency and the use of renewable energy) also contributes to the mitigation of CO_2 emissions. However, the implementation of the Energy Strategy 2050 will also lead to an increasing demand for electricity (e-mobility, heat pumps, etc.). In the short to medium term, it will not be possible to cover this demand entirely with renewable energies. Accordingly, the Swiss Federal Council has instructed the Swiss Federal Department of the Environment, Transport, Energy and Communications to draw up the necessary provisions for the construction and operation of peak-load power plants.[62] This may pose a challenge to Switzerland's efforts to reduce domestic CO_2 emissions, but the legal provisions are intended to ensure the climate-neutral operation of the peak-load power plants, for example through the use of CO_2-free energy sources or through compensation (e.g. gas-fired combined-cycle power plants are included in the emissions trading scheme). Peak-load power plants may only be used in exceptional situations when the electricity market can temporarily no longer meet demand, and they should not distort the electricity market. Implementing the Energy Strategy 2050 not only requires adjustments to the Energy Act, but also to the CO_2 Act.

Applying a computable general equilibrium model, *EPFL and Infras* (2016) and *EPFL* (2017) suggested that the combined mitigation impact of policies and measures in the energy sector may be larger than the sum of the mitigation impacts estimated for individual policies and measures. In their model, the combined effects of policies and measures result to be responsible for about 12 per cent of the aggregate effect individual policies and measures.

II.D.9 Policies and measures no longer in place

The climate policies and measures developed over the past years to decades are well-established. As described under the respective sections, some of the policies and measures implemented have been adapted and strengthened over time. Apart from the following exceptions, all policies and measures listed in Switzerland's eight national communication and fifth biennial report are still part of the national portfolio:[63]

- **Climate Cent:** In the transport sector, the 'Climate Cent' is not reported any more, because this measure is continued under the 'Partial compensation of CO_2 emissions from motor fuel use' (see section II.D.3.4);
- **Enhancement of label standards:** In the agricultural sector, the 'Enhancement of label standards' is not reported any more, because this measure is not part of national policy.

62 https://www.uvek.admin.ch/uvek/de/home/uvek/medien/medienmitteilungen.msg-id-87202.html

63 The following polices and measures have been renamed in preparation of this report: (i) the previous 'Feed-in tariff system' is now named 'Feed-in tariff system and floating market premium', (ii) the previous 'Agricultural policy 2014–2017 and 2018–2021' is now named 'Direct payments ', and (iii) the previous 'Climate strategy for agriculture' is now named 'Climate strategy for agriculture and food'.

II.D.10 Modification of longer-term trends in greenhouse gas emissions and removals

Switzerland's policies and measures described in section II.D.1 to II.D.7 are generally set out to modify the short-term and longer-term trends in anthropogenic greenhouse gas emissions and removals (obviously aiming at reducing net emissions of greenhouse gases). In line with the general objectives of the Convention, they aim at promoting efficiency improvements in the energy, transport and waste sectors, give preference to the sustainable use of renewable resources in agriculture and forestry, and set incentives for the use of climate-friendly substances in the industry sector. The modification of the longer-term trend in greenhouse gas emissions achieved by Switzerland's policies and measures becomes obvious when comparing the 'with existing measures' (WEM) and 'without measures' (WOM) scenarios as presented in chapter II.F (and in particular in Fig. 51). Further, emission trends will be modified by measures where the immediate effect on greenhouse gas emission levels is not a priority, but where longer-term contributions to a low-emission economy and society are targeted. Some examples of particular interest are:

- **Promotion of renewable energies:** Article 34a of the third CO_2 Act aims to promote renewable energy projects for decarbonisation. In particular, the following project types are supported: (i) direct utilisation of geothermal energy for the provision of heat, (ii) regional spatial energy planning, (iii) production of renewable gases, and (iv) installations for the utilisation of solar thermal energy for process heat. The budget of a maximum of 45 million Swiss francs annually comes from the CO_2 levy on heating and process fuels;
- **Technology fund:** In the context of the CO_2 Act (Article 35), a technology fund, financed with 25 million Swiss francs per year from the revenue of the CO_2 levy, was established in 2013. This fund provides for loan guarantees for innovative companies in order to ease access to capital for investments in developing new low-emission technologies. The website of the technology fund contains detailed information on the conditions and procedures to receive loan guarantees, and on the portfolio with innovative companies that already received a loan guarantee due to their contribution to climate protection.[64] Moreover, the website of the Swiss Federal Office for the Environment includes annual review reports.[65] At the end of 2022, the portfolio consisted of 140 loan guarantees to 128 companies with a total amount of 233.5 million Swiss francs. Components/sensors, agriculture/forestry, mobility and 'other sectors' together account for more than half of the total loan guarantees. The components/sensors segment (15 per cent) includes companies that offer Internet of Things (IoT) solutions, line monitoring, measurement devices for coating thickness, resource-saving surface treatment, inspection drones or compressors. The companies in the agriculture/forestry category (13 per cent) sell solar-powered water pumps, locally produced shrimps, fish and other food products, drones for optimised fertiliser use, products to promote bee health, and farm management software. Mobility (12 per cent) includes companies that build electric commercial vehicles and energy-efficient refrigerated containers or develop software for fleet management and tracking of containers and freight railcars. For many companies, it is difficult to assign them to a specific sector. They are thus summarised as 'other sectors' (16 per cent). They sell, for example, software for measuring CO_2 emissions, sustainable clothing or CO_2 ratings for securities, stocks and bonds, improved weather forecasts, data and apps on consumer goods (palm oil), online translation services for major events or methods for reducing shipping in online trading. Keywords describing further branches include: power sector (solar, wind, water, biomass), energy storage, energy supply, smart buildings (heating, ventilation, air conditioning), recycling, chemistry, construction and materials, air pollution control, and smart grid;
- **Information, training and advisory services:** Since 2013, the second CO_2 Act, in its Article 41, has requested the federal government and the cantons to support measures for the integration of elements relevant regarding climate change in communication, education and professional training programmes at all levels. This includes improving knowledge about mitigation of greenhouse gas emissions as well as adaptation to climate change. The third CO_2 Act now grants five million Swiss francs per year to support respective activities. Switzerland reports more detailed information in chapter VI.C;
- **Climate and financial markets:** The Climate and Innovation Act establishes, in its Article 1c, the general objective of directing financial flows towards a low-carbon and climate-resilient development in accordance with the Paris Agreement. In the Swiss context with its strong financial sector this stipulates that also private investments and financing are to adhere to the target of net-zero greenhouse gas emissions by 2050. The Climate and Innovation Act also requires the financial sector to make an effective contribution to achieving climate goals

[64] See https://www.technologyfund.ch and https://www.technologyfund.ch/portfolio.

[65] https://www.bafu.admin.ch/tech-fund

(Article 9). This will initially be done by financial markets measures on a voluntary basis and transparency efforts. The impact of voluntary climate measures is assessed periodically by the federal government. In 2024, Switzerland rolled out the so-called 'PACTA Climate test'[66] for the fourth time, after 2022, 2020 and 2017. All pension funds, insurance companies, banks and asset managers can participate voluntarily. The test creates comparable transparency across financial sectors and supports concrete, climate-relevant action;

- **Carbon capture and storage (CCS), negative emission technologies (NETs):** CCS, i.e. the capture and storage of fossil and process-based CO_2 at installations to reduce emissions, and NET or carbon dioxide removal (CDR), i.e. the permanent removal of CO_2 from the atmosphere, are essential to achieving Switzerland's long-term climate targets. These technologies shall be developed gradually to address hard-to-abate emissions, namely from industry, waste treatment, agriculture, and international aviation.[67] Due to the limited CO_2 storage capacity in Switzerland, international cooperation is crucial, e.g. with regard to CO_2 export and trading of negative emissions. The development of these technologies is also seen as an opportunity for the Swiss economy and academia. In this context, the Swiss government is actively supporting early pilot projects with national and international partners, including CDR transfers under Article 6 of the Paris Agreement with Sweden and Norway,[68] cross-border CDR projects led by academia and industry,[69] government certification of a CDR project pipeline up to 2030,[70] and CO_2 injection tests to explore domestic onshore underground storage potential.[71] In addition, funding for industrial-scale CCS and CDR is foreseen under the Climate and Innovation Act from 2025 (see II.D.1.9).

II.D.11 Economic and social consequences of response measures

The Swiss Confederation regularly analyses and documents the economic and social consequences of response measures, in particular within the process of revisions of its climate policy. The most recent analysis was part the Swiss Federal Council's draft of the third CO_2 Act covering the period 2025–2030 (see section II.D.1.4) and was published on 16 September 2022.[72] In the following, the most important points are summarised.

Economic Consequences

According to its nationally determined contribution, Switzerland aims to halve its greenhouse gas emissions by 2030. Switzerland has been more strongly affected by climate change than the global average. Surface temperature in Switzerland has risen by almost three degrees Celsius, compared to a global average of about one degree Celsius. Switzerland therefore has a strong interest in a swift reduction of global emissions in line with the goals of the Paris Agreement. To contribute its part to these efforts, Switzerland focuses primarily on targeted incentives and funding instruments, combined with market-based policies.

The economic impact of policies and measures to mitigate climate change also brings opportunities for various sectors. Industries such as cleantech, IT, and finance stand to benefit. Cleantech companies, specialising in green technologies, and IT companies developing digital solutions for emission reductions see growth potential in transitioning to a more sustainable economy. Reducing reliance on fossil fuels increases domestic energy production, strengthening the national economy while decreasing dependence on foreign energy.

As a globally leading financial centre, Switzerland is also well-positioned to play a crucial role in shifting financial flows towards climate-friendly investments, as outlined in the Paris Agreement. Switzerland already excels in developing negative emission technologies, which remove CO_2 from the atmosphere, and plans to unlock even more innovation through targeted funding programmes.

However, this transition presents short-term challenges for some sectors. Industries reliant on fossil fuels are facing higher costs and likely a decline in demand for high-emission goods, fossil fuels, and inefficient vehicles. Structural changes are expected in these sectors. However, because Swiss companies participate in the emissions trading system of

66 www.bafu.admin.ch/pacta-climate-test

67 https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-88850.html

68 https://www.bafu.admin.ch/bilateral-climate-agreements

69 https://www.aramis.admin.ch/Grunddaten/?ProjectID=49400&Sprache=en-US

70 https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-88808.html and https://www.klimarappen.ch/en/Negative-emissions-technologies-.1.html

71 https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-102087.html

72 See chapter 5 of https://www.fedlex.admin.ch/eli/fga/2022/2651/de#lvl_5/lvl_5.4.

the European Union and operate under the same regulations as their European competitors, no negative effects on international competitiveness are expected. Additionally, exemptions from the CO_2 levy are available to all sectors, which can help mitigate financial burdens.

The transportation sector is also affected by stricter CO_2 emission regulations for vehicles, encouraging a shift toward more fuel-efficient models. These new technologies lead to long-term fuel savings, though some vehicle importers might face sanctions if their fleets fail to meet the set targets. Importers whose brands already focus on low-emission engines benefit from a competitive advantage, at least in the short term.

In aviation, promoting sustainable aviation fuels is expected to strengthen Switzerland's innovation and research capacities. The public transportation sector also sees additional investments in eco-friendly technologies, with a significant portion of the costs covered by the government, minimising fare increases for consumers. An increase in renewable energy production is necessary to meet the anticipated rise in electricity demand by 2030, driven by electric mobility and heat pumps.

Social Consequences

In addition to their economic effects, policies and measures also have significant social consequences. By reducing greenhouse gas emissions, Switzerland contributes not only to global climate efforts but also relieves future generations from bearing the costs of today's environmental damages. Failing to act decisively would lead to significantly higher costs by 2050 and beyond, making immediate action crucial. From a social justice perspective, swift measures are necessary to prevent future generations from paying for today's inaction.

Switzerland's existing CO_2 levy will continue to be applied, with partial refunding to households on a per capita basis. This redistribution serves as a social safeguard, protecting lower-income households from excessive financial burdens. However, as emissions from fossil fuels decline, revenue from the CO_2 levy, and thus the redistributed amounts, will also decrease. Nevertheless, the switch to non-fossil heating systems is expected to lower energy costs, and building owners can benefit from increased property values following energy-efficient renovations.

In the housing sector, measures to promote climate-friendly heating systems and energy-efficient building renovations will continue. Not only property owners benefit from the funds provided by the Swiss Confederation and the cantons, but also tenants, the construction industry, and local businesses, particularly small and medium-sized enterprises.

Public transport is also affected by policies and measures. The electrification of bus fleets and other eco-friendly investments reduce the relevance of fuel tax refunds for transport companies. Initially, higher operating costs might arise, but these are expected to be offset by the lower operating costs of electric buses. Rail transport is also being promoted, especially cross-border night train services, which provide an attractive alternative to short-haul flights, increasing the competitiveness of public transport.

In conclusion, climate protection measures will reduce long-term environmental risks and promote the sustainable use of natural resources. At the same time, they ensure social equity by redistributing revenues from the CO_2 levy and by supporting climate-friendly investments in housing and transportation. These measures foster solidarity between generations, ensuring that future generations are less burdened by the consequences of climate change.

II.E Summary of greenhouse gas emissions and removals

This chapter presents comprehensive summary information of Switzerland's national greenhouse gas inventory in a tabular format. The presented data cover the period from 1990 to 2022 and are fully consistent with the reporting tables (CRT) and the national inventory document of Switzerland's most recent annual inventory submission of April 2024 (*FOEN*, 2024a). While CTF-NDC table 6 gives a general overview, the tables presented in section II.E.1 (Tab. 14 to Tab. 20) provide additional details to further increase transparency. Global warming potential values according to the fifth assessment report of the Intergovernmental Panel on Climate Change (*IPCC*, 2013) based on the effect of greenhouse gases over a 100-year time horizon were used.[73] Chapter 2 of Switzerland's national inventory document provides additional information, including tables, diagrams as well as a brief description of the observed trends by gas and by sector (*FOEN*, 2024a).

II.E.1 Summary tables

Tab. 14 > Switzerland's greenhouse gas emissions and removals by sector and gas, 2022.

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Indirect CO_2	Total	Share
	kt CO_2eq									
1 Energy	30 730	132.2	238.8	NA	NA	NA	NA	9.5	**31 111**	74.0%
2 Industrial processes and product use	2 028	7.7	37.6	1 273	25.7	55.8	0.3	82.9	**3 511**	8.3%
3 Agriculture	44.1	4 233	1 611	NA	NA	NA	NA	NA	**5 888**	14.0%
4 LULUCF	364.6	17.7	50.8	NA	NA	NA	NA	NA	**433.1**	1.0%
5 Waste	8.1	537.1	565.1	NA	NA	NA	NA	1.1	**1 111**	2.6%
6 Other	8.3	0.5	0.3	NA	NA	NA	NA	0.8	**9.9**	0.0%
Total	**33 183**	**4 928**	**2 504**	**1 273**	**25.7**	**55.8**	**0.3**	**94.3**	**42 064**	**100.0%**
International aviation bunkers	4 186	0.4	30.5	NA	NA	NA	NA	NA	4 217	10.0%
International marine bunkers	15.1	0.0	0.1	NA	NA	NA	NA	NA	15.3	0.0%

FOEN (2024a)

[73] These global warming potential values are consistently used by Switzerland, i.e. in particular also regarding the definition of the nationally determined contribution (chapter II.B) and for the calculation of the projections of greenhouse gas emissions (chapter II.F).

Tab. 15 > Switzerland's greenhouse gas emissions and removals by gas (from the sectors 1, 2, 3, 4, 5, and 6, excluding international bunkers), selected years. Also provided are the shares of the different gases in total emissions and removals.

	1990		1995		2000		2005		2010	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
CO_2	41 101	78.9%	39 037	78.9%	47 971	82.4%	42 506	80.4%	41 856	80.2%
CH_4	6 257	12.0%	5 864	11.8%	5 494	9.4%	5 476	10.4%	5 431	10.4%
N_2O	4 103	7.9%	3 964	8.0%	3 736	6.4%	3 471	6.6%	3 307	6.3%
HFCs	0.0	0.0%	227.4	0.5%	603.5	1.0%	996.8	1.9%	1 245	2.4%
PFCs	104.8	0.2%	16.0	0.0%	54.3	0.1%	45.6	0.1%	35.7	0.1%
SF_6	141.2	0.3%	96.1	0.2%	156.8	0.3%	210.4	0.4%	154.8	0.3%
NF_3	0.0	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%	11.9	0.0%
Indirect CO_2	392.3	0.8%	284.0	0.6%	204.5	0.4%	144.2	0.3%	132.5	0.3%
Total	**52 099**	**100.0%**	**49 488**	**100.0%**	**58 220**	**100.0%**	**52 850**	**100.0%**	**52 174**	**100.0%**

	2015		2020		2021		2022	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
CO_2	37 114	78.4%	33 516	77.7%	34 444	78.5%	33 183	78.9%
CH_4	5 243	11.1%	4 956	11.5%	4 965	11.3%	4 928	11.7%
N_2O	3 147	6.6%	3 034	7.0%	2 933	6.7%	2 504	6.0%
HFCs	1 429.2	3.0%	1 350	3.1%	1 267	2.9%	1 273	3.0%
PFCs	23.6	0.0%	34.1	0.1%	28.0	0.1%	25.7	0.1%
SF_6	281.1	0.6%	155.8	0.4%	130.6	0.3%	55.8	0.1%
NF_3	0.7	0.0%	0.4	0.0%	0.4	0.0%	0.3	0.0%
Indirect CO_2	107.1	0.2%	99.9	0.2%	95.3	0.2%	94.3	0.2%
Total	**47 346**	**100.0%**	**43 146**	**100.0%**	**43 864**	**100.0%**	**42 064**	**100.0%**

FOEN (2024a)

Tab. 16 > Switzerland's greenhouse gas emissions and removals by gas (from the sectors 1, 2, 3, 4, 5, and 6, excluding international bunkers), 1990–2022 (steps of two years for years before 2020). Also indicated are the relative changes in emissions and removals in 2022 relative to 1990 (last column). In 1990, there were virtually no emissions of HFCs and no emissions of NF_3, therefore the relative increases are not indicated for these gases.

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008
	kt CO_2eq									
CO_2	41 101	41 550	39 651	37 795	41 397	47 971	40 864	41 742	44 793	42 591
CH_4	6 257	6 056	5 853	5 810	5 607	5 494	5 509	5 420	5 498	5 568
N_2O	4 103	4 028	3 961	3 932	3 748	3 736	3 711	3 469	3 426	3 345
HFCs	0.0	14.6	75.6	277.9	428.6	603.5	787.1	961.1	1 103	1 214
PFCs	104.8	72.5	19.0	18.6	21.5	54.3	32.2	66.2	57.8	42.1
SF_6	141.2	145.7	110.2	92.8	157.5	156.8	165.8	192.0	204.0	245.7
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Indirect CO_2	392.3	347.1	306.4	266.7	229.6	204.5	176.9	150.3	142.2	135.2
Total	**52 099**	**52 214**	**49 976**	**48 193**	**51 590**	**58 220**	**51 246**	**52 000**	**55 224**	**53 142**

	2010	2012	2014	2016	2018	2020	2021	2022	Relative change 1990 to 2022
	kt CO_2eq								
CO_2	41 856	40 537	38 456	37 068	36 913	33 516	34 444	33 183	–19.3%
CH_4	5 431	5 350	5 274	5 204	5 102	4 956	4 965	4 928	–21.2%
N_2O	3 307	3 208	3 181	3 108	3 071	3 034	2 933	2 504	–39.0%
HFCs	1 245	1 375	1 388	1 396	1 427	1 350	1 267	1 273	See caption
PFCs	35.7	36.7	20.6	18.3	32.7	34.1	28.0	25.7	–75.5%
SF_6	154.8	224.9	270.0	254.4	184.1	155.8	130.6	55.8	–60.5%
NF_3	11.9	0.5	0.6	0.7	0.5	0.4	0.4	0.3	See caption
Indirect CO_2	132.5	121.8	112.5	107.5	99.8	99.9	95.3	94.3	–76.0%
Total	**52 174**	**50 854**	**48 703**	**47 158**	**46 831**	**43 146**	**43 864**	**42 064**	**–19.3%**

FOEN (2024a)

Tab. 17 > Switzerland's greenhouse gas emissions and removals by sector (excluding international bunkers), selected years. Also indicated are the shares of the different sectors and source categories in total greenhouse gas emissions and removals.

	1990		1995		2000		2005		2010	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
1 Energy	41 636	79.9%	41 633	84.1%	42 007	72.2%	43 839	83.0%	43 088	82.6%
1A1 Energy industries	2 514	4.8%	2 640	5.3%	3 172	5.4%	3 818	7.2%	3 854	7.4%
1A2 Manufacturing industries and construction	6 576	12.6%	6 299	12.7%	6 002	10.3%	6 035	11.4%	5 854	11.2%
1A3 Transport	14 673	28.2%	14 278	28.9%	15 951	27.4%	15 847	30.0%	16 320	31.3%
1A4 Other sectors	17 535	33.7%	18 112	36.6%	16 600	28.5%	17 863	33.8%	16 793	32.2%
1A5 Other (military)	219.4	0.4%	162.7	0.3%	151.0	0.3%	138.6	0.3%	137.3	0.3%
1B Fugitive emissions from oil and natural gas	119.4	0.2%	140.7	0.3%	130.1	0.2%	137.8	0.3%	130.1	0.2%
2 Industrial processes and product use	3 913	7.5%	3 318	6.7%	3 654	6.3%	4 277	8.1%	4 373	8.4%
3 Agriculture	6 852	13.2%	6 615	13.4%	6 164	10.6%	6 100	11.5%	6 205	11.9%
4 Land use, land-use change and forestry	–2 959	–5.7%	–4 307	–8.7%	4 411	7.6%	–3 211	–6.1%	–3 118	–6.0%
5 Waste	2 251	4.3%	1 931	3.9%	1 764	3.0%	1 685	3.2%	1 484	2.8%
6 Other	14.2	0.0%	15.0	0.0%	16.5	0.0%	15.3	0.0%	10.6	0.0%
Indirect CO_2	392.3	0.8%	284.0	0.6%	204.5	0.4%	144.2	0.3%	132.5	0.3%
from 1 Energy	54.9	0.1%	44.8	0.1%	31.6	0.1%	23.8	0.0%	19.7	0.0%
from 2 Industrial processes and product use	333.9	0.6%	235.9	0.5%	169.7	0.3%	117.5	0.2%	110.4	0.2%
from 5 Waste	2.2	0.0%	1.9	0.0%	1.8	0.0%	1.6	0.0%	1.5	0.0%
from 6 Other	1.3	0.0%	1.4	0.0%	1.5	0.0%	1.4	0.0%	0.9	0.0%
Total	**52 099**	**100.0%**	**49 488**	**100.0%**	**58 220**	**100.0%**	**52 850**	**100.0%**	**52 174**	**100.0%**

	2015		2020		2021		2022	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
1 Energy	36 976	78.1%	32 541	75.4%	34 027	77.6%	31 101	73.9%
1A1 Energy industries	3 303	7.0%	3 290	7.6%	3 239	7.4%	3 186	7.6%
1A2 Manufacturing industries and construction	4 971	10.5%	4 500	10.4%	4 595	10.5%	4 219	10.0%
1A3 Transport	15 327	32.4%	13 563	31.4%	13 752	31.4%	13 581	32.3%
1A4 Other sectors	13 159	27.8%	10 998	25.5%	12 264	28.0%	9 926	23.6%
1A5 Other (military)	135.1	0.3%	119.4	0.3%	114.6	0.3%	123.4	0.3%
1B Fugitive emissions from oil and natural gas	81.8	0.2%	71.3	0.2%	63.0	0.1%	64.6	0.2%
2 Industrial processes and product use	4 323	9.1%	4 094	9.5%	3 939	9.0%	3 428	8.1%
3 Agriculture	6 135	13.0%	5 883	13.6%	5 925	13.5%	5 888	14.0%
4 Land use, land-use change and forestry	–1 543	–3.3%	–650	–1.5%	–1 274	–2.9%	433	1.0%
5 Waste	1 338	2.8%	1 171	2.7%	1 142	2.6%	1 110	2.6%
6 Other	9.8	0.0%	8.3	0.0%	9.2	0.0%	9.1	0.0%
Indirect CO_2	107.1	0.2%	99.9	0.2%	95.3	0.2%	94.3	0.2%
from 1 Energy	13.7	0.0%	9.9	0.0%	9.5	0.0%	9.5	0.0%
from 2 Industrial processes and product use	91.2	0.2%	88.1	0.2%	83.8	0.2%	82.9	0.2%
from 5 Waste	1.3	0.0%	1.2	0.0%	1.2	0.0%	1.1	0.0%
from 6 Other	0.8	0.0%	0.7	0.0%	0.8	0.0%	0.8	0.0%
Total	**47 346**	**100.0%**	**43 146**	**100.0%**	**43 864**	**100.0%**	**42 064**	**100.0%**

FOEN (2024a)

Tab. 18 > Switzerland's greenhouse gas emissions and removals in different sectors and source categories (excluding international bunkers), 1990–2022 (steps of two years for years before 2020). Also indicated are the relative changes in emissions and removals in 2022 relative to 1990 (last column).

	1990	1992	1994	1996	1998	2000	2002	2004	2006	2008
	kt CO_2eq									
1 Energy	41 636	44 039	40 730	42 510	43 190	42 007	41 847	43 389	43 461	42 817
1A1 Energy industries	2 514	2 891	2 602	2 858	3 223	3 172	3 390	3 684	4 035	3 842
1A2 Manufacturing industries and construction	6 576	6 385	6 158	6 044	6 202	6 002	5 803	6 037	6 200	6 067
1A3 Transport	14 673	15 491	14 586	14 342	15 108	15 951	15 577	15 783	15 964	16 637
1A4 Other sectors	17 535	18 943	17 060	18 969	18 358	16 600	16 794	17 631	16 996	16 024
1A5 Other (military)	219.4	193.8	180.1	151.8	160.8	151.0	154.4	128.8	142.6	130.5
1B Fugitive emissions from oil and natural gas	119.4	135.5	143.9	145.1	138.4	130.1	128.4	126.7	123.4	116.8
2 Industrial processes and product use	3 913	3 375	3 314	3 225	3 244	3 654	3 854	4 137	4 321	4 359
3 Agriculture	6 852	6 732	6 616	6 518	6 252	6 164	6 125	6 019	6 141	6 298
4 Land use, land-use change and forestry	–2 959	–4 406	–2 953	–6 247	–3 161	4 411	–2 533	–3 432	–510.2	–2 048
5 Waste	2 251	2 112	1 946	1 901	1 820	1 764	1 759	1 720	1 655	1 569
6 Other	14.2	16.2	15.5	18.0	15.1	16.5	16.5	16.3	13.9	11.7
Indirect CO_2	392.3	347.1	306.4	266.7	229.6	204.5	176.9	150.3	142.2	135.2
from 1 Energy	54.9	55.6	51.6	43.4	38.2	31.6	26.3	25.1	23.5	21.2
from 2 Industrial processes and product use	333.9	287.9	251.4	219.9	188.3	169.7	147.3	122.1	115.9	111.4
from 5 Waste	2.2	2.2	1.9	1.8	1.7	1.8	1.7	1.6	1.6	1.6
from 6 Other	1.3	1.5	1.4	1.7	1.4	1.5	1.5	1.5	1.2	1.0
Total	**52 099**	**52 214**	**49 976**	**48 193**	**51 590**	**58 220**	**51 246**	**52 000**	**55 224**	**53 142**

	2010	2012	2014	2016	2018	2020	2021	2022	Relative change 1990 to 2022
	kt CO_2eq								
1 Energy	43 088	40 419	37 306	37 372	35 093	32 541	34 027	31 101	–25.3%
1A1 Energy industries	3 854	3 651	3 614	3 389	3 372	3 290	3 239	3 186	26.7%
1A2 Manufacturing industries and construction	5 854	5 425	5 090	4 975	4 790	4 500	4 595	4 219	–35.8%
1A3 Transport	16 320	16 258	16 063	15 164	14 908	13 563	13 752	13 581	–7.4%
1A4 Other sectors	16 793	14 847	12 309	13 626	11 822	10 998	12 264	9 926	–43.4%
1A5 Other (military)	137.3	132.3	138.6	139.3	126.5	119.4	114.6	123.4	–43.7%
1B Fugitive emissions from oil and natural gas	130.1	107.2	91.1	79.2	75.8	71.3	63.0	64.6	–45.9%
2 Industrial processes and product use	4 373	4 354	4 366	4 282	4 273	4 094	3 939	3 428	–12.4%
3 Agriculture	6 205	6 181	6 231	6 122	6 014	5 883	5 925	5 888	–14.1%
4 Land use, land-use change and forestry	–3 118	–1 643	–703.6	–2 037	116.4	–650.4	–1 274	433.1	–114.6%
5 Waste	1 484	1 409	1 380	1 300	1 224	1 171	1 142	1 110	–50.7%
6 Other	10.6	10.5	10.6	9.7	9.8	8.3	9.2	9.1	–35.9%
Indirect CO_2	132.5	121.8	112.5	107.5	99.8	99.9	95.3	94.3	–76.0%
from 1 Energy	19.7	16.8	15.3	12.3	11.4	9.9	9.5	9.5	–82.7%
from 2 Industrial processes and product use	110.4	102.7	94.9	93.0	86.4	88.1	83.8	82.9	–75.2%
from 5 Waste	1.5	1.4	1.3	1.3	1.2	1.2	1.2	1.1	–50.5%
from 6 Other	0.9	0.9	0.9	0.8	0.8	0.7	0.8	0.8	–40.2%
Total	**52 174**	**50 854**	**48 703**	**47 158**	**46 831**	**43 146**	**43 864**	**42 064**	**–19.3%**

FOEN (2024a)

Tab. 19 > Switzerland's emissions of precursor gases and SO_2 (excluding emissions from land use, land-use change and forestry), 1990–2022.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	kt																
NO_x	144.1	140.9	134.1	122.0	119.2	114.8	109.3	105.0	104.5	104.0	101.9	99.0	94.4	93.3	92.8	93.5	91.9
CO	816.8	778.8	718.8	627.1	574.3	531.5	511.3	479.8	459.3	444.5	418.7	391.3	364.7	353.4	336.6	321.2	299.3
NMVOC	305.1	290.3	267.9	241.3	227.2	210.7	199.3	186.4	174.8	167.5	157.3	147.8	135.9	127.6	118.4	115.0	111.6
SO_2	39.1	37.0	32.7	28.1	26.0	26.4	25.2	21.9	21.7	17.6	15.8	17.0	15.2	15.1	15.5	14.2	13.3

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	kt															
NO_x	90.5	90.3	85.6	83.3	79.2	79.6	79.7	75.9	71.8	69.8	65.7	62.3	58.7	52.1	50.7	46.9
CO	284.5	276.9	261.4	252.6	229.0	221.9	213.8	192.8	183.9	184.4	179.2	169.4	168.6	152.8	153.0	142.8
NMVOC	108.6	106.1	102.9	99.3	94.7	91.8	88.9	84.9	81.2	78.4	77.6	76.3	75.3	73.2	73.5	72.6
SO_2	11.5	11.5	10.0	10.0	8.2	8.2	7.8	6.7	5.7	5.0	4.7	4.5	4.2	3.6	3.5	3.1

FOEN (2024a)

Tab. 20 > Switzerland's emissions of precursor gases and SO_2 by sector, 2022.

	NO_x	CO	NMVOC	SO_2
	kt			
1 Energy	42.8	136.0	15.9	2.7
2 Industrial processes and product use	0.2	4.9	37.0	0.4
3 Agriculture	3.7	NA	17.9	NA
5 Waste	0.1	1.4	1.7	0.0
6 Other	0.0	0.5	0.1	0.0
Total (excluding LULUCF)	46.9	142.8	72.6	3.1
4 LULUCF	0.0	1.1	77.9	0.0
Total (including LULUCF)	46.9	144.0	150.5	3.1

NA, not applicable
FOEN (2024a)

II.F Projections of greenhouse gas emissions and removals

In this chapter, Switzerland's projections of greenhouse gas emission and removals under the following three scenarios are reported:

- The 'with existing measures' (WEM) scenario, encompassing currently implemented and adopted policies and measures. The WEM scenario thus reflects the current state of legislation (as of summer 2024), also taking into account the stipulated strengthening of existing policies and measures (i.e. any strengthening foreseen under current legislation);
- The 'without measures' (WOM) scenario, excluding all implemented, adopted and planned policies and measures to the extent possible. However, autonomous diffusion of technological progress takes place also under the WOM scenario, leading to a gradual improvement of energy efficiency (which is obviously slower than under the WEM scenario);
- The 'with additional measures' (WAM) scenario, encompassing implemented, adopted and planned policies and measures. The WAM scenario thus takes into account – in addition to all policies and measures considered under the WEM scenario – the planned strengthening of existing policies and measures as well as new policies and measures that have not yet been put in concrete terms but are planned in order to further advance Switzerland's contribution to climate mitigation.

Section II.F.1 presents Switzerland's total greenhouse gas emissions and removals projected under the WEM, WOM and WAM scenarios from 1990 to 2040, disaggregated by sector and by gas. The projections are presented relative to actual and unadjusted inventory data for the preceding years (*FOEN*, 2024a). An overview of the measures considered in the different scenarios and details of projected key underlying assumptions and parameters driving the scenarios are provided in the sections II.F.2 and II.F.3, respectively. Information on the methodology applied as well as the underlying assumptions and parameters specific to each sector are presented in section II.F.4.1 for the energy sector (including transport), in section II.F.4.2 for the industrial processes and product use sector, in section II.F.4.3 for the agriculture sector, in section II.F.4.4 for the land use, land-use change and forestry sector, in section II.F.4.5 for the waste sector, in section II.F.4.6 for indirect CO_2 emissions, and in section II.F.4.7 for international transport. Section II.F.4.8 and section II.F.4.9 provide information on the main changes since Switzerland's last submission and on the sensitivity analysis, respectively. The CTF-NDC tables 7 to 11 provide a summary of Switzerland's updated projections and key underlying assumptions.

II.F.1 Results

Tab. 21 and Tab. 22 provide a general overview of the projections of Switzerland's greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios, detailed by sector and by gas (the tables complement the results presented in CTF-NDC tables 7 to 9). For a direct comparison with Switzerland's emission reduction targets, the total emissions and removals presented in the tables and figures of this chapter are composed as follows:

- Emissions and removals of all greenhouse gases from the sectors 1 'Energy', 2 'Industrial processes and product use', 3 'Agriculture', 4 'Land use, land-use change and forestry', 5 'Waste', and 6 'Other' are included (as required, the total is also shown excluding the contribution from land use, land-use change and forestry, but Switzerland's first nationally determined contribution as well as the national targets do include these emissions and removals);
- Indirect CO_2 emissions from all sectors are included;
- Greenhouse gas emissions from international transport are excluded, but to increase transparency, they are reported separately and briefly discussed.

Therewith, the projection of Switzerland's total greenhouse gas emissions and removals under the WEM scenario also corresponds to the projection of Switzerland's key indicator ('Total emissions and removals') to determine progress towards the nationally determined contribution (see section II.C.1.2 and CTF-NDC table 10).

Fig. 51 displays the projections of net emissions as relevant for Switzerland's emission reduction targets under the WEM, WOM and WAM scenarios, while the various panels in Fig. 52 and Fig. 53 present the disaggregation by sector and gas,

respectively. To provide more details for the energy sector and to allow for a distinction of the contribution of transport[74], the evolution of the different source categories of sector 1 'Energy' (1A1, 1A2, 1A3, 1A4, 1A5, and 1B) is shown in Fig. 54 and Fig. 55. Finally, Fig. 56 shows the projections of indirect CO_2 emissions and Fig. 57 the projections of Switzerland's greenhouse gas emissions from international transport. In the following, a brief description of the characteristics of each of the three scenarios is presented.

Box: 'With existing measures' (WEM) scenario

Including the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions and removals under the WEM scenario are projected to decrease to 68.6 and 60.7 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Excluding the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions under the WEM scenario are projected to decrease to 66.2 and 56.7 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Under the **WEM scenario**, the evolution of emissions is as follows (see lower panel in Fig. 51). While the source category covering residential and commercial/institutional buildings (1A4) dominated total emissions in 1990, its emissions gradually decreased and are projected to continue on a decreasing pathway, reaching 50.2 per cent and 40.8 per cent of the level in 1990 by 2030 and 2040, respectively (Fig. 55). Emissions from transport (1A3), on the other hand, increased considerably (by 13.4 per cent) between 1990 and 2008, exceeding emissions from residential and commercial/institutional buildings by 2007. Emissions from the transport sector are largely driven by passenger cars. In the course of about the last decade, efforts to reduce specific vehicle emissions have finally become sufficiently effective to counterbalance growth in vehicle kilometres. Thanks to the CO_2 emission regulations for newly registered vehicles (section II.D.3.2), as well as thanks to the autonomous technological progress, greenhouse gas emissions from the transport sector are projected to further decrease over the coming years. The emission reduction projected to be achieved by 2030 and 2040 is 28.3 per cent and 47.1 per cent compared to the highest level in 2008, bringing the emissions from the transport sector to 79.7 per cent and 58.9 per cent of the emissions in 1990, respectively. By 2030, the source category 'Manufacturing industries and construction' (1A2) contributes a reduction of 2.9 million tonnes of CO_2 equivalents below the level in 1990. Further contributions come from sector 2 'Industrial processes and product use' (overall reduction of 1.0 million tonnes of CO_2 equivalents, including an increase of F-gases by about 0.5 million tonnes of CO_2 equivalents[75]), sector 3 'Agriculture' (reduction of 1.2 million tonnes of CO_2 equivalents), sector 5 'Waste' (reduction of 1.3 million tonnes of CO_2 equivalents), and indirect CO_2 emissions (reduction of 0.3 million tonnes of CO_2 equivalents). Emissions from source category 1A1 are projected to be at about the level of 1990 by 2030, but an increase is projected after 2030. The source categories 1B and 1A5 are both projected to decrease by 0.1 million tonnes of CO_2 equivalents. Finally, management of forest land leads to net removals in the order of 2.9 million to 0.0 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040. In total, the land use, land-use change and forestry sector produces net removals of 2.5 million tonnes of CO_2 equivalents per year to net emissions of 0.4 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040 (Tab. 21).

[74] In the CTF-NDC tables 7 to 9, 'energy' consists of the greenhouse gas emissions from the source categories 1A1, 1A2, 1A4, 1A5 and 1B (which are targeted with the policies and measures presented in the sections II.D.1 and II.D.2), while 'transport' consists of the greenhouse gas emissions from source category 1A3 (which are targeted with the policies and measures presented in section II.D.3).

[75] By 2030, emissions of F-gases are projected to remain above the level of 1990, but historical data (and projections) indicate that emissions have been decreasing since about the year 2020.

Box: 'Without measures' (WOM) scenario

Including the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions and removals under the WOM scenario are projected to decrease to 99.3 and to increase to 102.5 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Excluding the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions under the WOM scenario are projected to decrease to 99.4 and to increase to 100.4 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Under the **WOM scenario**, policies and measures are excluded as of the bifurcation points indicated in Tab. 26, i.e. with a few exceptions as early as 1990. Consequently, the evolution of emissions under the WOM scenario does not show a distinct trend, but is rather characterised by inter-annual fluctuations around the level of 1990 (see lower panel in Fig. 51). The fact that emissions do not increase over time (e.g. due to population growth) is a result of autonomous technological progress improving the greenhouse gas efficiency even in the absence of (domestic) policies and measures. Emissions from energy industries (1A1) are projected to increase, particularly in 2029 and 2033, i.e. at the time when nuclear power plants are decommissioned and are assumed to be replaced by gas-fired combined-cycle power plants (see also Fig. 21 in Switzerland's fourth biennial report; *FOEN*, 2020). Accordingly, greenhouse gas emissions from energy industries (1A1) are projected to exceed, by 2030 and 2040, the emissions in 1990 by about 4.0 million and 7.0 million tonnes of CO_2 equivalents, respectively. A continuously increasing trend is also projected for emissions from sector 2 'Industrial processes and product use', which, driven by emissions of HFCs, increase by 1.4 million and 1.6 million tonnes of CO_2 equivalents by 2030 and 2040 compared to 1990, respectively. On the other hand, the source categories covering residential and commercial/institutional buildings (1A4), transport (1A3) and manufacturing industries and construction (1A2) show a decreasing trend also under the WOM scenario (1A2), offsetting the increasing trends in other sectors and source categories (see Fig. 54). Finally, management of forest land leads to net removals of 4.4 million to 2.3 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040. In total, the land use, land-use change and forestry sector produces net removals of 4.0 million to 1.9 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040 (Tab. 21). Notably, net emissions from land use, land-use change and forestry are lower under the WOM scenario compared to the WEM and WAM scenarios (see Fig. 52 and explanations below).

Box: 'With additional measures' (WAM) scenario

Including the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions and removals under the WAM scenario are projected to decrease to 69.4 and 59.3 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Excluding the contribution from land use, land-use change and forestry, Switzerland's total greenhouse gas emissions under the WAM scenario are projected to decrease to 62.9 and 51.9 per cent of the emissions in 1990 by 2030 and 2040, respectively.

Under the **WAM scenario**, emissions decrease faster, as new policies and measures are introduced and existing policies and measures are strengthened beyond the strengthening already stipulated under current legislation (i.e., under the WEM scenario, see lower panel in Fig. 51). While the energy sector (in particular transport, but also the source categories covering residential and commercial/institutional buildings, manufacturing industries and construction as well as energy industries) is mainly responsible for the additional emission reductions, contributions also come from the agriculture sector and from the additional reduction of emissions of F-gases within the industrial processes and product use sector (Fig. 52). Overall, the differences between the WEM and WAM scenarios are modest, as many of the previously planned polices and measures (or the planned strengthening of existing polices and measures) could be implemented/adopted within the framework of the third CO_2 Act and the Climate and Innovation Act. Finally, management of forest land leads to net emissions in the order of 0.6 million to 1.9 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040. In total, the land use, land-use change and forestry sector produces net emissions of 1.0 million to 2.3 million tonnes of CO_2 equivalents per year in the period from 2023 to 2040 (Tab. 21). Notably, net emissions from land use, land-use change and forestry are higher under the WAM scenario compared to the WEM and WOM scenarios (see Fig. 52 and explanations below).

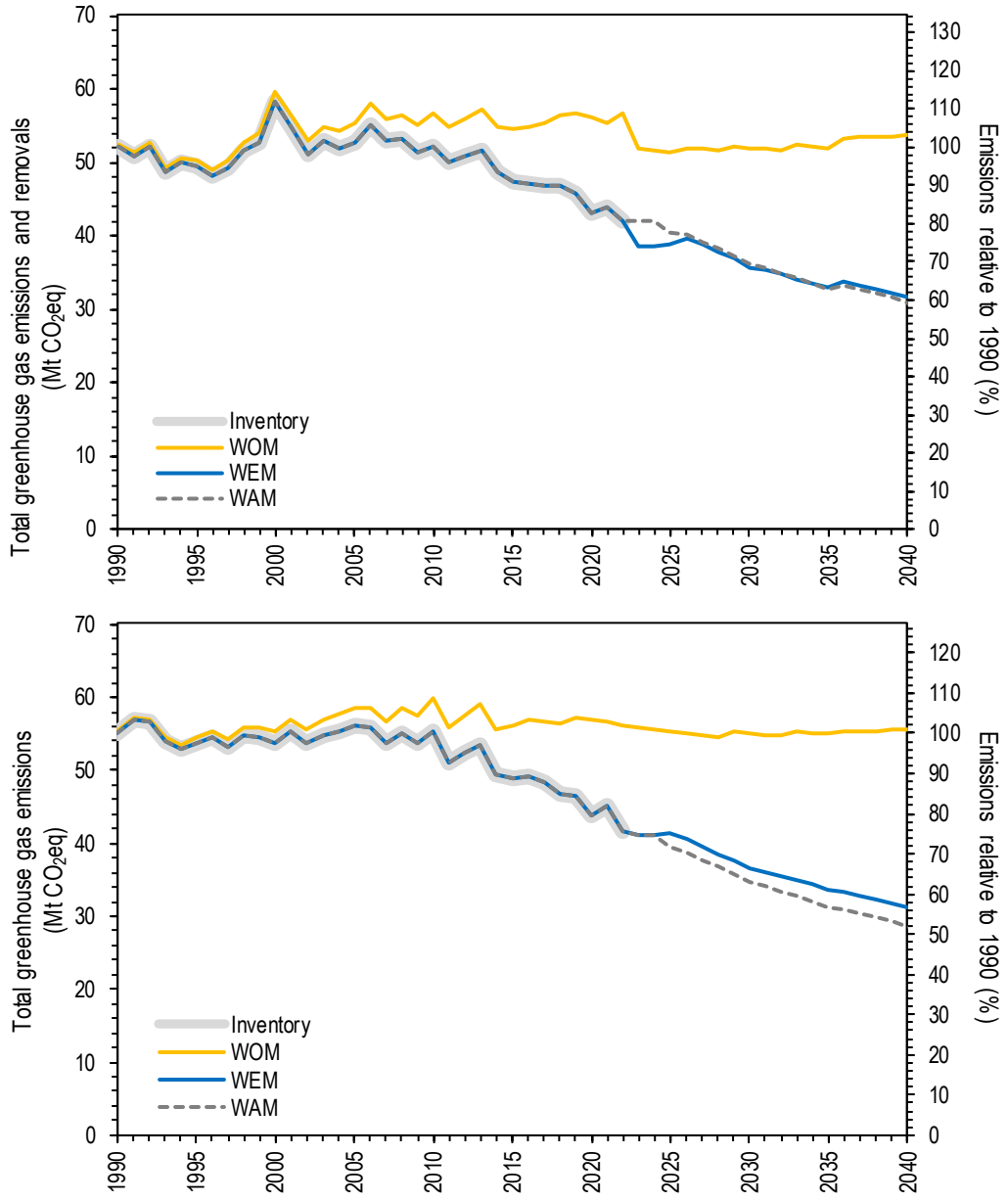
Regarding **land use, land-use change and forestry**, the differences between the WEM, WAM, and the WOM scenarios result from different assumptions in forest management practices, because all other parameters are identical for all scenarios (see section II.F.4.4). Under the WEM scenario, harvesting is assumed to increase, making the land use, land-use change and forestry sector a net source, with differences between the WEM and the WOM scenarios of 1.5 million to 2.3 million tonnes of CO_2 equivalents over the period from 2023 to 2040. The harvesting rates assumed under the WOM scenario, as derived from the continuation of recent forest management practices observed between 1990 and 2006, could lead to an unsustainable forest stand in the long run and, amongst other effects, jeopardise the capacity of forests to adapt to climate change. Therefore, despite the positive (short-term) effect with regard to carbon sequestration, the WOM scenario is not considered a preferable policy option. Under the WAM scenario, harvesting rates are increased to create forest stands with optimal conditions for adaptation to climate change and improving the resilience through natural regeneration or planting. This leads to a decline in carbon stocks and thus higher net emissions compared to the WEM and WOM scenarios. In Fig. 52, there is a distinctive shift from 2022 to 2023 in the WEM and the WOM scenarios. There a several reasons for this:

- Inventory data as reported in Switzerland's most recent greenhouse gas inventory (*FOEN*, 2024a) include the years 1990–2022. From 2023 onwards, simulation results are shown for the three scenarios. However, in the forest sector, scenarios and simulation with the model Massimo start at 2006 (see section II.F.4.4), leading to different pathways across the scenarios starting in 2006 and thus also differing from observed values for the period 2006–2022. The model Massimo calculates in 10-years intervals; in between the data are kept constant, explaining the step-wise output (values available for 2006, 2016, 2026 and 2036);
- The WEM scenario does not completely reflect reality. The scenarios used for this report were originally designed for forest development purposes, not for reporting under the UNFCCC. Swiss forest policy, the basis for the WEM scenario, defines goals to be reached, but the measures are not stringent in the sense that they do not include 'penalties' when goals are missed. The WOM scenario, which reflects recent management practices according to *Stadelmann et al.* (2021), is not a measure-based scenario, but a stochastic scenario. The forest management applied in reality lies somewhere between the forest management assumed under the WOM and WEM scenarios;
- Further, there are also methodological challenges which lead to a shift in the modelled and observed estimates (*Thürig et al.*, 2021). One of them is that the model runs on the forest plots common to the second national forest inventory (NFI2/1994–1996) and the third national forest inventory (NFI3/2004–2006), whereas the actual inventory data are valid for all plots being forest at the time of the inventory. Also, slightly different allometric functions are used for the simulation and the (more detailed) inventory estimates.

Regarding **international transport (bunkers)**, virtually all (more than 99 per cent, see Tab. 14) greenhouse gas emissions come from aviation, while greenhouse gas emissions from navigation are negligible. Greenhouse gas emissions from international transport are assumed to be the same under the WEM and WAM scenarios, while the absence of the sustainable aviation fuel policy (II.D.3.13) is projected to lead to higher emissions under the WOM scenario (see section II.F.4.7 for details). By 2030 and 2040, emissions from international transport are projected to increase to 213.1 and 216.8 per cent of the emissions in 1990 under the WEM and WAM scenario, respectively. Under the WOM scenario, emissions are projected to increase to 226.7 and 230.6 per cent of the emissions in 1990 by 2030 and 2040, respectively. Accordingly, emissions from international transport more than double by 2030 and 2040 compared to 1990 under all scenarios.

This chapter focuses on projections of domestic emissions and removals under the different scenarios. While Switzerland's focus is indeed on domestic emission reductions, internationally transferred mitigation outcomes play a subsidiary role in achieving international and national emission reduction targets, but are not taken into account in the scenarios presented here.

Fig. 51 > Total greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios up to 2040 (values are provided in Tab. 21 and Tab. 22). Also shown are actual inventory data for the years 1990 to 2022. The vertical axis to the right indicates the percentage relative to historical emissions and removals according to the greenhouse gas inventory in 1990. Upper panel: Emissions and removals as relevant for Switzerland's emission reduction targets (i.e. including net emissions of all greenhouse gases from the sectors 1, 2, 3, 4, 5 and 6, including indirect CO_2 emissions, excluding emissions from international transport), corresponding to the projection of Switzerland's key indicator to determine progress towards the nationally determined contribution. Lower panel: As upper panel, but excluding emissions and removals from land use, land-use change and forestry (sector 4).



Tab. 21 > Switzerland's greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios, by sector. The total is shown as relevant for Switzerland's emission reduction targets (i.e. including net emissions of all greenhouse gases from the sectors 1, 2, 3, 4, 5 and 6, including indirect CO_2 emissions, excluding emissions from international transport). In addition, the total is also shown without the contribution from land use, land-use change and forestry. From 1990 to 2022, the WEM and WAM scenarios correspond to actual inventory data.

		1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
		Mt CO_2eq										
Total (as relevant for Switzerland's emission reduction targets)	**WEM**	52.1	49.5	58.2	52.8	52.2	47.3	43.1	38.9	35.7	32.9	31.6
	WOM	52.4	50.2	59.6	55.4	56.8	54.7	56.3	51.3	52.0	52.0	53.7
	WAM	52.1	49.5	58.2	52.8	52.2	47.3	43.1	40.5	36.1	32.8	30.9
Total excluding LULUCF	**WEM**	55.1	53.8	53.8	56.1	55.3	48.9	43.8	41.4	36.4	33.6	31.2
	WOM	55.3	54.5	55.2	58.6	59.9	56.2	57.0	55.3	55.0	55.0	55.6
	WAM	55.1	53.8	53.8	56.1	55.3	48.9	43.8	39.6	34.6	31.3	28.6
1 Energy	WEM	41.6	41.6	42.0	43.8	43.1	37.0	32.5	31.1	26.9	24.3	22.2
	WOM	41.9	42.1	43.0	45.7	46.6	43.0	43.9	42.2	42.0	42.0	42.6
	WAM	41.6	41.6	42.0	43.8	43.1	37.0	32.5	29.3	25.2	22.6	20.5
1A1 Energy industries	WEM	2.5	2.6	3.2	3.8	3.9	3.3	3.3	3.0	2.5	2.6	2.8
	WOM	2.5	2.7	3.2	3.8	4.0	4.1	5.2	5.2	6.5	7.7	9.5
	WAM	2.5	2.6	3.2	3.8	3.9	3.3	3.3	2.7	2.3	2.3	2.5
1A2 Manufacturing industries and construction	WEM	6.6	6.3	6.0	6.0	5.9	5.0	4.5	4.5	3.7	3.5	3.5
	WOM	6.6	6.3	6.0	6.1	6.0	5.6	5.6	5.3	5.1	5.1	5.0
	WAM	6.6	6.3	6.0	6.0	5.9	5.0	4.5	4.1	3.3	3.2	3.1
1A3 Transport	WEM	14.7	14.3	16.0	15.8	16.3	15.3	13.6	13.6	11.7	10.1	8.6
	WOM	14.7	14.3	16.1	16.2	17.0	16.1	15.8	15.2	14.8	14.2	13.7
	WAM	14.7	14.3	16.0	15.8	16.3	15.3	13.6	13.0	11.2	9.6	8.1
1A4 Other sectors	WEM	17.5	18.1	16.6	17.9	16.8	13.2	11.0	9.9	8.8	7.9	7.2
	WOM	17.8	18.6	17.5	19.4	19.3	17.0	17.1	16.2	15.4	14.8	14.2
	WAM	17.5	18.1	16.6	17.9	16.8	13.2	11.0	9.3	8.3	7.4	6.6
1A5 Military	WEM	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WOM	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WAM	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1B Fugitive emissions from oil and natural gas	WEM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WOM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WAM	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2 Industrial processes and product use	WEM	3.9	3.3	3.7	4.3	4.4	4.3	4.1	3.4	2.9	2.7	2.5
	WOM	3.9	3.3	3.7	4.5	4.9	5.0	5.1	5.3	5.3	5.4	5.5
	WAM	3.9	3.3	3.7	4.3	4.4	4.3	4.1	3.4	2.8	2.4	2.3
3 Agriculture	WEM	6.9	6.6	6.2	6.1	6.2	6.1	5.9	5.7	5.6	5.6	5.6
	WOM	6.9	6.6	6.2	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2
	WAM	6.9	6.6	6.2	6.1	6.2	6.1	5.9	5.7	5.6	5.2	4.9
4 LULUCF	WEM	–3.0	–4.3	4.4	–3.2	–3.1	–1.5	–0.7	–2.5	–0.7	–0.7	0.4
	WOM	–3.0	–4.3	4.4	–3.2	–3.1	–1.5	–0.7	–4.0	–3.0	–3.0	–1.9
	WAM	–3.0	–4.3	4.4	–3.2	–3.1	–1.5	–0.7	1.0	1.5	1.5	2.3
5 Waste	WEM	2.3	1.9	1.8	1.7	1.5	1.3	1.2	1.1	1.0	0.9	0.8
	WOM	2.3	2.0	1.9	1.8	1.7	1.5	1.4	1.2	1.1	1.0	0.9
	WAM	2.3	1.9	1.8	1.7	1.5	1.3	1.2	1.1	1.0	0.9	0.8
6 Other	WEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WOM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WAM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect CO_2	WEM	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WOM	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4
	WAM	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
International transport (not included in the total)	*WEM*	3.1	3.7	4.7	3.6	4.3	5.0	2.1	6.4	6.7	6.9	6.8
	WOM	3.1	3.7	4.7	3.6	4.3	5.0	2.1	6.4	7.1	7.3	7.3
	WAM	3.1	3.7	4.7	3.6	4.3	5.0	2.1	6.4	6.7	6.9	6.8

Tab. 22 > Switzerland's greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios, by gas. Values are shown as relevant for Switzerland's emission reduction targets (i.e. including net emissions of all greenhouse gases from the sectors 1, 2, 3, 4, 5 and 6, including indirect CO_2 emissions, excluding emissions from international transport). In addition, the total as well as the gases CO_2, CH_4 and N_2O are also shown without the contribution from land use, land-use change and forestry (sector 4). From 1990 to 2022, the WEM and WAM scenarios correspond to actual inventory data. For all scenarios, the maximum value for NF_3 is reached in the year 2010 (11.9 thousand tonnes of CO_2 equivalents).

		1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
		Mt CO_2eq										
Total (as relevant for Switzerland's emission reduction targets)	**WEM**	52.1	49.5	58.2	52.8	52.2	47.3	43.1	38.9	35.7	32.9	31.6
	WOM	52.4	50.2	59.6	55.4	56.8	54.7	56.3	51.3	52.0	52.0	53.7
	WAM	52.1	49.5	58.2	52.8	52.2	47.3	43.1	40.5	36.1	32.8	30.9
Total excluding LULUCF	**WEM**	55.1	53.8	53.8	56.1	55.3	48.9	43.8	41.4	36.4	33.6	31.2
	WOM	55.3	54.5	55.2	58.6	59.9	56.2	57.0	55.3	55.0	55.0	55.6
	WAM	55.1	53.8	53.8	56.1	55.3	48.9	43.8	39.6	34.6	31.3	28.6
CO_2 (including LULUCF, excluding international transport)	WEM	41.1	39.0	48.0	42.5	41.9	37.1	33.5	30.4	27.9	25.4	24.4
	WOM	41.4	39.5	49.0	44.4	45.3	43.1	44.8	39.8	40.5	40.5	42.2
	WAM	41.1	39.0	48.0	42.5	41.9	37.1	33.5	32.0	28.4	25.9	24.6
CO_2 (excluding LULUCF, excluding international transport)	WEM	44.1	43.4	43.6	45.8	45.0	38.7	34.2	32.9	28.7	26.1	24.0
	WOM	44.4	43.9	44.7	47.7	48.5	44.7	45.5	43.8	43.6	43.6	44.2
	WAM	44.1	43.4	43.6	45.8	45.0	38.7	34.2	31.1	27.0	24.5	22.3
CH_4 (including LULUCF, excluding international transport)	WEM	6.3	5.9	5.5	5.5	5.4	5.2	5.0	4.8	4.7	4.7	4.6
	WOM	6.3	6.0	5.6	5.6	5.6	5.4	5.4	5.3	5.2	5.1	5.1
	WAM	6.3	5.9	5.5	5.5	5.4	5.2	5.0	4.8	4.7	4.4	4.0
CH_4 (excluding LULUCF, excluding international transport)	WEM	6.2	5.8	5.5	5.5	5.4	5.2	4.9	4.8	4.7	4.6	4.6
	WOM	6.2	5.9	5.6	5.6	5.6	5.4	5.4	5.2	5.2	5.1	5.1
	WAM	6.2	5.8	5.5	5.5	5.4	5.2	4.9	4.8	4.7	4.3	4.0
N_2O (including LULUCF, excluding international transport)	WEM	4.1	4.0	3.7	3.5	3.3	3.1	3.0	2.4	2.3	2.2	2.1
	WOM	4.1	4.0	3.7	3.5	3.3	3.3	3.2	3.2	3.2	3.1	3.1
	WAM	4.1	4.0	3.7	3.5	3.3	3.1	3.0	2.4	2.3	2.1	2.0
N_2O (excluding LULUCF, excluding international transport)	WEM	4.0	3.9	3.7	3.4	3.3	3.1	3.0	2.4	2.2	2.2	2.1
	WOM	4.0	3.9	3.7	3.4	3.3	3.2	3.2	3.1	3.1	3.1	3.0
	WAM	4.0	3.9	3.7	3.4	3.3	3.1	3.0	2.4	2.2	2.1	1.9
HFCs	WEM	0.0	0.2	0.6	1.0	1.2	1.4	1.4	1.1	0.7	0.5	0.4
	WOM	0.0	0.2	0.6	1.3	1.8	2.1	2.3	2.4	2.5	2.5	2.6
	WAM	0.0	0.2	0.6	1.0	1.2	1.4	1.4	1.1	0.6	0.3	0.1
PFCs	WEM	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WOM	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WAM	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF_6	WEM	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.0	0.0
	WOM	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2
	WAM	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.0	0.0
NF_3	WEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WOM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WAM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indirect CO_2	WEM	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WOM	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4
	WAM	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Fig. 52 > Switzerland's greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios, by sector as shown in Tab. 21 (international transport is visualised in Fig. 57). Also shown are actual inventory data for the years 1990 to 2022. See Fig. 54 for a more detailed disaggregation within the energy sector, in particular allowing for a distinction of the transport sector. The reason for the substantial reduction of emissions in sector 2 'Industrial processes and product use' from 2020 to 2021 under the WEM and WAM scenarios is that a chemical plant installed a new catalyst in the course of 2021, thereby substantially reducing N_2O emissions. For sector 6 'Other', all scenarios are identical.

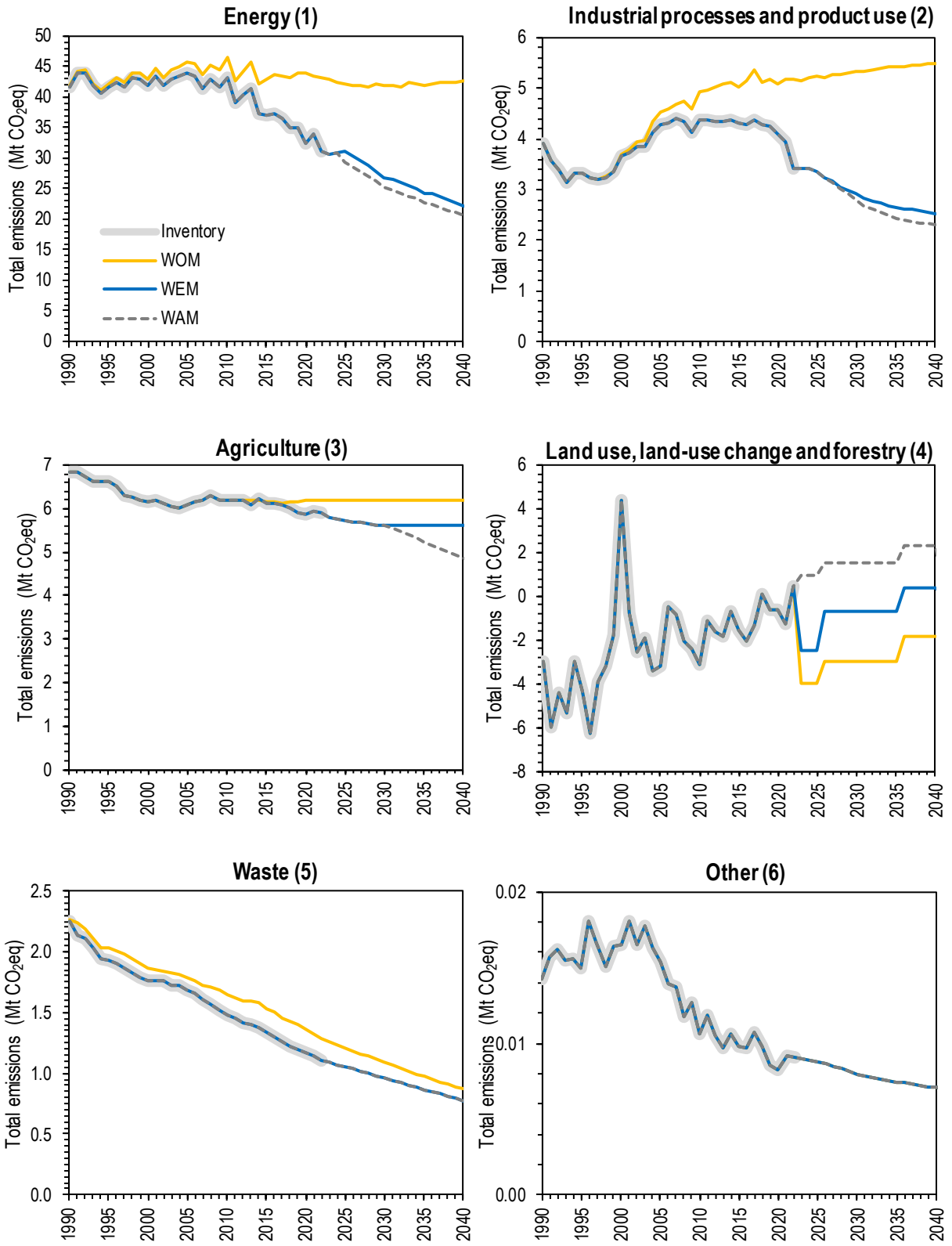


Fig. 53 > Switzerland's greenhouse gas emissions and removals under the WEM, WOM and WAM scenarios by gas as shown in Tab. 22. Values are shown as relevant for Switzerland's emission reduction targets (i.e. including net emissions of all greenhouse gases from the sectors 1, 2, 3, 4, 5 and 6, excluding emissions from international transport). Indirect CO_2 emissions are shown in Fig. 56. Also shown are actual inventory data for the years 1990 to 2022. The panel for SF_6 and NF_3 shows the sum of the two gases (SF_6 strongly dominates, see Tab. 22 for the individual contributions). The reason for the substantial reduction of N_2O emissions from 2020 to 2021 under the WEM and WAM scenarios is that a chemical plant installed a new catalyst in the course of 2021.

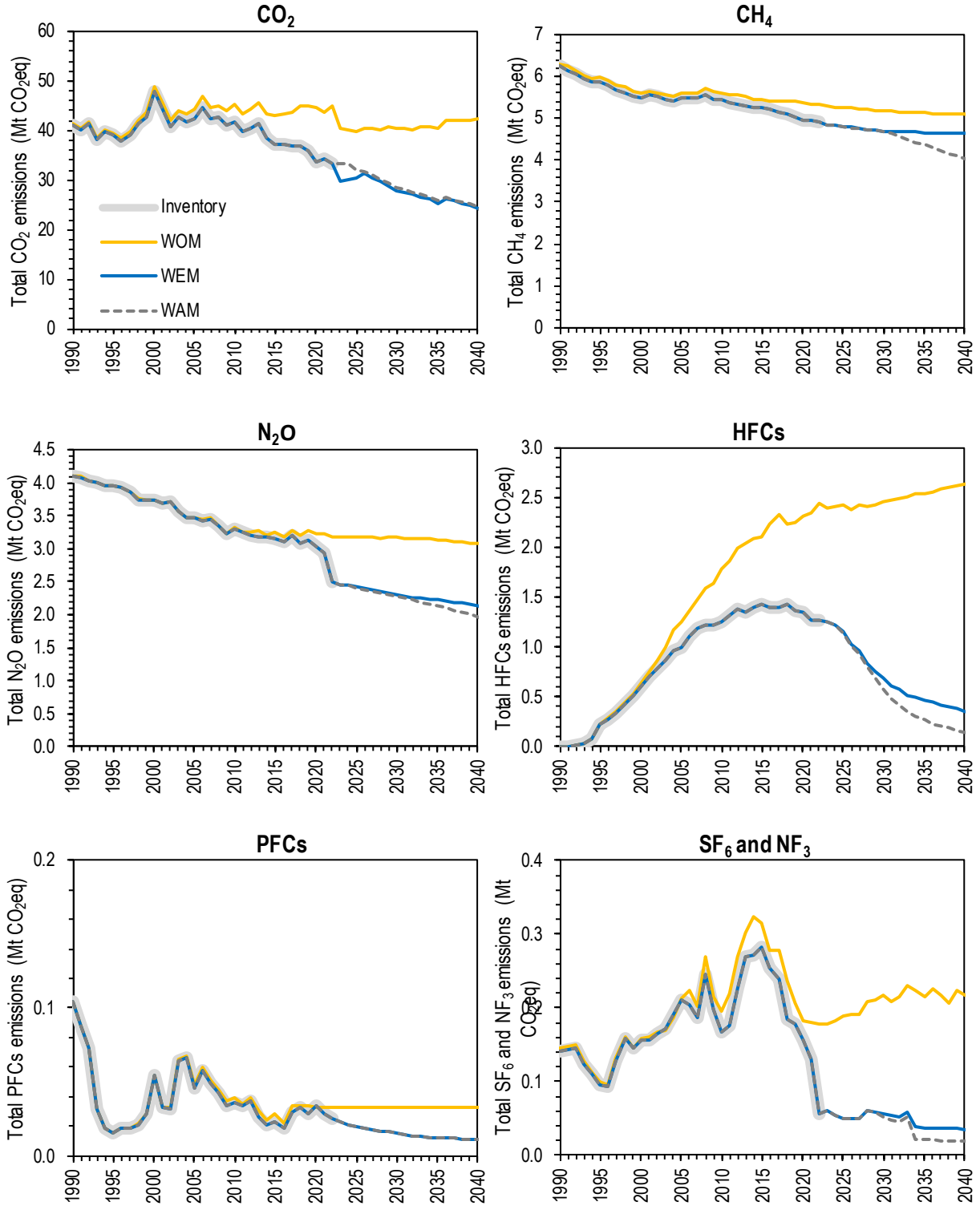


Fig. 54 > Switzerland's greenhouse gas emissions in the different source categories of the energy sector under the WEM, WOM and WAM scenarios as shown in Tab. 21. Also shown are actual inventory data for the years 1990 to 2022. 'Transport' corresponds to source category 1A3. Source category 1A4 is dominated by greenhouse gas emissions from residential and commercial use of fossil fuels, while source category 1A5 covers greenhouse gas emissions from non-road military vehicles including military aviation. For the source categories 1A5 'Other' and 1B 'Fugitive emissions from oil and natural gas' the WOM scenarios (hidden orange lines) are identical to the WEM scenarios.

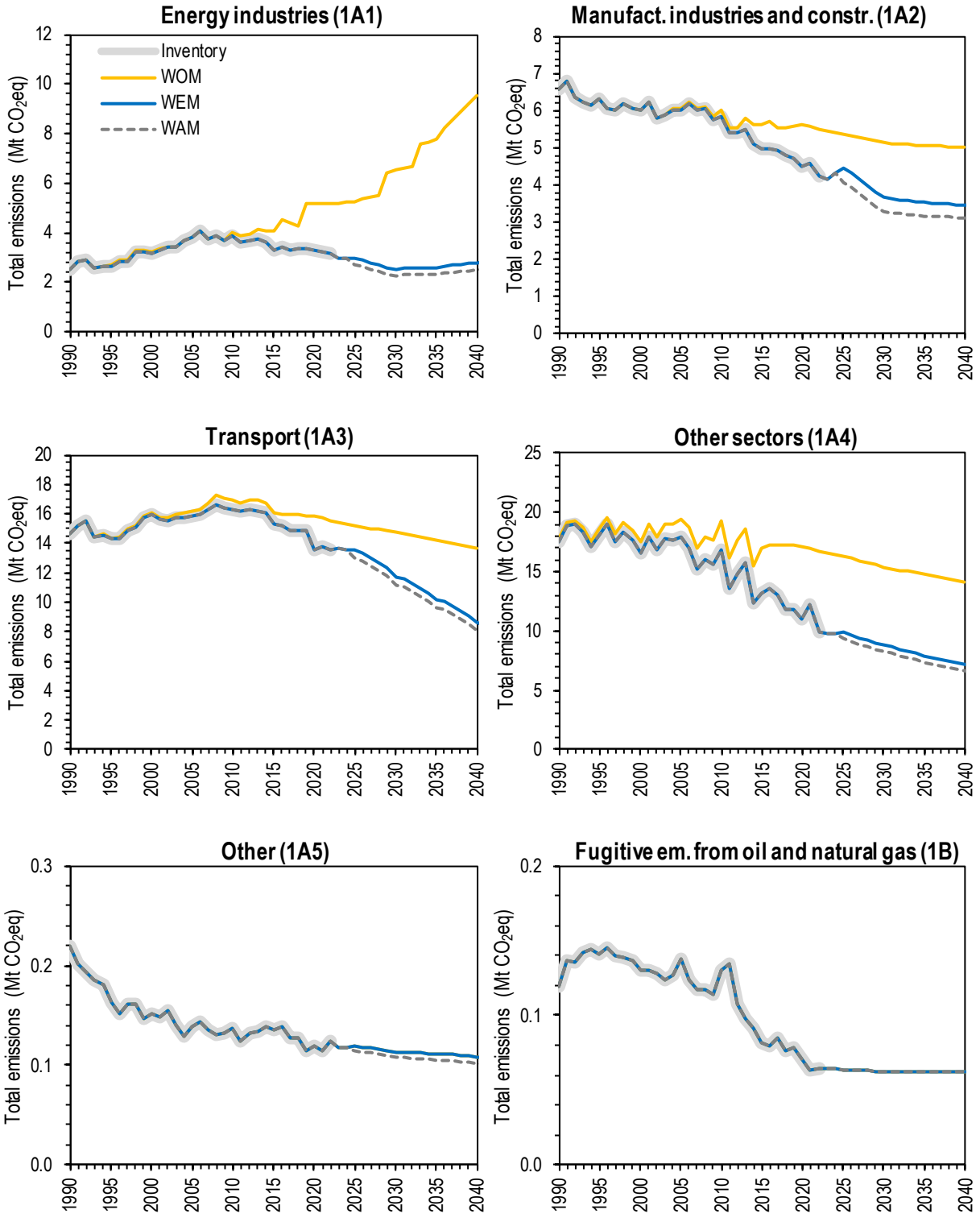


Fig. 55 > Contribution of the different sectors to the evolution of Switzerland's total greenhouse gas emissions under the WEM, WOM and WAM scenarios. The energy sector is further disaggregated (1A1, 1A2, 1A3, 1A4, 1A5, and 1B) to illustrate the most important source categories. Not shown are emissions and removals from land use, land-use change and forestry as well as emissions from international transport.

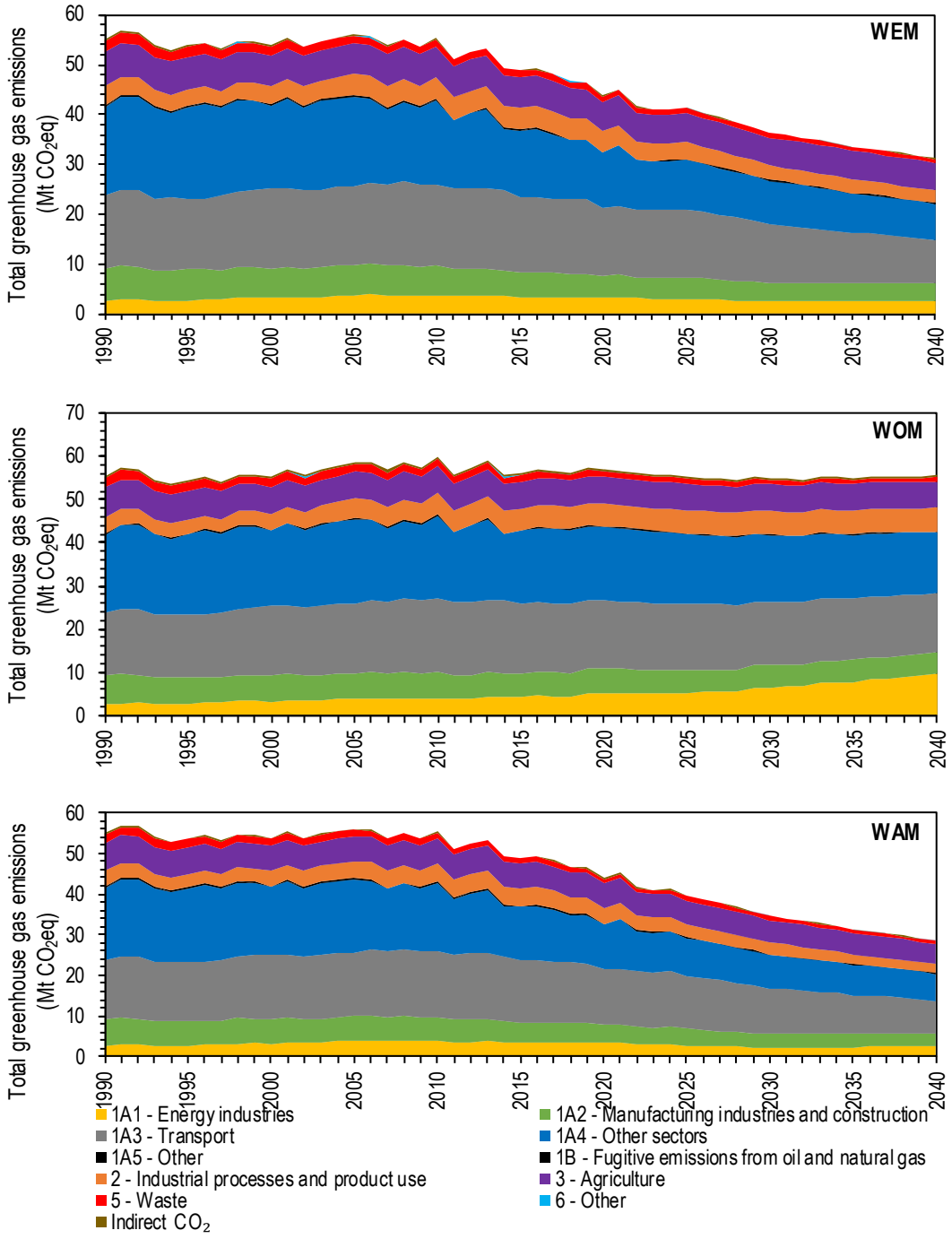


Fig. 56 > Switzerland's indirect CO_2 emissions under the WEM, WOM and WAM scenarios as shown in Tab. 21. Indirect CO_2 emissions are relevant for Switzerland's emission reduction targets. Also shown are actual inventory data for the years 1990 to 2022. The WEM and the WAM scenarios are identical.

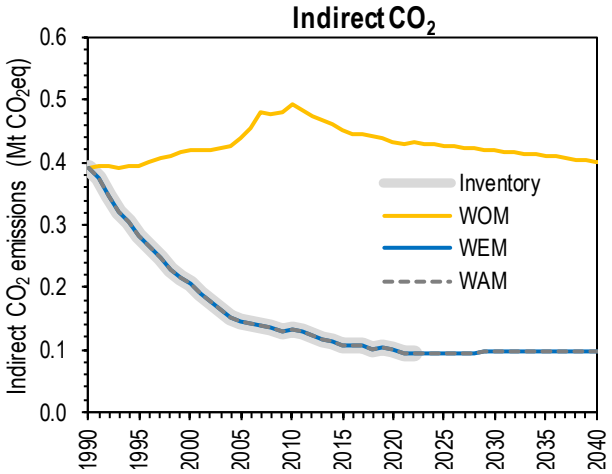
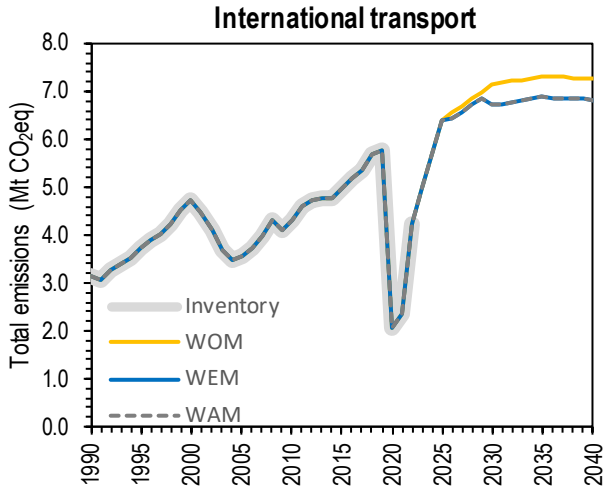


Fig. 57 > Switzerland's greenhouse gas emissions from international transport under the WEM, WOM and WAM scenarios as shown in Tab. 21. Also shown are actual inventory data for the years 1990 to 2022. The WEM and the WAM scenarios are identical.



II.F.2 Policies and measures considered under the WEM, WOM and WAM scenarios

Tab. 23 gives an overview of the policies and measures considered under the different scenarios; details regarding each policy and measure are discussed in chapter II.D.

Tab. 23 > Policies and measures considered under the WEM, WOM and WAM scenarios (policies and measures marked with a dot are considered under the respective scenario). The bifurcation points for the WEM and WOM scenarios are shown in Tab. 26. Under the WAM scenario, some measures are strengthened/adjusted compared to the WEM scenario.

Measure	Section in chapter II.D	Sector	WEM	WOM	WAM	Remark
First CO_2 Act (1999)	II.D.1.2	Cross-sectoral	●		●	
Second CO_2 Act (2011)	II.D.1.3	Cross-sectoral	●		●	
Third CO_2 Act (2025)	II.D.1.4	Cross-sectoral	●		●	The strengthening of the WAM compared to WEM is not yet well enough defined to be translated to a concrete mitigation impact and could therefore not be taken into account (the legislative process is currently at the very beginning).
Climate and Innovation Act	II.D.1.5	Cross-sectoral	●		●	
CO_2 levy on heating and process fuels	II.D.1.6	Cross-sectoral	●		●	
Emissions trading scheme	II.D.1.7	Cross-sectoral	●		●	WAM strengthened compared to WEM, however, the planned strengthening is also considered under the WEM scenario as the corresponding adjustments are a condition for maintaining the link between the Swiss and the European emissions trading schemes.
Negotiated reduction commitments (for exemption from the CO_2 levy)	II.D.1.8	Cross-sectoral	●		●	WAM strengthened compared to WEM.
Promotion of innovative technologies and processes	II.D.1.9	Cross-sectoral	●		●	
Exemplary function of the Swiss Confederation and the cantons	II.D.1.10	Cross-sectoral				This policy and measure could not yet be included in the WEM and WAM scenarios, because definition of the most relevant measures is still ongoing.
Act on a Secure Electricity Supply from Renewable Energy Sources	II.D.2.2	Energy	●		●	The Swiss Federal Office of Energy refrains from estimating the mitigation impact of the SwissEnergy programme (for explanations see section II.D.2.2). In contrast, *Prognos et al.* (2020) implicitly include this policy and measure when estimating overall technical progress.
SwissEnergy programme	II.D.2.3	Energy	●		●	The Swiss Federal Office of Energy refrains from estimating the mitigation impact of the SwissEnergy programme (for explanations see section II.D.2.3). In contrast, *Prognos et al.* (2020) implicitly include this policy and measure when estimating overall technical progress.
National buildings refurbishment programme	II.D.2.4	Energy	●		●	
Building codes of the cantons	II.D.2.5	Energy	●		●	The strengthening of the WAM compared to WEM is not yet well enough defined to be translated to a concrete mitigation impact and could therefore not be taken into account.
Feed-in tariff system and floating market premium	II.D.2.6	Energy	●		●	
Investment aids	II.D.2.7	Energy	●		●	
Decarbonisation of installations in the emissions trading scheme	II.D.2.8	Energy	●		●	
Impulse programme for the replacement of heat generation systems and energy efficiency measures	II.D.2.9	Energy	●		●	
Safeguarding against the risks of investments in public infrastructure	II.D.2.10	Energy	●		●	
Negotiated reduction commitment of municipal solid waste incineration plant operators	II.D.2.11	Energy				This policy and measure points at the net emissions of municipal solid waste incineration plants, i.e. it is expected that emission reductions are achieved mainly by indirect savings thanks to the additional production of electricity and heat as well as the recovery of metals from the bottom ash. In particular the latter may indirectly reduce greenhouse gas emissions outside Switzerland. For these reasons, the policy and measure is not considered for the projections (all scenarios). The new agreement which aims at equipping at least one plant with a unit for carbon capture and storage is also not considered, given its limited impact and pilot character.

CO_2 emission regulations for newly registered vehicles	II.D.3.2	Transport	●		●	
Energy label for new motor vehicles	II.D.3.3	Transport	●		●	
Partial compensation of CO_2 emissions from motor fuel use	II.D.3.4	Transport	●		●	The mitigation impact of the preceding 'Climate Cent' is considered as well under the WEM and WAM scenarios. WAM strengthened compared to WEM.
Heavy vehicle charge	II.D.3.5	Transport	●		●	The strengthening/adjustment of the WAM compared to WEM is not yet well enough defined to be translated to a concrete mitigation impact and could therefore not be taken into account.
Mineral oil tax reduction on biofuels and natural gas	II.D.3.6	Transport	●		●	
Promotion of electric propulsion technologies in public transport	II.D.3.7	Transport	●		●	
International exhaust gas regulations (NMVOC)	II.D.3.8	Transport	●		●	Relevant for indirect CO_2 emissions.
CO_2 emissions standard for aircraft	II.D.3.9	Transport	●	●	●	As this policy and measure is of global significance, it is assumed that it does not lead to differences between the WEM, WOM and WAM scenarios.
Carbon offsetting and reduction scheme for international civil aviation (CORSIA)	II.D.3.10	Transport				Not explicitly included in the emission perspectives.
Non-volatile particulate matter emission regulation for aircraft engines	II.D.3.11	Transport				Relevant for aviation non-CO_2 climate impacts from clouds.
NO_x emission regulation for aircraft engines	II.D.3.12	Transport				Relevant for aviation non-CO_2 climate impacts from clouds.
Sustainable aviation fuel policy	II.D.3.13	Transport	●		●	
Provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, NF_3)	II.D.4.2	IPPU	●		●	WAM strengthened compared to WEM.
Ordinance on Air Pollution Control	II.D.4.3	IPPU	●		●	Relevant for indirect CO_2 emissions.
NMVOC incentive fee	II.D.4.4	IPPU	●		●	Relevant for indirect CO_2 emissions.
Obligations in relation to chemical conversion processes (N_2O)	II.D.4.5	IPPU	●		●	Catalyst installed at the respective chemical plant in the course of 2021.
Reduction pathway on nutrients	II.D.5.2	Agriculture	●		●	
Direct payments	II.D.5.3	Agriculture	●		●	
Proof of ecological performance to receive direct payments	II.D.5.4	Agriculture	●	●	●	Because the bifurcation point of the WEM and WOM scenarios of this measure is 2011 (Tab. 26), most of the mitigation impact provided in section II.D.5.2 and Tab. 11 is reflected in all scenarios (as the mitigation impact reported in Tab. 11 is mostly achieved in the early 1990s).
Resource programme (subsidies for a more efficient use of natural resources)	II.D.5.5	Agriculture				Historical data include the impact of the resource programme, but it is technically not possible to model the future impact (see explanations in section II.F.4.3).
Structural improvement measures	II.D.5.6	Agriculture	●		●	The planned strengthening concerns exclusively emissions from fossil fuel combustion and does not affect emissions from the agriculture sector.
Notification requirement for the trade in nutrients	II.D.5.7	Agriculture				The policy and measure increases transparency and controllability, however, it has no direct effect on greenhouse gas emissions.
Climate strategy for agriculture and food	II.D.5.8	Agriculture	●		●	WAM strengthened compared to WEM.
Forest Act (sustainable forest management and forest area conservation)	II.D.6.2	LULUCF	●		●	
Wood Action Plan (implementation of Swiss Wood Resource Policy)	II.D.6.3	LULUCF	●		●	
Measures within Forest Policy (objectives and implementation)	II.D.6.4	LULUCF	●		●	
Forest Act (changes due to revision 2017)	II.D.6.5	LULUCF	●		●	
Ban on landfilling of combustible waste	II.D.7.2	Waste	●		●	
Ordinance on the Avoidance and Management of Waste	II.D.7.3	Waste	●		●	

IPPU, industrial processes and product use; LULUCF, land use, land-use change and forestry

II.F.3 Key underlying assumptions and parameters

To provide a general overview of the drivers of Switzerland's scenarios, Tab. 24 shows key underlying assumptions and parameters used for the modelling of projections. The information provided corresponds to the information reported in CTF-NDC table 11 and provides the basis for all scenarios (see section II.F.4 for assumptions which vary from scenario to scenario). Population is assumed to increase considerably over the coming decades.[76] Other key underlying assumptions and parameters are also projected to increase in the future. Indeed, Switzerland's gross domestic product, which also strongly influences energy consumption and greenhouse gas emissions, is assumed to increase considerably over the coming decades. The projection of the energy reference area – i.e. the sum of heated gross floor areas, above and below ground – is closely related to the projection of population, but additionally reflects the increasing demand for living area per capita and fewer persons per household (Tab. 24 shows the total energy references area, including household, services and industries). The projection of heating degree days follows the climate scenarios established for Switzerland (RCP4.5, see section 6.3.9 of Switzerland's eighth national communication and fifth biennial report for more details). While for historical years the heating degree days reflect the observed natural variability of meteorological conditions (mainly during winter), a smooth trend is assumed for projected years reflecting the expected average meteorological conditions. Accordingly, for future years the greenhouse gas emissions scenarios are based on average meteorological conditions, which are also reflected in the average day temperatures. However, as in the past, actual emissions may vary substantially from year to year in the future as well. The projections of energy prices reflect the values used by the International Energy Agency in its World Energy Outlook 2018.[77] The key underlying assumptions and parameters 1–8 stem from *Prognos et al.* (2020)[78], no values are provided for the year 1990 (relevant for the projections are in particular the values reaching beyond the latest inventory year). In the data table[78], *Prognos et al.* (2020) provide plenty of further and very detailed assumptions used to establish the projections, such as energy uses in different sectors, split of energy carriers, etc. The key underlying assumptions and parameters 9–10 with regard to transport stem from *FOEN* (2024a) and are directly implemented in the national air pollution database EMIS.

Tab. 24 > Historical and projected key underlying assumptions and parameters used for the modelling of Switzerland's greenhouse gas emission projections.

Key underlying assumptions and parameters	Unit	Historical				Projected			
		1990 [a]	2000	2010	2020 [b]	2025	2030	2035	2040
1 Population (annual mean)	Million inhabitants	NA	7.18	7.83	8.71	9.11	9.49	9.82	10.02
2 Gross domestic product (prices 2017)	Billion Swiss francs	NA	520	603	713	760	805	851	893
3 Energy reference area (total)	Million square metres	NA	621	706	782	816	847	874	890
4 Full-time equivalents (all sectors)	Million	NA	3.42	3.76	4.14	4.24	4.31	4.38	4.42
5 Heating degree days	Number	NA	3 081	3 586	3 182	3 135	3 089	3 042	2 997
6 Average day temperature	Degrees Celsius	NA	10.4	9.0	10.2	10.3	10.5	10.6	10.8
7 Crude oil price (prices 2017)	US dollars per megawatt-hour	NA	38.8	87.5	74.8	88.0	96.0	104.5	112.0
8 Price for natural gas (prices 2017)	US dollars per megawatt-hour	NA	13.3	28.5	24.4	26.7	28.0	29.4	30.7
9 Passenger cars	Million vehicle kilometres	42 649	45 613	52 066	53 371	61 749	63 691	65 335	66 154
10 Freight transport (road) and buses	Million vehicle kilometres	4 874	5 529	6 090	7 436	7 687	8 111	8 529	8 941

[a] The key underlying assumptions and parameters and parameters 1–8 stem from *Prognos et al.* (2020), no values are provided in the respective data table for the year 1990 (relevant for the projections are in particular the values reaching beyond the latest inventory year).

[b] The values used by *Prognos et al.* (2020) for 2020 are based on projections and may differ from real historical values.

Prognos et al. (2020); *FOEN* (2024a)

[76] https://www.bfs.admin.ch/bfs/en/home/statistics/population/population-projections/national-projections.html

[77] https://www.iea.org/reports/world-energy-outlook-2018

[78] See data table named 'EP2050+_Ergebnissynthese_2020-2060_WWB_KKW50_aktuelleRahmenbedingungen_2022-04-12.xlsx'.

II.F.4 Methodology

The methodologies applied to establish Switzerland's greenhouse gas emission scenarios are tailored to the particular characteristics of each sector, always ensuring consistency with actual data of the greenhouse gas inventory. To provide a basic understanding of the models and approaches used, details relevant for each sector are summarised in Tab. 25 and discussed in the following sections.

Tab. 25 > Overview of models and approaches used to project Switzerland's greenhouse gas emissions from different sectors.

	Gases	Type and characteristics of approach or model	Original purpose of approach or model	Strengths and weaknesses	Accounting of overlaps and synergies
1 Energy[79] (including international transport)	CO_2, CH_4, N_2O	Model network of various energy system models. The resulting energy demand is transferred to the national air pollution database EMIS to calculate emissions of greenhouse gases.	Energy perspectives 2050+ of the Swiss Confederation to develop an energy system that is compatible with the long-term climate goal of net-zero greenhouse gas emissions by 2050 and, at the same time, ensures a secure energy supply.	Comprehensive simulation of Switzerland's energy system (due to the level of detail, development takes several years), simultaneously taking into account the medium to long-term climate and energy policy targets.	Accounts implicitly for the overall interactions between the effects of different policies and measures, direct and indirect rebound effects, as well as spill-over effects in all economic sectors.
2 Industrial processes and product use	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	Bottom-up estimates according to the 2006 IPCC guidelines for national greenhouse gas inventories.	Greenhouse gas inventory (no fundamental adjustments needed).	Calculations at the level of single processes, requiring a full set of projections of activity data and emission factors.	Policies and measures are assumed to target distinct sources of greenhouse gases, i.e. overlaps and synergies are considered negligible.
3 Agriculture	CO_2, CH_4, N_2O				
4 Land use, land-use change and forestry		Stochastic empirical single tree forest management scenario model (Massimo) for CO_2, simple assumptions for CH_4 and N_2O.	Projections of the development of forest resources.	Specifically designed to reflect the characteristics of Swiss forests, based on data from the national forest inventories.	
5 Waste		Bottom-up estimates according to the 2006 IPCC guidelines for national greenhouse gas inventories.	Greenhouse gas inventory (no fundamental adjustments needed).	Calculations at the level of single processes, requiring a full set of projections of activity data and emission factors.	
Indirect CO_2	Indirect CO_2				

Tab. 26 > Bifurcation points of the WEM and WOM scenarios for the individual sectors. For the WEM and WAM scenarios, historical data from the most recent greenhouse gas inventory are used, i.e. until 2022. After 2022, the WAM scenario starts to increasingly deviate from the WEM scenario as planned policies and measures (or the planned strengthening of implemented policies and measures) come into force.

Sector	Bifurcation points of the WOM and WEM scenarios
Energy sector (including transport)	The bifurcation point is 1990. Some policies and measure in the energy sector already have a minor mitigation impact in 1990, see *EPFL and Infras* (2016) and *EPFL* (2017) for details.
Industrial processes and product use sector	No measures specifically targeting process emissions of CO_2 and CH_4 are considered under any of the scenarios. The WEM and WAM scenarios deviate from the WOM scenario as of 2021 as a result of the obligations in relation to chemical conversion processes (N_2O), see also section II.D.4.5. Regarding F-gases, the bifurcation point is 1990.
Agriculture sector	The bifurcation point is 2011 (first calculation with different assumptions for the WEM and WOM scenarios for the following year, see section II.F.4.3 for more explanations).
Land use, land-use change and forestry sector	The bifurcation point is 2022 (first values taken from the modelling starting in 2006 with different assumptions for the WEM and WOM scenarios for the following year, see section II.F.4.4 for more explanations).
Waste sector	The bifurcation point is 1990.
Indirect CO_2	The bifurcation point is 1990.

[79] The energy perspectives 2050+ as described in this table form the basis for the WEM and WAM scenarios. The WOM scenario relies and the model of *EPFL and Infras* (2016) and *EPFL* (2017), see Switzerland's fourth biennial report (*FOEN*, 2020) for details.

II.F.4.1 Energy

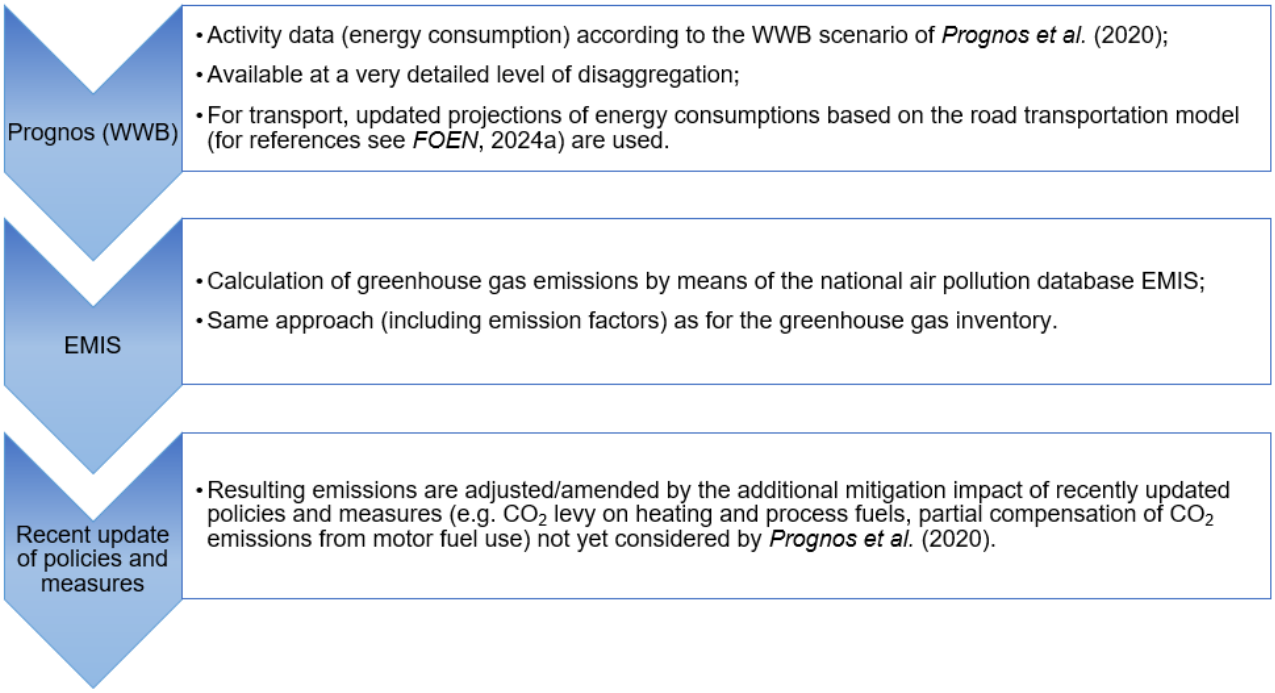
The WEM and WAM scenarios for the energy sector are based on the results from the energy perspectives 2050+ (*Prognos et al.*, 2020). As in previous submissions, the WOM scenario for the energy sector is based on the work of *EPFL and Infras* (2016) and *EPFL* (2017). An overview of the key steps performed to establish the WEM, WOM and WAM scenarios for the energy sector, including information on underlying assumptions, is provided in the following.

WEM scenario (energy)

The energy perspectives 2050+ (*Prognos et al.*, 2020) analyse how to develop an energy system that is compatible with the long-term climate goal of net-zero greenhouse gas emissions by 2050 and, at the same time, ensures a secure energy supply. Different versions of the net-zero emissions scenarios ('ZERO') – considering different combinations of technologies and varying paces of the transition to renewable energy in the electricity sector – are compared with the 'business as usual ('continue as before', 'WWB') scenario to gain insights into the additional need for action and the additional technical measures required to achieve the 2050 target. The results of the energy perspectives 2050+ also assess necessary investments and additional or reduced costs.

Fig. 58 provides a schematic overview of the development of the WEM scenario for the energy sector, based on the WWB scenario of *Prognos et al.* (2020). In the following, the three essential steps are discussed.

Fig. 58 > Schematic overview of the three steps performed to derive the WEM scenario for the energy sector based on the WWB scenario of *Prognos et al.* (2020).



As a first step, the WWB scenario of the energy perspectives 2050+ (*Prognos et al.*, 2020) forms the basis for the WEM scenario used for Switzerland's eight national communication and fifth biennial report. Comprehensive information regarding the different scenarios established in the framework of the energy perspectives 2050+, including methodologies applied, are available on the website of the Swiss Federal Office of Energy.[80] The documentation includes an executive summary, a concise report (110 pages) and a technical report (501 pages).[81] Moreover, extensive tables with results and underlying assumptions are available, as well as additional commentaries that dive deeper into selected individual aspects (such as on electricity supply during winter, potential and use of biomass, power generation and heat-power cogeneration, etc.).

[80] https://www.bfe.admin.ch/bfe/en/home/policy/energy-perspectives-2050-plus.html

[81] Executive summary, Concise report, Technical report

In brief, the scenarios of the energy perspectives 2050+ are calculated with different energy system models. The models follow a bottom-up approach with a detailed representation of the relevant technologies in each sector. The modelling is integrated for the entire energy system; results from the individual sector models thus flow directly into the modelling of the other sectors. This is particularly important for the interface of the energy demand sectors with the modelling of the electricity sector, district heating generation and other energy conversion. *Prognos et al.* (2020) implicitly include the mitigation impact of all implemented policies and measures, e.g. by estimating the overall technical progress.

Regarding the evolution of the transport sector, the WWB scenario of *Prognos et al.* (2020) relies on inputs from the road transportation model primarily used for the greenhouse gas inventory (see section 3.2.9 in *FOEN*, 2024a). The road transportation model is based on a bottom-up approach, taking into account the composition of the Swiss vehicle fleet and differentiating various vehicle classes, fuel types and emissions standards. For past and future years, energy consumption is then calculated based on parameters such as the composition of the fleet, the distances travelled, the fuel types used, and the specific fuel consumption. The road transportation model directly targets vehicle kilometres, i.e. passengers per vehicle are not quantified for this exercise.

At the time of preparing the energy perspectives 2050+, the greenhouse gas inventory up to and including the year 2018 was available. In order to gain results that are completely consistent with Switzerland's latest greenhouse gas inventory, slight corrections are applied in the second step where necessary (see below). A complete recalibration with most recent inventory data, i.e. historical emissions up to 2020, could not be performed, as the modelling exercise is very costly and took several years to be completed. However, as the road transportation model is annually updated, the WEM scenario includes projections of energy consumptions based on the version establish for Switzerland's latest greenhouse gas inventory (*FOEN*, 2024a). Overall, the WWB scenario of the energy perspectives 2050+, together with the latest version of the road transportation model, provide activity data (energy consumption) at a highly disaggregated level.

As a second step, the activity data (energy consumption) obtained from the first step are integrated into the national air pollution database EMIS. Therewith, greenhouse gas emissions (CO_2, CH_4, N_2O) can be calculated with exactly the same approach (including emission factors) as used for the greenhouse gas inventory, guaranteeing consistency between historical and projected data. The methodologies for each source category are described in detail in Switzerland's latest national inventory report (*FOEN*, 2024a). As the activity data based on *Prognos et al.* (2020) do not reflect the impact of measures to contain the corona virus pandemic, projected activity data are considered as of 2025 in most cases (with linear interpolation between 2022 and 2025). Therewith, the recovery from the observed decrease in the historical data appears to be realistic, but the short-term evolution should still be viewed with caution.

Prognos et al. (2020) do not provide explicit activity data of source category 1B. As greenhouse gas emissions from this source category are of minor importance, emissions are assumed to remain constant up to 2040.

As a third and final step, resulting emissions are adjusted/amended by the additional mitigation impact of recently updated policies and measures. In its original version, the WWB scenario of *Prognos et al.* (2020) considers – for past and future years – all energy and climate policy measures and instruments in force until the end of 2018, i.e. generally assuming that the policies and measures will be continued in a similar manner, without any strengthening or weakening, up to 2040. The development of technologies (efficiency, equipment, installations, vehicles, devices, etc.) and their use follow the autonomous technical progress and the legal basis existing at the end of 2018. To take into account the most recent developments in Switzerland's climate policy and, thus, to establish a WEM scenario that is fully consistent with the currently implemented and adopted policies and measures (Tab. 23), the following adjustments/amendments need to be made with regard to the WWB scenario:[82]

- **CO_2 levy on heating and process fuels** (section II.D.1.6): The WWB scenario does not take into account the latest increase of the rate of the CO_2 levy from 96 to 120 Swiss francs per tonne of CO_2 introduced as of 1 January 2022. Therefore, for the WEM scenario, the additional mitigation impact realised as of 2022 is factored in. The additional mitigation impact is estimated at 250 thousand tonnes of CO_2 equivalents per year and is attributed to three quarters to the source categories 1A4a and 1A4b ('buildings') and to one quarter to the source categories 1A1 and 1A2 ('industry');

[82] The adjustments/amendments are applied as a final step, i.e. at the level of resulting greenhouse gas emissions (and not at the level of energy consumption provided by *Prognos et al.*, 2020).

- **Partial compensation of CO_2 emissions from motor fuel use** (section II.D.3.4): The WWB scenario does not take into account the increases of the compensation rate from 2021 to 2024. Therefore, for the WEM scenario, the additional mitigation impact realised for the years 2021 to 2024 is factored in. The additional domestic mitigation impact is estimated at slightly above 700 thousand tonnes of CO_2 equivalents per year;
- **Third CO_2 Act** (section II.D.1.4): The WWB scenario does not take into account policies and measures introduced or strengthened within the framework of the third CO_2 Act. The additional mitigation impact realised between 2025 and 2030 is thus factored in for the WEM scenario. The amendments concern various policies and measures, as shown in the detailed lists of polices and measures available in section II.D.1.4 (including references to further sections);
- **Climate and Innovation Act** (section II.D.1.5): The WWB scenario does not take into account policies and measures introduced within the framework of the Climate and Innovation Act. The additional mitigation impact realised between 2025 and 2030 is thus factored in for the WEM scenario. A detailed lists of polices and measures is available in section II.D.1.5 (including references to further sections);
- **National buildings refurbishment programme** (section II.D.2.4): As a consequence of the planned policies and measures, the funding available for the national buildings refurbishment programme are expected to be slightly reduced as of 2025. Accordingly, a reduction of the mitigation impact is considered under the WEM scenario compared to the WWB scenario.

The three steps discussed above provide detailed and up-to-date results for the WEM scenario. The strength of this approach is that it is based on a comprehensive simulation of Switzerland's energy system, including a very detailed representation of all relevant technologies. Resulting greenhouse gas emissions are fully consistent with the greenhouse gas inventory. Another advantage is that the modelling takes into account energy and climate policy at the same time, the results are thus consistent with the goals from both areas. However, the modelling does not explicitly represent single policies and measures, but takes into account the overall mitigation impact, e.g. based on assumptions regarding technical progress and energy use (expert judgements and empirical values thereby play a certain role). Due to the high complexity and the high level of detail, the development of projections takes several years, making this approach not suitable for short-term updates. These latter remarks may be considered as weaknesses of the approach.

WOM scenario (energy)

The WOM scenario was not updated in the framework of the energy perspectives 2050+. A new edition of the scenario would require considerable capacities and costs, but it is not expected to reveal any new insights. Accordingly, the WOM scenario for the energy sector is based on the work of *EPFL and Infras* (2016) and *EPFL* (2017) as in previous submissions.

Detailed information with regard to the WOM scenario – including methodologies, strengths and weaknesses – is available in Switzerland's fourth biennial report (*FOEN*, 2020). The WOM scenario includes some updates and improvements in order to take into account recalculations that are also reflected in the greenhouse gas inventory as well as in the WEM and WAM scenarios. Accordingly, the WOM scenario includes an adjustment in order to correctly attribute the energy consumption and related greenhouse gas emissions from heated greenhouses in source category 1A4c, as well as minor recalculations to some emission factors.

The computable general equilibrium model of *EPFL and Infras* (2016) and *EPFL* (2017) does not address emissions from source category 1B. Therefore, the WOM scenario for source category 1B is assumed to be identical to the WEM scenario for the full time period from 1990 to 2040.

WAM scenario (energy)

The WAM scenario is closely coupled to the WEM scenario, i.e. to the energy perspectives 2050+ (*Prognos et al.*, 2020; see above). However, compared to the WEM scenario, the WAM scenario additionally takes into account the impact of the planned strengthening of currently implemented and adopted policies (see Tab. 23 and section II.D). For the energy sector, the following adjustments of the most important measures are considered under the WAM scenario:

- **Negotiated reduction commitments (for exemption from the CO_2 levy)** (section II.D.1.8): The planned adjustments to the negotiated reduction commitments (for exemption from the CO_2 levy), in particular the

opening of the policy and measure to all companies (with a few exceptions), leads to an additional mitigation impact that is considered under the WAM scenario;

- **Partial compensation of CO_2 emissions from motor fuel use** (section II.D.3.4): The planned increase of the share of CO_2 emissions from motor fuels to be offset by fuel importers within Switzerland leads to an additional mitigation impact that is considered under the WAM scenario.

The calculations with regard to the strengthening of policies and measures considered under the WAM scenario as described above provide the additional mitigation impact realised compared to the WEM scenario up to 2030. The estimates of the additional mitigation impact, mostly based on bottom-up approaches, are available in CO_2 equivalents and for highly aggregated subsets of the energy sector as defined under the CO_2 Ordinance (buildings, transport, industry, other). The distributions on individual gases (CO_2, CH_4, N_2O) and source categories (1A1, 1A2, 1A3, 1A4, 1A5) then follow the respective distributions of emissions under the WEM scenario in each single year. Where no additional polices and measures are planned, the additional mitigation impact equals zero (e.g. for source category 1B). Beyond 2030, no concrete policies and measures are planned yet (or the additional mitigation impact cannot be estimated yet, see sections II.D.1, II.D.2 and II.D.3). Accordingly, between 2030 and 2040, it is assumed that the additional estimated mitigation impact remains constant (i.e. the WEM and WAM scenarios for the energy sector evolve in parallel). Finally, the WAM scenario is constructed by subtracting the estimates for the additional mitigation impacts from the WEM scenario.

The approach applied to derive the WAM scenario for the energy sector has strengths and weaknesses. The bottom-up approach allows for a targeted estimation of the mitigation impact of each measure, taking full account of their specific effects in each sector. A drawback of this approach is that interactions between measures can only be partially considered.

II.F.4.2 Industrial processes and product use

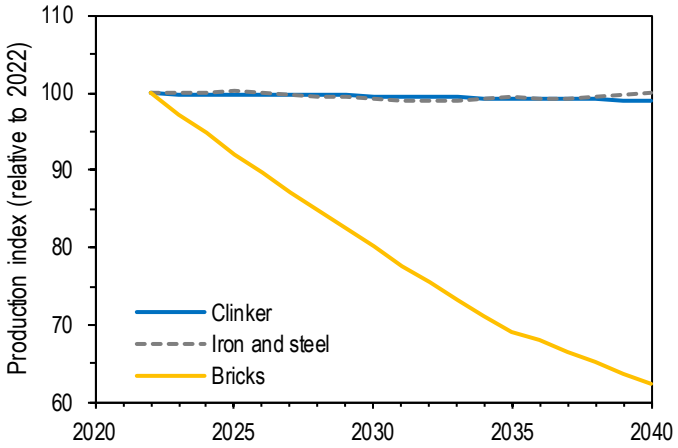
Greenhouse gas emission scenarios for the industrial processes and product use sector are based on exactly the same methodology as used for the greenhouse gas inventory, i.e. bottom-up estimates according to the 2006 IPCC guidelines for national greenhouse gas inventories (*IPCC*, 2006). Details about the methodologies, including relevant emission factors, are documented in *FOEN* (2024a). The strength of this approach is that greenhouse gas emission scenarios are calculated at the level of single processes. This, however, requires a full set of projections of activity data and emission factors (which may potentially be considered a weakness of the approach).

In Switzerland, there are few industrial branches that release relevant amounts of process-related greenhouse gases. The primary source of process-related greenhouses gases emitted from the industrial processes and product use sector is the cement industry, followed by emissions of F-gases from the use as refrigerants and by emissions of CO_2 from the thermal cracking process (production of ammonia and ethylene). Before a catalyst was installed in autumn 2021, N_2O emissions from the chemical industry (production of niacin) were substantial as well. The installation has eliminated almost all N_2O emissions, previously amounting to around 500 thousand tonnes of CO_2 equivalents per year. The WEM and WAM scenarios assume that the strong catalytic effect will continue. Measures in the industry sector are primarily targeting energy-related emissions (section II.D.2), which are included under the energy sector (for the respective methodology see section II.F.4.1). However, the emissions trading scheme (section II.D.1.7) also covers process-related emissions, permitting companies to reach their reduction obligations not only by more efficient use of energy, but also by optimisation of their production processes leading to reduced process-related emissions of greenhouse gases. Nevertheless, for most emitters of process-related greenhouse gases covered by the emissions trading scheme (in particular for the cement industry, the major emitter) this possibility hardly exists due to physical/chemical limits regarding further reductions of the emission factors. As the Ordinance on Air Pollution Control (section II.D.4.3) and the NMVOC incentive fee (section II.D.4.4) are exclusively considered regarding the scenarios for indirect CO_2 emissions, the following two policies and measures are solely responsible for the differences between the WEM, WOM and WAM scenarios for the industrial processes and product use sector: (i) provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, NF_3) (section II.D.4.2), and (ii) obligations in relation to chemical conversion processes (N_2O) (section II.D.4.5).

The relevant activity data for industrial production are inferred from production indices available from the energy perspectives of *Prognos et al.* (2020). Accordingly, the production of goods (such as clinker, cement, iron and steel, bricks, chemicals, etc.) underlying the activity data are consistent with the use of energy underlying the emissions reported in the energy sector. Fig. 59 provides a few examples of production indices applied under the WEM, WOM and WAM scenarios. Production indices of clinker as well as iron and steel are assumed to remain about constant over the coming

decades. The decline in the production index of brick is substantial, but the effect on total geogenic CO_2 emissions from the industrial processes and product use sector is limited as these emissions are dominated by cement production. For some industrial processes whose emissions are of minor importance and for which detailed projections of production indices are unavailable, it is assumed that the activities remain constant at the level of past years (depending on the process, mean values over the last ten years or over the full time period since 1990 are used). Where projections are deduced from *Prognos et al.* (2020), values are calculated based on the production indices from 2025 onwards, with linear interpolation between the last inventory year and 2025.

Fig. 59 > Production indices for clinker, iron and steel as well as bricks until 2040 (relative to 2022). Identical production indices are used for the WEM, WOM and WAM scenarios.



Prognos et al. (2020)

Emissions estimates of F-gases are based on a well-established bottom-up model that is not only used for the annual greenhouse gas inventory (*FOEN*, 2024a), but that also serves to project future emissions (*Carbotech*, 2024). For historical years (i.e. from 1990 up to the most recent inventory year), the model is based on detailed statistics of F-gases imported into Switzerland, supplemented by information from the branch associations and companies concerned. The model makes assumptions about product life time as well as emission factors relevant for assembly, operation and disposal of appliances. For the projections, the two most important applications of fluorinated gases – refrigeration and electrical equipment – are considered in detail, while emissions from other applications are mostly hold constant over time. The main factors defining the scenarios are the phase-out of HFCs, decreasing emission factors in refrigeration, and the limit set on SF_6 emissions following the provisions relating to substances stable in the atmosphere (HFCs, PFCs, SF_6, NF_3) (section II.D.4.2). Emissions of HFCs show a substantial change to a faster decrease rate at around 2025 under the WEM and WAM scenarios (Fig. 53). The reason is that the model assumes that HFCs with relatively high global warming potentials are disposed at this time as the respective appliances reach their end of life. Therewith, emissions from the remaining appliances (in operation as well as at their disposal) are lower. The large changes reflect past changes of filling amounts, as the lifetimes are assumed to be a fixed number without smoothing over several years. The WEM and WAM scenarios were updated at the same time as the data for the most recent greenhouse gas inventory was compiled (*FOEN*, 2024a). Due to limited resources, the WOM scenario is based on a previous version computed in 2018, but with updated global warming potentials of all gases.[83]

Tab. 27 provides an overview of assumptions in the industrial processes and product use sector with regard to the WEM, WOM and WAM scenarios. Regarding F-gases, *Carbotech* (2024) provides further details about underlying assumptions and methodologies.

[83] Due to the model adjustments that have been made in the meantime, there are small discrepancies of at most a few kilotonnes of CO_2 equivalents in individual years, with emission values for the WOM scenario below the values for the WEM scenario (e.g. for SF_6). These discrepancies are of minor importance and do not affect the overall emission trend and conclusions. Switzerland plans to completely update all three scenarios for its ninth national communication and second biennial transparency report to be submitted in 2026.

Tab. 27 > Assumptions used for the projections of emissions from the industrial processes and product use sector under the WEM, WOM and WAM scenarios.

	WEM	WOM	WAM
Industrial production	In close correspondence with the assumptions on industrial production used in the energy perspectives of *Prognos et al.* (2020), the production indices for cement and metal are assumed to remain about constant up to 2040, while the production index for bricks declines over the coming decades. For other processes, which are of minor importance, it is assumed that activities remain at the level of past years.	As there are no policies and measures affecting the production rates, the evolution is identical for all scenarios.	As there are no policies and measures affecting the production rates, the evolution is identical for all scenarios.
HFCs	Existing restrictions on the use of F-gases (in concert with technological progress) are considered. This leads to a gradual replacement of HFCs used as refrigerants (*Carbotech*, 2024). Further, measures to reduce leakage (secure handling of refrigerants, monitoring etc.) are continuously introduced.	The WOM scenario assumes no forced phase-out and replacement of fluorinated gases and therefore emissions of HFCs keep increasing (*Carbotech*, 2024).	Similar but faster replacement of HFCs used as refrigerants compared to the WEM scenario, optimisation of disposal processes as well as more restrictions for other applications are assumed (*Carbotech*, 2024). Overall, the planned measures ensure compliance with Switzerland's commitment under the Kigali Amendment to the Montreal Protocol.
SF_6	Agreements with relevant sectors, leading to reduction of emissions.	Constant use of SF_6 and higher emission factors compared to the WEM and WAM scenarios.	Stepwise prohibition of SF_6, leading to a replacement for use in electrical equipment.
Gases from other industrial processes and solvent use	Other process-related emissions (e.g. from ammonia/ethylene production, nitric acid production) and emissions from solvent use are assumed to maintain the level of past years (depending on the process, mean values over the last ten years or over the full time period since 1990 are used). The evolution of N_2O emissions from the chemical industry is dominated by a major and persistent downward shift over the years from 2020 to 2022, as a chemical plant installed a new catalyst in the course of 2021, leading to a substantial reduction of the corresponding emission factor (to only about one per cent of its original value).	Identical evolution as for the WEM scenario, with the only exception that it is assumed that the chemical plant continues to operate its niacin production without catalyst (i.e. N_2O emissions do not decrease as under the WEM and WAM scenarios and the respective emission factor is assumed to remain – from 2021 onward – at the average observed over the years 2016 to 2020).	Identical evolution as for the WEM scenario.

II.F.4.3 Agriculture

Greenhouse gas emission scenarios for the agriculture sector are based on projected activity data, e.g. livestock numbers, crop production data (amount of crops harvested, areas of crop cultures, meadows and pastures) and use of synthetic fertilisers and recycling fertilisers from different agricultural policy evaluation models. The productivity of mature dairy cows (i.e. milk yield) and its influence on CH_4 emissions are also considered in all scenarios. For the WEM and WAM scenario the impact of additional technological measures on model parameters such as nitrogen excretion rates, ammonia emission factors and rates of nitrate leaching and runoff are modelled.

Generally, time series beyond 2022 (WEM, WAM) and 2011 (WOM) are extended by continuing the time series according to the development of the respective reference parameters in the policy evaluation models used. Some data such as e.g. crop yields may exhibit considerable year-to-year variability and this may lead to somewhat arbitrary projections due to an arbitrary starting point. However, observing the overall behaviour of the projections, no indication that this would lead to a systematic misalignment is found. Hence, it is concluded that the eventual offsets of individual time series projections cancel each other out.

In the following, the most important aspects relevant under the WEM, WOM and WAM scenarios are presented:

- **Animal livestock population:** The development of livestock populations depends on price scenarios and consequently on policies concerning market price support and free trade agreements with other countries, particularly the European Union, as well as on consumer demand (*Peter et al.*, 2009; *Peter et al.*, 2010; *Möhring et al.*, 2015). Furthermore, the design of the agricultural subsidy and direct payments system is an important driver for the development of livestock populations;

- **Feeding regimes:** Feeding regimes are generally assumed to remain unchanged in the WOM scenario (from 2011 onward) and the WEM scenarios (from 2022 onward) with the exception of dairy cows (whose feed energy intake depends on milk production). Additionally, two important measures related to livestock feeding are the governmental programme for grassland-based milk and meat production (*Mack et al.*, 2017), and the promotion of phase feeding with protein-reduced feed for swine (NPr). Both measures are considered under the WEM and WAM scenario;

- **Manure management:** Manure management is governed by the stable system, which is again mainly influenced by requirements for animal-friendly livestock husbandry and the respective incentives and label programmes. A report by the Swiss Federal Office for the Environment and the Swiss Federal Office for Agriculture regulates the respective environmental provisions (*FOEN and FOAG*, 2012). Different modes of (financial) incentives and legal provisions may further promote low-emission stable and manure management systems in the future. Technical measures for a further reduction of emissions from housing and manure storage are investigated in the Agroscope 'emission research stable' (*Schrade et al.*, 2018);

- **Nitrogen excretion by animals:** Nitrogen excretion rates determine the amount of manure nitrogen managed and applied to soils and hence govern N_2O emissions. Nitrogen excretion rates varied in the past mainly due to increasing productivity of dairy cows and due to the feeding of protein-reduced animal feeds for swine and poultry. It is most likely that nitrogen excretion rates will continue to decrease in the future although a precise change rate is hard to predict due to partially contrary developments in livestock management. For cattle, the governmental programme for grassland-based milk and meat production (*Mack et al.*, 2017) might be decisive, while for monogastrics other environmental regulations as well as financial constraints and the subsidy systems may be most influential;

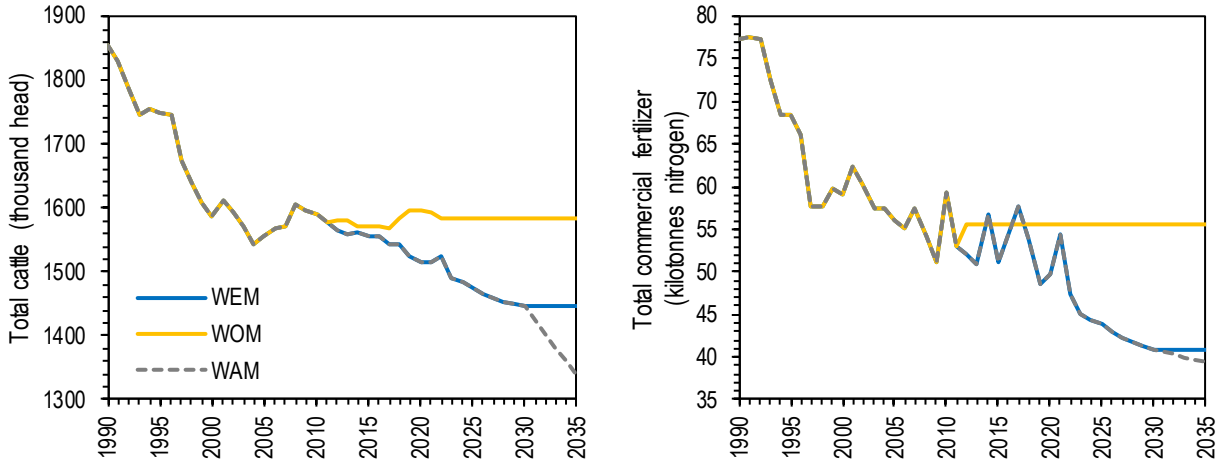
- **Crop cultures:** An important driver for the future development of the cropping areas and the respective agricultural portfolio is the design of the direct payment system. Accordingly, trends in the development of individual crop cultures may differ due to differential governmental incentives. The current system of direct payments contains several mechanisms to incentivise more sustainable production such as support for environmental-friendly production systems (e.g. organic agriculture), promotion of ecological compensation areas (biodiversity) or advancement of extensive crop management (*Möhring et al.*, 2016). In addition to the governmental subsidy system, macroeconomic price levels particularly related to possible free-trade agreements as well as the need for animal fodder will determine the portfolio of crop cultures in the future. Finally, development of cropping areas and yields of individual crops may be affected by the restrictions in the use of pesticides and by measures to promote biodiversity;

- **Fertilisers and nutrient management:** The required amount of nutrients and consequently also mineral fertilisers is primarily dependent on the portfolio of crop cultures (including grasslands) and the respective provisions in the Suisse-Bilanz (nutrient balance tool) that have to be observed in order to fulfil the proof of ecological performance and get access to direct payments (*Swiss Federal Council*, 2009; *Herzog and Richner*, 2005). For the future it is planned to revise the Suisse-Bilanz, eventually altering the determination of the maximum fertiliser allowances. More stringent provisions and a stronger enforcement could have substantial effects on fertiliser management and promote nitrogen use efficiency;

- **Nitrogen use efficiency:** Nitrogen use efficiency is strongly related to agricultural greenhouse gas emissions and nitrogen surplus can be used as proxy for N_2O emissions (e.g. *Schils et al.*, 2007). Parameters determining the nitrogen surplus and hence the nitrogen use efficiency are primarily the ammonia emission factors and the share of nitrogen lost as nitrate (leaching and runoff). Nitrogen use efficiency in Switzerland is influenced mainly by the general requirements under the proof of ecological performance (Suisse-Bilanz and possible follow-up tools), by the programmes for resource efficiency ('Resource Programme', e.g. *Swiss Federal Council*, 2009) as well as by the Ordinance on the Promotion of Quality and Sustainability in the Agrifood Sector (*Swiss Confederation*, 2013). More recently, the Federal Council adopted the nutrient reduction pathway that aims at reducing nitrogen losses by 15 per cent (see II.D.5.2). In this context, it is expected that more measures will target to increasing nitrogen use efficiency in the future. Compared to the actual situation, possible additional measures are precision-farming, breeding of new crop varieties, use of nitrification and urease inhibitors or an increased share of leguminous crops in crop rotations.

In the following, the circumstances and sources of information relevant for the WEM, WOM and WAM scenarios are discussed. Fig. 60 shows the evolution of the most relevant key parameters under the different scenarios.

Fig. 60 > Evolution of the most relevant key parameters under the WEM, WOM and WAM scenarios for agriculture: Total cattle (left) and total commercial fertiliser (right).



Based on *FOEN* (2024a), *Mack and Möhring* (2021) and *Peter et al.* (2010)

WEM scenario

The basis of the WEM scenario is the continuation of the agricultural policy 2018–2021 (section II.D.5). As of 2022, the new agricultural policy (AP22+) should have entered into force. Due to its suspension by the Swiss Parliament, central elements of the policy were implemented through a parliamentary initiative (PaIv 19.475) instead (*Swiss Confederation*, 2019). *Mack and Möhring* (2021) investigated the repercussions of the PaIv 19.475 with the multi-agent model SWISSland. Although the ordinances under the initiative have not been implemented exactly as originally planned, the PaIv scenario of *Mack and Möhring* (2021) is used as basis for the calculations of the WEM scenario due to the lack of more updated projections. Projections are thus based on data and information available by 2021 on (i) the development of the macroeconomical variables (gross domestic product, population, crop yields), (ii) the expected development of the domestic producer prices, and (iii) the agricultural policy with the respective subsidy system as expected with the implementation of the parliamentary initiative. Based on *Mack and Möhring (2021)* development of animal populations, productivity of dairy cows (milk yield), development of cropping areas and fertiliser use are projected until 2027.

In addition to the projections of the structural data as described above several technical measures were implemented in the WEM scenario between 2022 and 2030. These measures are either directly mandated or indirectly promoted by the ordinances under the PaIv 19.475 as agreed by the parliament. The modelling was conducted stepwise with the agricultural greenhouse gas inventory model and is mainly based on the specifications in the 'Explanatory report on the opening of the consultation procedure' *(FOAG, 2021)* and assumptions made by an expert group of the Federal Office for Agriculture (FOAG), the Federal Office for Environment (FOEN) and Agroscope. The implementation of the measures follows the different policy instruments:

- Direct payments (see II.D.5.3): Different feeding of pigs according to age and nutritional needs (phase feeding, NPr), efficient use of nitrogen, longer useful life of dairy cows;
- Proof of ecological performance (see II.D.5.4): Abolition of the 10 per cent error margin in the 'Suisse-Bilanz', coverage of slurry and digestate tanks, low emission slurry spreading technique;
- Structural improvement measures (see II.D.5.6): Reduction of ammonia emissions from housing, manure storage and manure application;
- Reduction pathway on nutrients (see II.D.5.2): Nitrogen losses must be reduced by 15 per cent until 2030 as compared to the mean over the years 2014–2016.

Reductions of greenhouse gas emissions due to the implementation of the 'resource programme (subsidies for a more efficient use of natural resources)' (see section II.D.5.5) were not modelled for several reasons depending on the specific resource projects: (i) The number of pilot farms was too small to trigger a significant impact, (ii) methodological constraints (system boundaries, territorial principle), (iii) the project only started recently and relevant data is not yet available, and (iv) deadweight effects of other measures and/or effects already reflected in the current statistical data.

WOM scenario

The WOM scenario for agriculture is based on the continuation of the agricultural policy 2011. The great number of drivers that has influenced the development of agricultural structures since 1990 (e.g. technological progress, breeding programmes, macro-economic framework, agricultural policy, etc.) does not allow to distinguish the specific mitigation impacts of individual policies and measures retrospectively. Accordingly, 2011 is chosen as bifurcation point since concrete projections were made for the agricultural policy 2011 at this time (Tab. 26). The fundamental assumption is that the scheme of the direct payments and the requirements under the proof of ecological performance would have been maintained as established in 2011. Greenhouse gas emissions are projected according to *Peter et al.* (2010), as expected after the implementation of the agricultural policy 2011. *Peter et al.* (2010) projected the future development of the agricultural portfolio and structures according to calculations made with the S-Integral model. The S-Integral model is a comprehensive agricultural supply model which simultaneously takes into account economic, agronomic and ecological aspects and interrelationships (*Peter*, 2008). Projections are available for three agricultural price scenarios of which the high price level scenario is used here. The portfolio of agricultural operations (i.e. the production levels of the individual livestock animals and crop cultures) develops according to the macroeconomic development exogenously represented in the model. Technical, structural and organisational framework conditions are assumed to remain largely unchanged. The time horizons of the projections reach in most cases until 2022, and all values are kept constant for subsequent years.

WAM scenario

Up to 2030, emissions follow the same course as under the WEM scenario, i.e. the development of agricultural structures according to the PaIv scenario of *Mack and Möhring (2021)* and the implemented technical measures. After 2030 greenhouse gas emissions are projected to decline, according to the target of Switzerland's climate strategy for agriculture and food (*FOAG, FOEN, FSVO, 2023,* see II.D.5.8). The Swiss long-term climate strategy (*Swiss Federal Council*, 2021a) and the climate strategy for agriculture and food (section II.D.5.8) are not legally binding, but encompass both general and specific indications on the future roadmap of a climate-friendly agriculture. A substantial reduction of agricultural greenhouse gas emissions of 40 per cent until 2050 as compared to 1990 is aspired. Up to date, very few concrete measures are available that could be taken into account under the WAM scenario in addition to the measures of the parliamentary initiative 19.475. Further, the planned strengthening of the structural improvement measures (see II.D.5.6) concerns only emissions from fossil fuel combustion and thus no effect on emissions from the agriculture sector is expected.

Accordingly, the development of projected emissions is based on the assumed fulfilment of a political objective rather than on the effect of specific technical measures. However, tools and measures are being investigated and consolidated at the moment. For this purpose, two instruments intended to financially support relevant projects by agricultural stakeholders, namely the resource programme (section II.D.5.5) and the Ordinance on the Promotion of Quality and Sustainability in the Agrifood Sector (*Swiss Confederation*, 2013), were implemented by the Swiss Federal Office for Agriculture in the past. Under these voluntary programmes several pilot projects were financed that implement and test technical greenhouse gas reduction measures on the farms (e.g. AgroCO2ncept Flaachtal, KLIR-project of Aaremilch AG, IP-Suisse programme for the climate; *Alig et al.*, 2015; *Furrer et al.*, 2021; see also II.D.5.5). Furthermore, several cantons and organisations of the food and agriculture industry started to develop projects to promote climate-friendly farming. Accordingly, experiences and insights from these projects may be used to guide the further development of the agricultural policy framework. Promising measures and strategies may be further incentivised by financial contributions for environment-friendly production systems and for the efficient use of resources.

Due to the lack of specific technical measures that could be implemented in a modelling framework the intended emission reductions are modelled by reducing the amount of synthetic fertilisers and the livestock populations. A reduction of the consumption of animal products should accompany the reduction of the livestock populations in order to prevent the imports of greenhouse gas intensive animal products. In this sense, the projected reduction of livestock numbers is consistent with the scenarios of sustainable and healthy diets modelled by *Zimmermann et al.* (2017) and is thus also consistent with the respective goals concerning diet and food consumption in the climate strategy for agriculture and food.

Tab. 28 provides an overview of specific assumptions in the agriculture sector with regard to the WEM, WOM and WAM scenarios.

Tab. 28 > Assumptions used for the projections of emissions from the agriculture sector under the WEM, WOM and WAM scenarios.

	WEM	WOM	WAM
Animal livestock population	The continuation of the agricultural policy 2018–2021 influences animal population as predicted in the PaIv scenario in *Mack and Möhring* (2021). The slightly decreasing trend of the cattle population continues until 2027, whereas the numbers of swine and poultry remain more or less constant. The increasing lifetime of dairy cattle additionally contributes to the decreasing trend of the cattle population as less replacement animals are needed. Beyond 2030 animal populations are assumed to remain constant.	Overall, *Peter et al.* (2010) expected rather constant livestock populations until 2022. Beyond 2022, constant populations are assumed for all animal categories.	Until 2030, livestock populations are projected as in the WEM scenario. After 2030, livestock populations are projected to decrease in such a way that overall agricultural greenhouse gas emissions are in line with the reduction target of Switzerland's climate strategy for agriculture and food (*FOAG, FOEN, FSVO, 2023*). This means that livestock populations would fall by 30 per cent between 2030 and 2050. *Zimmermann et al. (2017)* show that such a scenario would be consistent with the switch to a more resource-conserving and healthy diet of the Swiss population.
Feeding regime	For most animal categories, energy intake and CH_4 rates remain constant at the value of 2022, i.e. no technical measures concerning animal diets are implemented. Milk yield and hence gross energy intake of mature dairy cattle are assumed to slightly increase until 2027 (*Mack and Möhring*, 2021). Accordingly, the CH_4 emission factor for both enteric fermentation and manure management increases proportionally. An important political measure could be the promotion of extensive milk and meat production based on grassland feeding. It is planned that the respective incentives implemented during the agricultural policy 2018–2021 will be maintained and eventually developed further. A first evaluation by *Mack et al.* (2017) concluded that so far, the programme mainly led to a preservation of the current feeding regime and had only limited influence on environmental issues as e.g., the nitrogen surplus. This is hence consistent with the assumptions made for the WEM scenario. For swine, an increased use of protein reduced feed according to age and nutritional needs is projected for the period 2023–2030 as promoted by the direct payment system.	With the exception of mature dairy cows, energy intake and CH_4 rates remain constant at the value of 2011, i.e. no technical measures concerning animal diets are implemented. Milk production and hence gross energy intake of mature dairy cattle level off approximately around 2011 (*Peter et al., 2010*). Accordingly, the CH_4 emission factors for both enteric fermentation and manure management of mature dairy cows also remain more or less at the level of 2011.	Feeding regimes are projected as in the WEM scenario. The further development of the governmental programme for grassland-based milk and meat production that may alter feeding regimes of ruminants is unclear and has not been considered. New scientific developments might help to define alternative cattle feeding strategies with low emission intensities in the future that reduce CH_4 emissions by 10–20 per cent (see e.g. *Kreuzer,* 2020). However, although first programmes are being started in practice, it is still too early to assess their impact on overall greenhouse gas emissions. Accordingly, the respective emission reductions are not yet included in the inventory model scenario.
Manure management	Further reductions of the gaseous losses from animal housing and manure management are aspired (*Swiss Confederation*, 2019). Specific measures are the obligation for coverage of slurry tanks and the 'promotion of environmental friendly production (structural improvement measures)' (*FOAG*, 2021). Implementation of these measures between 2022 and 2030 are thought to lower CH_4 and N_2O emissions from manure management and particularly NH_3 volatilisation from animal housing and manure storage. Due to the projected reduction of the respective nitrogen losses, the amount of applied synthetic nitrogen fertiliser was reduced accordingly. As these measures do not yet lead to the aspired reduction of the nitrogen surplus (i.e. –15 per cent until 2030), loss rates of NH_3 and NO_3^- are further reduced by three per cent between 2022 and 2030. The governmental programme for grassland-based milk and meat production is thought to have little influence on manure management (*Mack et al.*, 2017).	All parameters affecting manure management are assumed to remain constant (distribution of manure to different management systems and emission factors as in 2011).	Manure management is projected as in the WEM scenario. Further measures are explored scientifically. However, currently there are hardly any further measures with significant impact on greenhouse gas emissions that could be readily implemented.
Nitrogen excretion by animals	For swine, an increased use of protein reduced feed according to age and nutritional needs is projected for the period 2023–2030 as promoted by the direct payment system. Accordingly, the nitrogen excretion rate of swine is projected to decrease by seven per cent. All other nitrogen excretion rates are assumed to remain constant at the level of 2019 (last census of farm management techniques; *Kupper et al., 2022*). Without further incentives, it is unlikely that the governmental programme for grassland-based	Nitrogen excretion rates of all animal except mature dairy cattle are assumed to remain constant at the level of 2011. Nitrogen excretion rates of mature dairy cattle depend on milk production and are assumed to level off around 2011 as no further increase of milk yield is projected (*Peter et al.*, 2010).	Livestock nitrogen excretion rates are projected as in the WEM scenario.

	milk and meat production (*Mack et al.*, 2017) will lower animal nitrogen excretion rates of ruminants significantly.		
Crop cultures	Developments of the harvested amounts of individual crop cultures is projected according to the PaIv scenario in *Mack and Möhring* (2021). In general, arable crop production is projected to slightly decline, whereas feed production from grasslands remains more or less constant. Beyond 2027, constant yields and areas are assumed.	Development of crop cultures between 2011 and 2022 is calculated according to *Peter et al.* (2010). Areas of arable crops are slightly declining while land use for meadows and pasture is slightly increasing. For the time after 2022, areas and yields are assumed to remain constant.	Developments of the harvested amounts of individual crop cultures are projected as in the WEM scenario.
Fertilisers and nutrient management	Use of commercial fertilisers is projected to decrease between 2022 and 2030 by 14 per cent. The effect is due to various measures to increase nitrogen use efficiency of mainly manure nitrogen (see above). Additionally, it is assumed that the use of commercial fertilisers declines due to two more measures implemented under the parliamentary initiative 19.475 (*FOAG, 2021*): (i) the abolition of the 10 per cent error margin in the Swiss fertiliser balance (Suisse-Bilanz), and (ii) the promotion of the efficient use of nitrogen in special crops. As the 15 per cent target to reduce the nitrogen surplus is not yet reached with these measures, an additional reduction of the ammonia and nitrate losses is modelled until 2030 without further specification of the concrete measures. The 'Explanatory report on the opening of the consultation procedure' of the parliamentary initiative 19.475 (*FOAG, 2021*) envisages that these reductions would be achieved by additional measures taken by the industry and producer organisations. Beyond 2030, constant fertiliser use is assumed.	After 2011, the total amount of applied commercial fertiliser is assumed to remain constant as total agricultural area and total dry matter production is not changing significantly.	Development of the use of commercial fertilisers until 2030 is projected as under the WEM scenario. Between 2030 and 2050, the amount of synthetic fertiliser is projected to fall by another 15 per cent due to further promotion of nitrogen use efficiency.
Nitrogen use efficiency	Reducing the nitrogen surplus and simultaneously maintaining stable crop yields immediately implies that nitrogen use efficiency must increase. Specific measures to promote the efficient use of nitrogen are implemented in the parliamentary initiative 19.475 (*FOAG, 2021*) and are mentioned under 'manure management' and 'Fertilisers and nutrient management' above. In total, the nitrogen surplus shall fall by 15 per cent until 2030 as compared to the mean 2014–2016 (*Swiss Confederation*, 2019).	Since total amount of applied commercial fertiliser as well as total nitrogen available from animal manure are assumed to remain constant, no increase in nitrogen use efficiency is achieved. Ammonia emission factors and nitrogen loss rates are projected to remain constant at the level of 2011 in the inventory model.	Development of nitrogen use efficiency until 2030 is projected as in the WEM scenario. Additional efficiency gains could be achieved e.g., via the programmes for resource efficiency in agriculture and/or industry and producer organisations in the agriculture and food sector that conclude target agreements with the Federal Office of Agriculture (FOAG) on a voluntary basis. Specific measures could be plant breeding, precision farming or the increased use of leguminous crops in crop rotations. The respective efforts are projected to lead to an additional reduction of the use of synthetic fertilisers of 15 per cent between 2030 and 2050.

II.F.4.4 Land use, land-use change and forestry

To project greenhouse gas emissions and removals for the forestry sector, the stochastic empirical single tree forest management scenario model (Massimo), which is based on data from the national forest inventories (see section II.A.6.7), is used (*Stadelmann et al.*, 2019; *Stadelmann*, 2020). The model is specifically designed to reflect the characteristics of Swiss forests. The model mainly consists of a single tree growth component, a wood harvesting component, and a component on ingrowth. These model components as well as mortality rates are empirically derived from data of the national forest inventories (*Stadelmann et al.*, 2019), as detailed in the following:

- **Single tree growth:** Single tree growth is estimated using a single tree model. It depends on the diameter at breast height, on the basal area of the stand under consideration, on a competition index, on site fertility, on the elevation, and on the stand age. The estimate of stand age is based on a model that has been derived from tree ring analysis on the sample plots of the national forest inventory. Ingrowth rates are considered as well;
- **Wood harvesting component:** To calculate annual clearcut areas in even-aged forest (which occupy 80 per cent of the forest area), the following rotation periods are assumed: 90–110 years on very good sites, 110–130 years on good sites, 130–150 years on medium sites, and 180 years on poor sites in alpine regions. Mature stands are harvested within a time span of 20–30 years in order to promote natural regeneration. This is common practice

in the Swiss forestry sector and is reflected in the data of the national forest inventory. Stands are thinned as soon as their basal area has increased by ten per cent since the last thinning event. This criterion guarantees that a stand reaches the development stage of mature timber during a rotation period. The thinning techniques implemented in the model runs are derived from the national forest inventories;

- **Ingrowth:** By not simulating regeneration pools but directly simulating ingrowth (i.e., trees growing over the 12 centimetres calliper threshold of the Swiss national forest inventory), the number, diameter and main tree species based on stand, site and environmental characteristics are simulated (*Zell et al.*, 2019);
- **Mortality rates:** The updated mortality model formulates mortality depending on tree species, basal area and diameter at breast height as a quadratic term (for details see *Stadelmann et al.*, 2021). The mortality model accounts for density-dependent (i.e. increasing basal area results in increasing mortality) and age-dependent mortality (i.e. the U-shaped dependence on diameter at breast height shows both large mortality in the self-thinning phase of a forest and as well as for old trees).

Massimo produces a time series of carbon stocks, harvest rates, and gross growth for Swiss forests per decade starting in 2006. The model thus gives information on changes in carbon stored in productive forests. Changes in emissions or in removals of non-CO_2 gases are not calculated by the model. No changes are expected in the occurrence of wildfires. Also, there are no assumptions made for the development of the areas under afforestation and deforestation. Accordingly, it is assumed that, until 2040, the non-CO_2 emissions from productive forests as well as emissions and removals from afforestation and deforestation equal the mean value of emissions and removals in the period from 1990 to 2022.

For the land use, land-use change and forestry sector, only detailed projections for the forestry sector are available, as described above. As greenhouse gas net emissions and removals in the land use, land-use change and forestry sector are dominated by greenhouse gas fluxes in category 4A1 'Forest land remaining forest land', projections are focusing on this category, assuming that all other categories in the sector keep their current level of net emissions and removals, respectively, i.e. the mean of the period 1990–2022. Category 4A1 directly represents the managed forest land (MFL) under the Paris Agreement (land-based accounting). Using Massimo and defining future harvesting rates to derive forest management scenarios, greenhouse gas balances under the WEM, WOM and WAM scenarios are calculated. The scenarios presented include net emissions and removals from all pools as reported in the greenhouse gas inventory. The characteristics of the WEM, WOM and WAM scenarios are detailed in Tab. 29.

The existing policies and measures (WEM) define a distinct increase in harvesting rates up to the level of the potential sustainable wood supply in Swiss forests (objective 1 in *FOEN*, 2021b). Without political measures (WOM), Swiss forests would act as a considerable CO_2 sink because standing volume in Swiss forests would further increase, thereby leading to an instable forest structure with regard to future challenges of climate change and not fulfilling the objectives of sustainable forest management. The scenario with additional measures (WAM) is based on objective 2 in *FOEN* (2021b), which aims at improving the resilience of Swiss forests, to create forest stands with optimal conditions for adaptation to climate change and optimising the mitigation potential on the long run. The Forest Policy (*FOEN*, 2021b) includes a general description of forest adaptation, but concrete measures, to be used for modelling purposes, are not yet defined in detail.

Tab. 29 > Assumptions used for the projections of emissions from the land use, land-use change and forestry sector under the WEM, WOM and WAM scenarios.

	WEM	WOM	WAM
Forest area, afforestation, deforestation	The forest area as well as the changes in forest area (afforestation, deforestation) are calculated using an extrapolation of the trend 1990–2009 (values derived from the Swiss land use statistics AREA; *SFSO*, 2021a).	Identical assumptions for all scenarios.	Identical assumptions for all scenarios.
Forest management, political measures	In order to reach the optimal combination of the objectives identified in Switzerland's Forest Policy (section II.D.6.4), it is important that Swiss forests are managed in a sustainable way. The WEM scenario reflects all policies and measures adopted until 2009.	Policies and measures are not explicitly considered in this scenario.	In the WAM scenario, a steep decline in carbon stocks is established through increased harvesting rates, to create forest stands with optimal conditions for adaptation to climate change and improving the resilience through natural regeneration or planting. This long-term objective is generally described in objective 2 in *FOEN* (2021b). Further, all climate services of the forest

			(sequestration in forest biomass, carbon storage in wood products and substitution effects) are optimised.
Harvesting rates	Objective 1 in *FOEN* (2021b) aims at exploiting the potential sustainable wood supply: harvesting rates have to further increase to 8.2 million cubic metres in 2030. Afterwards, harvesting rates are assumed to stay at this level (*Stadelmann et al.*, 2021). This aim is also based on Switzerland's wood policy: increase wood production by 2025 (*FOEN/SFOE/SECO*, 2021).	Under the WOM scenario, it is assumed that the management practices observed between 1990–2009 (periods of NFI1/1983–1985, NFI2/1993–1995 and NFI3/2004–2006) are continued. The harvesting rates correspond to the continuation of these recent management practices and are strongly related to the age class distribution (*Stadelmann et al.*, 2021).	Under the WAM scenario, harvesting rates are strongly increased until 2040 in order to lower growing stock to 300 cubic metres per hectare (*Stadelmann et al.*, 2021).
Other categories and greenhouse gases	As greenhouse gas net emissions and removals in the land use, land-use change and forestry sector are dominated by greenhouse gas fluxes in category 4A1 'Forest land remaining forest land', projections are focusing on this category, assuming that emissions by sources and removals by sinks from all other land uses (including emissions of CH_4 and N_2O) remain constant (at the level of the respective mean over the years 1990–2022).	Identical assumptions for all scenarios.	Identical assumptions for all scenarios.

II.F.4.5 Waste

Greenhouse gas emission scenarios for the waste sector are calculated following exactly the same methodology as used for the greenhouse gas inventory, i.e. bottom-up estimates according to the 2006 IPCC guidelines for national greenhouse gas inventories (*IPCC*, 2006). Details about the methodologies are documented in *FOEN* (2024a). The underlying assumptions used under the different scenarios to project greenhouse gas emissions are described in Tab. 30. As in the waste sector policies and measures are rather limited, the WEM, WOM and WAM scenarios are largely based on the same underlying assumptions, with differences for the WOM scenario regarding landfilling of combustible waste and emissions from biogas production. For all scenarios, it is assumed that waste generation per capita remains at current levels. The strength of the chosen approach is that greenhouse gas emission scenarios are calculated at the level of single processes. This, however, requires a full set of projections of activity data and emission factors (which may potentially be considered a weakness of the approach).

Tab. 30 > Assumptions used for the projections of greenhouse gas emissions from the waste sector under the WEM, WOM and WAM scenarios. In consistency with the greenhouse gas inventory, greenhouse gas emissions from waste incineration facilities are reported under public heat and electricity generation in the energy sector.

	WEM	WOM	WAM
Landfilling of combustible waste	As landfilling of combustible waste was only of secondary importance and has been completely banned since the year 2000 (section II.D.7.2), greenhouse gas emissions from solid waste disposal sites are low, further decreasing, and only result from waste deposited before the implementation of the ban on landfilling of combustible waste. The WEM scenario is thus based on a continuation of the model for landfilling of combustible waste until 2040 (*IPCC*, 2006; *FOEN*, 2024a). The share of CH_4 flared (current value 10 per cent) is assumed to reach 11 per cent by 2025 and again 10 per cent by 2030, followed by a linear decrease to zero by 2050 as the remaining emissions are getting too small to be flared.	It is assumed that the ban on landfilling of combustible waste was not implemented. Consequently, the amount of waste disposed of at waste disposal sites under the WOM scenario follows the same evolution as under the WEM and WAM scenarios until 1999, but then only decreases to 10 per cent of this value by 2020, remaining constant thereafter.[84] It is further assumed that the share of CH_4 recovered for power production (on total CH_4 produced) is the same under the WOM scenario as under the WEM and WAM scenarios (the share decreases disproportionately as the cost-income ratio is changing for the worse with decreasing CH_4 production of the waste disposal site). Finally, it is assumed that the share of CH_4 flared remains constant at 3.5 per cent from 1990 to 2030, and then declines to zero by 2050.	Same as for the WEM scenario.
Wastewater treatment	Activity data related to wastewater treatment are assumed to scale with the evolution of population. While the (implied)	Identical assumptions for all scenarios.	Identical assumptions for all scenarios.

[84] The reasoning for this assumption is a decreasing public acceptance of waste disposal sites (odour, need of space, pollution, etc.), leading to the closing of waste disposal sites (where practicable) even without an official ban.

	emission factor for CH_4 is assumed to remain roughly constant between 2022 and 2040, the emission factor for N_2O is assumed to decrease by about 50 per cent due to technical improvements in wastewater treatment plants. Overall, this leads to a continuously decreasing trend between 1990 and 2040.		
Biogas production	It is assumed that the projected increase in the use of biogas (*Prognos et al.*, 2020) can only be provided if additional biogas facilities are constructed. As *Prognos et al.* (2020) do not explicitly model the number of biogas facilities, the trend over the years 2011–2020 is extrapolated. Accordingly, the total number of biogas facilities increases from 146 in 2020 to 165, 184, 203, and 223 by 2025, 2030, 2035, and 2040, respectively. The additional biogas facilities lead to a related increase of fugitive emissions over the coming years.	It is assumed that the amount of biogas upgraded under the WOM scenario is half of that under the WEM and WAM scenarios. The additional number of biogas facilities constructed after 2010 under the WOM scenario is then derived assuming the same amount of additionally upgraded biogas per facility as under the WEM and WAM scenarios. Consequently, reduced emissions from biogas facilities result under the WOM scenario compared to the WEM and WAM scenarios.	Same as for the WEM scenario.

II.F.4.6 Indirect CO_2 emissions

For the WEM and WAM scenarios, projections of indirect CO_2 emissions are based on the same assumptions and methodologies as the projections of direct greenhouse gas emissions in the respective sectors (see above). For the WOM scenario, it is assumed that due to the absence of policies and measures, the emission factors for precursor emissions do not improve over time and, thus, remain constant at the values in 1990 (see section II.D.4.4). The same activity data as under the WEM and WAM scenarios are then used to derive precursor emissions and subsequently indirect CO_2 emissions under the WOM scenario. For all scenarios, only fossil emissions and only emissions not already included elsewhere are considered (for more details see chapter 9 of Switzerland's national inventory document as referenced in chapter I).

II.F.4.7 International transport

The scenarios for international aviation are based on the WWB scenario of *Prognos et al.* (2020). As described in the info box on page 37 of the concise report (see footnote 81), the following assumptions are underlain:

- The development of fuel consumption is extrapolated on the basis of a projection of passenger numbers; until 2030 according to *Intraplan* (2015), thereafter parallel to the development of the population, taking into account an increase in the efficiency of flights in relation to passenger numbers. The increase in efficiency results from technical improvements of aircraft, but also through an increase in the load factor and the use of larger aircraft. Overall, efficiency is assumed to increase with a rate of 0.57 per cent per year, based on scenario 5 in *ICAO* (2016). This increase in efficiency also reflects the effect of the CO_2 emissions standard for aircraft (section II.D.3.9).[85] These assumptions lead to the passenger numbers shown in Tab. 31;
- As the activity data based on *Prognos et al.* (2020) do not reflect the impact of measures to contain the corona virus pandemic, projected activity data were considered as of 2025, with linear interpolation between 2022 and 2025. Based on recent passenger numbers[86], a full recovery to pre-pandemic levels by 2025 appears to be realistic;
- The inclusion of aviation in the emissions trading scheme (section II.D.1.7) as well as the carbon offsetting and reduction scheme for international civil aviation (CORSIA; section II.D.3.10) overall enforce a carbon neutral growth. However, since both systems involve compensation outside the aviation sector and possibly also outside Switzerland, they cannot be offset against emissions in the logic of the energy perspectives (*Prognos et al.*, 2020);
- With regard to the share of sustainable aviation fuels in international aviation from Switzerland, *Prognos et al.* (2020) assume for the WWB scenario that it rises continuously from zero per cent in 2030 to three per cent in 2045 (corresponding to an increase rate of 0.2 per cent per year starting in 2030). However, the adopted sustainable aviation fuel policy (see section II.D.3.13) requires a share of two per cent as of 2025 and six per

[85] As this policy and measure is of global significance, it is assumed that it does not lead to differences between the WEM, WOM and WAM scenarios.

[86] https://www.bfs.admin.ch/bfs/en/home/statistics/mobility-transport/cross-sectional-topics/civil-aviation.html

cent as of 2030 (a stepwise increase is assumed). As at this time, the starting date of the blending mandate is subject to discussions, it is assumed that the introduction will be delayed by one year (i.e. it is assumed that a share of two per cent will be mandatory as of 2026). For the WOM scenario, the share already considered under the WWB scenario is therefore removed, while for the WEM scenario the share according to the sustainable aviation fuel policy is added (resulting in a difference between the WOM and WEM scenarios of two per cent as of 2026 and six per cent as of 2030). The WAM scenario is currently identical to the WEM scenario;

- As for the energy sector, the calculations are performed by means of the national air pollution database EMIS, i.e. the same emission factors are applied as for the greenhouse gas inventory.

For Switzerland, emissions from international transport are dominated by international aviation. The minor emissions from international navigation are assumed to remain constant at the level of emissions in 2022 up to 2040 (for the WEM, WOM and WAM scenarios).

Tab. 31 > International aviation: Passenger numbers used for the WEM, WOM and WAM scenarios.

	2025	2030	2035	2040
Departing passengers (million)	71	81	85	87

Prognos et al. (2020)

II.F.4.8 Changes and main differences compared to previous submissions

Fig. 61 compares the projections for total emissions as reported in Switzerland's first biennial transparency report (containing data up to 2040) with the projections as reported in and Switzerland's eighth national communication and fifth biennial report (containing data up to 2030). Fig. 62 provides the same comparison for all source categories of the energy sector. Compared to the previous submission, the most recent WEM scenario is 7.7 per cent and 9.5 per cent lower by 2030 and 2035, respectively. The most recent WOM scenario is 0.1 per cent and 0.4 per cent lower by 2030 and 2035, respectively. The most recent WAM scenario is 3.1 per cent and 4.9 per cent lower by 2030 and 2035, respectively. Altogether, the overall differences are of minor importance (see Fig. 61). Changes may result from updated methodologies and assumptions (also in the greenhouse gas inventory), but they also reflect actual changes in underlying legislation (the individual contributions from these two parts could not be disentangled). In particular, some previously planned policies and measures are now implemented or adopted, leading to a smaller difference between the WEM and WAM scenarios (as the mitigation impact is now also visible in the WEM scenario). Fig. 63 provides the same comparison for international transport. Overall, projections as presented in Switzerland's first biennial transparency report include updates and are fully consistent with Switzerland's latest greenhouse gas inventory (*FOEN*, 2024a), but the general evolution is still very similar to the projections as presented in Switzerland's eighth national communication and fifth biennial report.

Fig. 61 > Total emissions: Changes in projections as reported in Switzerland's first biennial transparency report (thicker lines) and Switzerland's eighth national communication and fifth biennial report (thinner lines) for the WEM (blue), WOM (orange) and WAM (grey) scenarios. The overall differences are of minor importance (in particular, some policies and measures previously exclusively considered under the WAM scenario are now also considered under the WEM scenario).

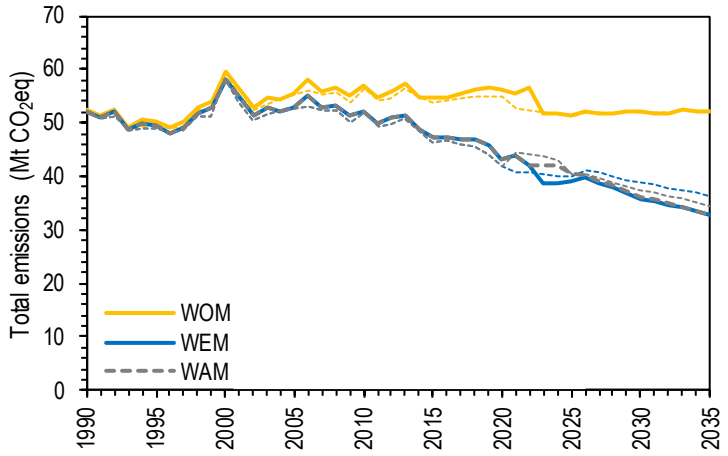


Fig. 62 > Source categories of the energy sector: Changes in projections as reported in Switzerland's first biennial transparency report (thicker lines) and Switzerland's eighth national communication and fifth biennial report (thinner lines) for the WEM (blue), WOM (orange) and WAM (grey) scenarios. Source categories 1A2, 1A3, 1A4: The WOM scenario remained unchanged (thinner orange lines hidden by thicker orange lines). Source category 1A5: The WOM scenarios correspond to the WEM scenarios (orange lines hidden by the blue lines). Source category 1B: The WEM, WOM and WAM scenarios are identical (all thinner lines overlap and all thicker lines overlap, the difference compared to the previous submission results from recalculations of fugitive emissions of natural gas).

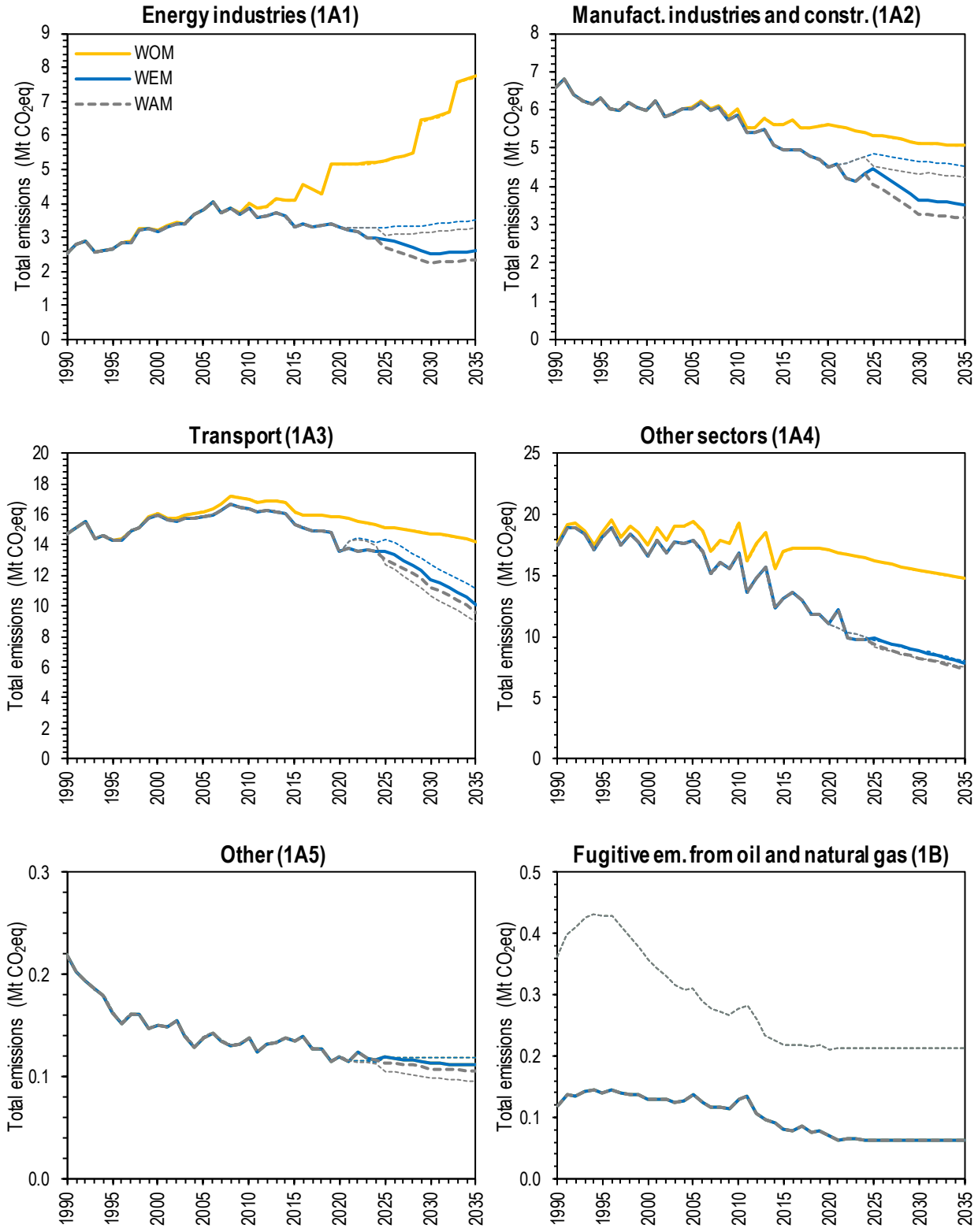
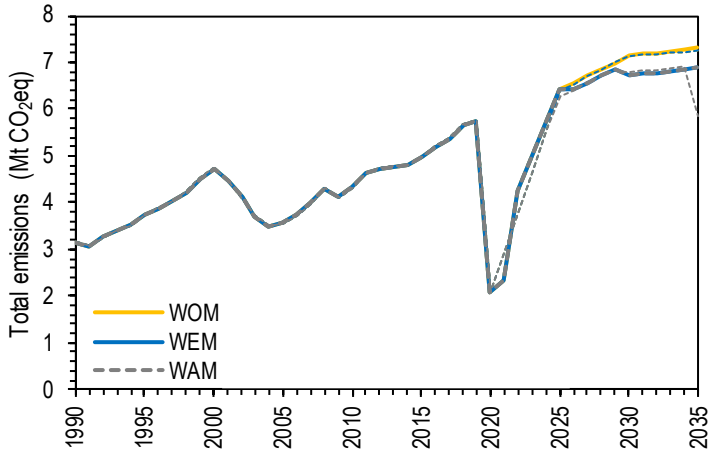


Fig. 63 > International transport: Changes in projections as reported in Switzerland's first biennial transparency report (thicker lines) and Switzerland's eighth national communication and fifth biennial report (thinner lines) for the WEM (blue), WOM (orange) and WAM (grey) scenarios. The sustainable aviation fuel policy (II.D.3.13) is now considered as 'adopted'.



II.F.4.9 Sensitivity analysis

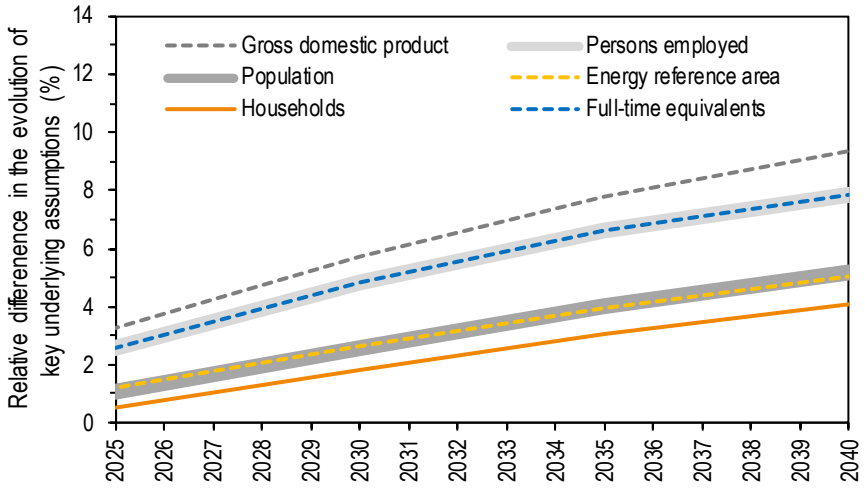
In the context of the development of the energy perspectives 2050+, *Prognos et al.* (2020) also performed a sensitivity analysis. Thereby, the potential impacts of higher growth rates of population and gross domestic product were estimated.[87] Detailed information is available in section 11.1 of the technical report (see footnote 81).

In brief, higher growth rates in population and gross domestic product lead to an increased number of employed persons. Due to the larger population, the higher number of employed persons and the higher gross value added, the quantity factors derived from this, such as the energy reference area, the transport performance and the production quantities, increase as well. The sensitivity analysis examines how these changed quantity factors affect energy consumption and greenhouse gas emissions. All other factors – including efficiency developments and substitution relationships – are left unchanged compared to the main scenario.

The evolutions of various key underlying assumptions and parameters (population, households, gross domestic product, persons employed, full-time equivalents, energy reference area) is shown in Fig. 64, where the given values provide the relative difference (in per cent) between the sensitivity scenario and the main scenario. The basis for population is the 'high scenario' (B-00-2015) of the Swiss Federal Statistical Office (*SFSO*, 2015). In the sensitivity scenario, the population rises to 9.7 million (main scenario: 9.5 million) in 2030 and to 10.5 million (main scenario: 10.0 million) in 2040. In 2040, this corresponds to a difference of 5.2 per cent. The differences between the sensitivity scenario and the main scenario for the total energy reference area evolves very similar as for population. The development of the household structure is also based on the scenario BM-00-2015 of the Swiss Federal Statistical Office. The differences in the mean household size compared to the main scenario are minor, but the mean household size is slightly higher in the sensitivity scenario. Due to the slightly larger mean household size, the relative difference between the sensitivity scenario and the main scenario in the number of households is slightly smaller than in the population. In 2040, the number of private households in the sensitivity scenario is by 4.1 per cent higher than in the main scenario. Persons employed and full-time equivalents evolve in parallel and reach a value, in the sensitivity scenario and by 2040, of 7.9 per cent above the main scenario. The largest relative difference is assumed for the gross domestic product, with the sensitivity scenario being 9.4 per cent higher than the main scenario by 2040.

[87] In addition, the sensitivity to energy price assumptions was analysed, but only for the net-zero emissions scenarios ('ZERO'), while energy prices for the scenario 'WWB' (used here as the basis for the WEM scenario) remained unchanged.

Fig. 64 > Evolution of various key underlying assumptions and parameters under the sensitivity scenario. Shown are the relative differences between the sensitivity scenario and the main scenario. Additional parameters are available in the technical report and the corresponding data tables (*Prognos et al.*, 2020).

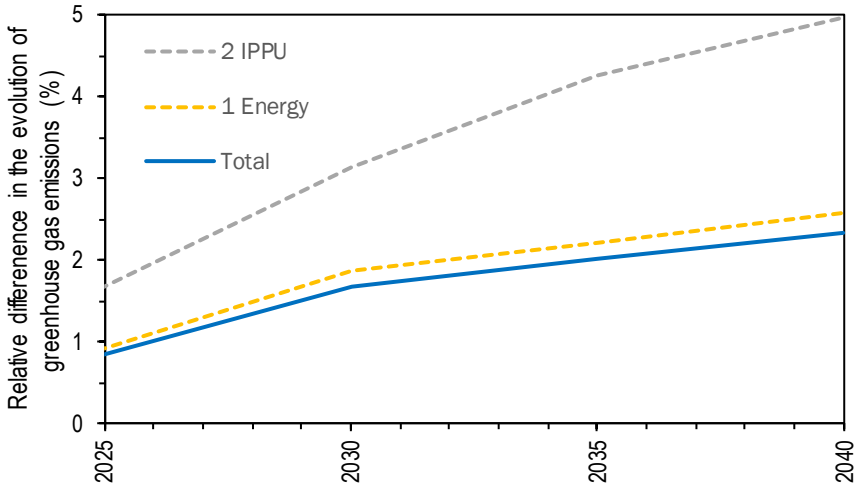


The main results of the sensitivity analysis are as follows:

- Final energy consumption in the sensitivity scenario decreases from 783 petajoules in 2000 to 727 petajoules in 2030 and to 687 petajoules in 2040. In 2040, the energy consumption is thus 30 petajoules higher than in the main scenario. The additional 30 petajoules correspond to an increase in consumption of around five per cent;
- A large part of the additional consumption is accounted for by electricity (14 petajoules). The additional electricity demand is not offset by higher domestic generation, but by additional imports. There also results an additional consumption of fossil energy sources, which amounts to about five petajoules for petroleum products and about four petajoules for natural gas in 2040;
- The additional consumption of fossil energy sources in the sensitivity scenario leads to slightly higher emissions of greenhouse gases compared to the main scenario (see Fig. 65). Process emissions in sector 2 'Industrial processes and product use' are also slightly higher in the sensitivity scenario compared to the main scenario. For simplification, an identical development was assumed for agriculture and waste as in the main scenario;
- Overall, the sensitivity scenario results in additional greenhouse gas emissions of 0.7 and 0.8 million tonnes of CO_2 equivalents in 2030 and 2040, respectively, compared to the main scenario. CO_2 is responsible for the dominant share (between 98 and 99 per cent) of the resulting difference. The additional emissions mainly occur in industry (energy and process emissions) and transport. In contrast, additional emissions from services and private households are negligible;
- In relative terms, total greenhouse gas emissions are 2.3 per cent higher under the sensitivity scenario compared to the main scenario in 2040. The relative difference is 2.6 per cent for the energy sector and 5.0 per cent for process emissions in sector 2 'Industrial processes and product use' (Fig. 65).

A further discussion as well as additional figures are available in section 11.1 of the technical report (see footnote 81).

Fig. 65 > Evolution of greenhouse gas emissions (sum of all gases) under the sensitivity scenario. Shown are the relative differences between the sensitivity scenario and the main scenario. Additional parameters are available in the technical report and the corresponding data tables of *Prognos et al.* (2020).



II.G Other information

Switzerland reported all information relevant to tracking progress made in implementing and achieving its nationally determined contribution under Article 4 of the Paris Agreement in section II.A to II.F. There is no relevant other information to be reported.

III Climate change impacts and adaptation

Information related to climate change impacts and adaptation under Article 7 of the Paris Agreement

III.A General information

Most recent information related to climate change impacts and adaptation can be found in Switzerland's first adaptation communication submitted to the UNFCCC on 9 December 2020 (see *www.bafu.admin.ch/submissions-unfccc-2020*) as well as in chapter 6 of Switzerland's eighth national communication and fifth biennial report submitted to the UNFCCC on 16 September 2022 (see *www.bafu.admin.ch/nc-br*). Due to limited resources, Switzerland refrains from reporting on climate change impacts and adaptation in the present first biennial transparency report and plans to update the information available in the above-mentioned reports in its ninth national communication to be submitted in conjunction with the second biennial transparency report. The information will be included in section VI.A.

IV Support provided

Information on financial, technology development and transfer and capacity-building support provided and mobilised under Articles 9–11 of the Paris Agreement

IV.A National circumstances and institutional arrangements

The Federal Constitution of the Swiss Confederation stipulates that Switzerland is committed to the long-term preservation of natural resources and to a just and peaceful international order. It further states that Switzerland shall assist in the alleviation of need and poverty in the world and promote respect for human rights and democracy, the peaceful co-existence of peoples as well as the conservation of natural resources. Support for international climate action – through a variety of channels and instruments, such as dedicated multilateral climate funds, specific multilateral and bilateral climate programmes and projects, as well as integrating low-carbon development and climate resilience into Switzerland's development assistance – has thus been a cornerstone of Switzerland's international engagement since the early 1990s.

IV.A.1 Systems and processes

Regarding international climate finance, three government entities – the Swiss Agency for Development and Cooperation, the Swiss State Secretariat for Economic Affairs, and the Swiss Federal Office for the Environment – have specific roles and dedicated budgets. They cooperate closely to ensure the overall effectiveness and coherence of Swiss support for climate change adaptation and mitigation activities in developing countries and countries in transition.

The bulk of the funding is provided through two four-year framework credits; the credit for Switzerland's (general) international cooperation (2020–2024) managed by the Swiss Agency for Development and Cooperation and the Swiss State Secretariat for Economic Affairs and the much smaller, dedicated framework credit for the global environment (2018–2021) managed by the Swiss Federal Office for the Environment. In line with the national budgeting process, Parliament approves the framework credits and appropriates budgets annually. Fiscal planning is undertaken annually for three years in advance.

The responsibility of identifying, tracking and reporting on support provided and mobilised through public interventions is shared among the three entities; while the Swiss Agency for Development and Cooperation and the Swiss State Secretariat for Economic Affairs are primarily responsible for the identification and tracking, the Swiss Federal Office for the Environment, in close coordination with the two other authorities, is in charge of reporting.

Switzerland uses the Rio Marker Methodology, which labels development finance in support of climate change adaptation and mitigation through two 'Rio markers' which indicate whether climate change is the principal objective of the activity or a significant one. The detailed methodology for Rio markers is available in the document 'Converged Statistical Reporting Directives for the Creditor Reporting System (CRS) and the Annual DAC Questionnaire'.[88] Because the climate mitigation and adaptation markers are policy markers, Switzerland applies a quantified reduction factor to account for the climate-specific share of each climate-marked activity (see below for further information).

For multilateral organisations, Switzerland calculated, where possible, the climate relevant part of the Swiss multilateral contributions using the climate relevant share of the portfolio for the respective organisation according to the OECD Development Assistance Committee methodology for imputed shares (see below for further information).

IV.A.2 Challenges and limitations

Switzerland has a comparatively small public administration (*OECD*, 2023) where the different entities and their staff involved in identifying, tracking and reporting international climate finance have to handle multiple, at times conflicting priorities and tasks.

Also, Switzerland's direct democratic system is generally considered of very high quality. It ensures inclusiveness, very high levels of transparency and strong backing of policies by the public, but it also involves long consultation processes and legislative and regulatory change can therefore take longer than in other political systems.

[88] https://one.oecd.org/official-document/DCD/DAC/STAT(2024)2/ADD2/REV1/en

Tracking and reporting on mobilised private finance continue to be more challenging than tracking and reporting on international public finance, due to higher complexity in data collection. The data transfer from the format of the biennial report to the format of the biennial transparency report poses challenges for Switzerland because of the additional reporting fields and requirements. It may take a few reporting cycles to achieve the same level of completeness as in past reporting cycles under the format of the biennial report.

IV.A.3 Experience and good practices

Switzerland has longstanding experience in mobilising private funds as part of its international climate finance for mitigation and adaptation, for example through its Export Credit Agency (ECA), the Swiss Export Risk Insurance (SERV). SERV supports Swiss companies in their export transactions through tailor-made export risk insurances, covering political and economic (del credere) risks. SERV's insurances are supplementary to those offered by the private sector. The private funds mobilised through transactions in developing countries, which have a positive climate mitigation and/or adaptation impact, are accounted for as mobilised private funds by Switzerland in accordance with the Swiss Rio Marker methodology (see below).

Switzerland also takes action internationally and domestically to implement Article 2.1(c) of the Paris Agreement through disclosure regulation, as well as other instruments and initiatives. The voluntary Swiss Climate Scores enhance transparency and comparability at the financial product level and help investors better integrate climate aspects into their financial decision-making. Switzerland also offers a climate alignment test to the financial sector in Switzerland. In 2022, Switzerland conducted the Paris Agreement Capital Transition Assessment (PACTA) test with 133 financial institutions for the third time since 2017, allowing them to monitor the alignment of their portfolios with the goal of limiting global warming to well below two degrees Celsius and pursuing efforts to limit it to 1.5 degrees Celsius.[89] Switzerland has also helped promote the use of the PACTA test reaching around 20 government and supervisors around the globe to date.[90]

IV.A.4 Enhancing comparability and accuracy of information

Switzerland is an active member of the Organisation for Economic Co-operation and Development's (OECD) Development Assistance Committee (DAC). Ensuring the transparency, integrity and effectiveness of the provision but also tracking and reporting of aid provided to developing countries, including support for climate change adaptation and mitigation activities, is core to the mandate of the DAC. Therefore, the majority of the underlying definitions, methodologies and assumptions used in Switzerland's climate finance reporting is equivalent or based on the OECD DAC reporting standards.

Switzerland was part of the donor group, which provided significant methodological input to measure and report mobilised private climate finance in a transparent, comparable and aggregated manner in the context of the climate finance report series of the OECD.[91] Switzerland, together with other donors, developed a robust methodology for the assessment of the mobilised private sector investments (*TWG*, 2015).

IV.A.5 National circumstances and institutional arrangements for the provision of technology development and transfer and capacity-building support

Switzerland has the same national circumstances and institutional arrangements for the provision of technology development and transfer and capacity-building support as for climate finance.

IV.B Underlying assumptions, definitions and methodologies

Switzerland is committed to transparency in climate finance reporting as a way of tracking progress, fostering trust and ultimately mobilising more climate finance. Whereas transparency refers to both the actual support provided and funds mobilised as well as the underlying assumptions, definitions and methodologies. Switzerland follows, where possible and applicable, best international practice.

89 In 2024, the next round followed, see www.bafu.admin.ch/pacta-climate-test.

90 For further information see https://www.bafu.admin.ch/bafu/en/home/topics/climate/info-specialists/climate-and-financial-markets.html.

91 See https://www.oecd.org/en/topics/climate-finance-and-the-usd-100-billion-goal.html.

(a) The chosen reporting year (calendar year, fiscal year)

Switzerland uses the **calendar year** to report on all information on financial support provided and funds mobilised under Article 9 of the Paris Agreement (PA). In Switzerland the calendar year coincides with the fiscal year and covers the period of 12 consecutive months from 1 January until 31 December.

Switzerland's first biennial transparency report therefore covers the periods from 1 January 2021 to 31 December 2021 and 1 January 2022 to 31 December 2022.

(b) The conversion between domestic currency and United States dollars

Switzerland pledges and provides its support in domestic currency, that is Swiss francs, except in a few cases, such as the Swiss contribution to the first replenishment of the Green Climate Fund (GCF), where Switzerland pledged and disbursed its contribution in US dollars directly. To convert the amount reported in Swiss francs to US dollars in the common tabular format, Switzerland applies the standard annual average exchange rate as published by the OECD. Switzerland notes that the same exchanges rates (2021: 0.913846 Swiss francs per US dollar, 2022: 0.954832 Swiss francs per US dollar) are consistently used throughout Switzerland's first biennial transparency report and the accompanying CTF-FTC tables.

(c) The status (committed, disbursed)

Switzerland reports disbursed amounts in its tables on bilateral (CTF-FTC table 1) and multilateral (CTF-FTC table 2) support provided. Switzerland reports committed amounts in its tables on private finance mobilised (CTF-FTC table 3) through public interventions.

Underlying definition of disbursement: The release of funds to or the purchase of goods or services for a recipient; by extension, the amount thus spent.

Disbursements record the actual international transfer of financial resources, or of goods or services valued at the cost to the donor.

In the case of activities carried out in donor countries, such as training, administration or public awareness programmes, disbursement is considered to have occurred when the funds have been transferred to the service provider or the recipient. They may be recorded gross (the total amount disbursed over a given accounting period) or net (the gross amount less any repayments of loan principal or recoveries on grants received during the same period). It can take several years to disburse a commitment.[92]

Underlying definition for commitment: A firm obligation, expressed in writing and backed by the necessary funds, undertaken by an official donor to provide specified assistance to a recipient country or a multilateral organisation.

Bilateral commitments are recorded in the full amount of expected transfer, irrespective of the time required for the completion of disbursements. Commitments to multilateral organisations are reported as the sum of (i) any disbursements in the year reported on which have not previously been notified as commitments, and (ii) expected disbursements in the following year.

(d) The channel (bilateral, regional, multi-bilateral, multilateral)

Underlying definition of a bilateral channel: Flows provided directly by a donor country to an aid recipient country[93] or to a multilateral organization for the implementation of a project in a particular country or region (see below).

Underlying definition of a multilateral channel: Aid activities financed from multilateral development institutions' regular budgets.

92 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Private_Flows

93 https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/dac-glossary.htm#Total_Receipts

Projects executed by multilateral organizations on behalf of donor countries are classified as **bilateral** flows, since it is the donor country that effectively controls the use of the funds.[94]

Switzerland appreciates the advantages and disadvantages of the different **channels** – bilateral, regional, multi-bilateral, multilateral – and strives to use the channel that fits best according to the respective circumstances.

Indeed, Switzerland uses all the channels and provides a share of its financial support provided and mobilised under Article 9 of the PA through **multilateral channels** and the remaining share through **regional and bilateral channels**. To this end Switzerland also provides support via the operating entities of the financial mechanism of the convention, the Global Environment Facility (GEF) and its funds, including the Least Developed Country Fund (LDCF), the Special Climate Change Fund (SCCF), the Green Climate Fund (GCF) and the Adaptation Fund (AF) as well as the Climate Investment Funds among others. Switzerland also provides and mobilizes international climate finance through multilateral development banks (MDBs) and international organizations, including the United Nations Development Programme (UNDP), and others.

(e) The funding source (official development assistance (ODA), other official flows (OOF), other)

Switzerland uses the OECD definitions of official development assistance (ODA) and other official flows (OOF) as well as the categories for reporting purposes in line with the definitions below.

Underlying definition of ODA: Official development assistance (ODA) is defined as government aid that promotes and specifically targets the economic development and welfare of developing countries.[95]

Underlying definition of OOF: Other official flows (OOF) are defined as official sector transactions that do not meet official development assistance (ODA) criteria. OOF include (i) grants to developing countries for representational or essentially commercial purposes or e.g. in support of the UN climate regime, (ii) official bilateral transactions intended to promote development, but having a grant element of less than 25 per cent, and (iii) official bilateral transactions, whatever their grant element, that are primarily export-facilitating in purpose. This category includes, by definition: export credits extended directly to an aid recipient by an official agency or institution (official direct export credits); the net acquisition by governments and central monetary institutions of securities issued by multilateral development banks at market terms; subsidies (grants) to the private sector to soften its credits to developing countries; and, funds in support of private investment.[96]

Underlying definition of other: The definition varies and is explained each time in the explanations (or footnote).

(f) The financial instrument (e.g. grant, concessional loan, non-concessional loan, equity, guarantee, insurance, other (specify))

Switzerland has started to use a variety of instruments and carefully selects them depending on the respective circumstances, objectives and needs. However, Switzerland still uses primarily grants including non-reimbursable loans for providing financial, technology development and transfer and capacity-building support to developing countries, due to certain legal and administrative constraints and because Switzerland's development finance institution is small compared to other countries.

The Swiss Investment Fund for Emerging Markets (SIFEM), the Swiss development finance institution (DFI) uses an indirect investment approach with the majority of its investments allocated to funds including private equity and private debt funds. In addition, SIFEM provides different types of loans depending on the financial intermediary in question and its particular needs. The Swiss Export Risk Insurance SERV on the other hand offers insurance and re-insurance products to Swiss exporters and financial institutions. However, it does not provide direct export credits or financing.

94 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Private_Flows

95 https://www.oecd.org/dac/financing-sustainable-development/development-finance-standards/official-development-assistance.htm

96 https://data.oecd.org/drf/other-official-flows-oof.htm

Underlying definition of grant: Transfers made in cash, goods or services for which no repayment is required.[97]

Underlying definition of concessional loan (concessionality): A measure of the 'softness' of a credit reflecting the benefit to the borrower compared to a loan at market rate (see Grant Element). Technically, it is calculated as the difference between the nominal value of a credit and the present value of the debt service as of the date of disbursement, calculated at a discount rate applicable to the currency of the transaction and expressed as a percentage of the nominal value.[98]

Underlying definition of concessionality: The degree of concessionality of a loan is measured by its "grant element". The grant element is defined as the difference between the loan's nominal value (face value) and the sum of the discounted future debt-service payments to be made by the borrower (present value), expressed as a percentage of the loan's face value. Whenever the interest rate charged for a loan is lower than the discount rate, the present value of the debt is smaller than its face value, with the difference reflecting the (positive) grant element of the loan.[99]

Underlying definition of equity: For Switzerland equity means capital owned by the owner or shareholders of a company and/or capital raised from own resources to finance a venture or project.

Underlying definition of (re-)insurance: A contract, represented by a policy, in which a third-party policyholder receives financial protection or reimbursement against losses from the Swiss export risk insurance (SERV). With its insurance products, SERV covers the political and economic risk (del credere risk) associated with exporting goods and services. SERV's insurance policies and guarantees help companies to obtain export financing by offering protection against non-payment and by making it easier for companies to obtain low-interest loans or higher credit limits from banks. SERV also enables Swiss exporters to offer their customers longer payment terms without suffering liquidity shortfalls.

Underlying definition of guarantee: A financial guarantee is an agreement that guarantees that a debt will be repaid to a lender by the Swiss government or the Swiss export risk insurance (SERV). Essentially the Swiss government or SERV acting as guarantor promises to assume responsibility for a debt, should the borrower be unable to continue its payments to the creditor.

Underlying definition of policy intervention: For Switzerland, a policy intervention includes any type of policy support in a developing country or the implementation of a policy measure in Switzerland, which directly leads to the mobilization of private capital in developing countries for climate action and can causally be linked back to the Swiss policy measure and/or the Swiss policy development support.

Underlying definition of technical assistance: Technical assistance includes both (i) grants to nationals of aid recipient countries receiving education or training at home or abroad, and (ii) payments to consultants, advisers and similar personnel as well as teachers and administrators serving in recipient countries (including the cost of associated equipment).[100]

Underlying definition of capacity building: See below.

Underlying definition of technology transfer: See below.

Underlying definition of other: The definition varies and is explained each time in the explanations (or footnote).

97 https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/dac-glossary.htm#Grant

98 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Private_Flows

99 https://ida.worldbank.org/en/financing/debt/grant-element-calculations

100 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm

(g) Information on instruments and funding sources reported, including how a Party has determined finance to be concessional and/or ODA, including by using information such as grant equivalency, institution and/or instrument-based approaches

Currently SIFEM uses an institution-based approach. As explained above, the majority of its investments are allocated to funds including private equity and private debt funds. However, Switzerland intends to change to an instrument-based approach in the medium or long-term that would allow it to report each operation accordingly.

As mentioned, Switzerland has exclusively provided grants in the reporting period. So, by default the support provided by Switzerland is concessional and, accordingly, Switzerland does not have to use any particular approach to determine grant equivalency. This said, Switzerland subscribes to the grant equivalent accounting of the OECD.[101]

(h) The type of support (e.g., adaptation, mitigation, cross-cutting)

Switzerland reports on the type of support, namely adaptation, mitigation and cross-cutting as well as on sectors and subsectors.

Switzerland follows the OECD definitions and methodology to determine the type of support. Based on the definitions below, Switzerland uses OECD Rio policy markers to label and measure whether and to what extent the type of support targets adaptation, mitigation or cross-cutting action. More generally, Switzerland uses OECD and other policy markers for the monitoring of climate and other transversal themes.

Climate mitigation: The action contributes to the objective of stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, by promoting efforts to reduce or limit greenhouse gas emissions or to enhance greenhouse gas sequestration. In order to be eligible, the activity contributes to:

- The mitigation of climate change by limiting anthropogenic emissions of greenhouse gases, including gases regulated by the Montreal Protocol; or
- The protection and/or enhancement of greenhouse gas sinks and reservoirs; or
- The integration of climate change concerns into the recipient countries' development objectives through institution building, capacity development, strengthening the regulatory and policy framework, or research; or
- Developing countries' efforts to meet their obligations under the Convention.[102]

Climate adaptation: The action intends to reduce the vulnerability of human or natural systems to the impacts of climate variability and change, by maintaining or increasing resilience, through increased ability to adapt to, or absorb, climate change stresses, shocks and variability and/or by helping reduce exposure to them. This encompasses a range of activities from information and knowledge generation, to capacity development, planning and the implementation of climate adaptation actions. In order to be eligible, the activity contributes to:

- The climate change adaptation objective is explicitly indicated in the activity documentation; and
- The activity contains specific measures targeting the definition above.[102]

Switzerland developed a user manual for its project officer to facilitate the use of the Rio Markers.

Activities that fulfil both adaptation and mitigation eligibility criteria, in other words activities aimed both at mitigation and adaptation are marked as cross-cutting.

Rio marker methodology: To measure the climate-relevant and more specifically mitigation- and/or adaptation-relevant spending of an activity, Switzerland uses the Rio marker methodology and assigns one or more of the following scores

[101] See https://one.oecd.org/document/DCD/DAC/STAT(2018)9/ADD2/FINAL/en/pdf.

[102] https://one.oecd.org/document/DCD/DAC/STAT(2015)25/en/pdf

to identify whether mitigation and adaptation are (0) not targeted, (1) a significant objective or (2) a principal objective of a project:

- **(0) 'Not targeted'** score means that the activity has been screened against the policy objective but was found not to target that particular policy objective;
- **(1) 'Significant'** (secondary) policy objectives are a relevant part of the activity. They are not one of the principal reasons for undertaking the activity and are therefore not crucial to the activity;
- **(2) 'Principal'** (primary) policy objectives are those which can be identified as being fundamental to the design and forming the core of the concept of the activity. They may be selected by answering negatively to the question 'would the activity have been undertaken without this objective?'.

For activities marked 'not relevant', no climate-relevant funding is counted. For activities marked 'significant' 50 per cent is counted as climate-relevant funding, while for activities marked 'principal' 85 per cent of funding is counted as climate relevant funding.

Switzerland takes a very conservative approach to accounting climate-relevant funding to avoid over-reporting. Concretely speaking, Switzerland follows the following approach: When activities can be marked with both the mitigation and the adaptation Rio Markers, the climate-relevant funding is distributed between the two objectives:

- For an activity marked significant with both the mitigation and adaptation markers, 25 per cent of the funding is counted as mitigation-relevant and 25 per cent as adaptation-relevant funding;
- For an activity marked significant for mitigation and principal for adaptation (or the other way around), 35 per cent of the funding is counted as mitigation-relevant funding and 50 per cent of the funding is counted as adaptation-relevant funding (or the other way around);
- Finally, an activity marked principal for both mitigation and adaptation, 42.5 per cent of the funding is counted as mitigation-relevant and 42.5 per cent as adaptation-relevant funding.

Switzerland uses the **imputed share methodology** of the OECD DAC to determine the climate specific share of the Swiss contributions to multilateral organisations. Switzerland multiplies its core contribution to a specific multilateral organization with the climate specific imputed shares published by the OECD annually. For the reporting period the imputed shares for 2021 and 2022 as published by the OECD DAC were used.

(i) The sector; (j) The subsector

To determine the sector and subsector of support, Switzerland follows the OECD definitions and methodologies. The sector of an action or destination is assigned by answering the question 'which specific area of the recipient's economic and social structure is the transfer intended to strengthen'. It does not refer to the type of goods or services provided. To classify the sector, Switzerland uses the OECDs purpose code. One and only one purpose code is used per activity. For activities cutting across several sectors, either a multi-sector code or the code corresponding to the largest component of the aid activity is used.[103]

For the reporting in the context of the enhanced transparency framework, Switzerland matches the sectors and subsectors identified with the OECD purpose codes to the sectors according to the guidelines for the biennial transparency report.

(k) Whether it supported capacity-building and/or technology development and transfer objectives

Underlying definition of capacity building: Capacity building is the process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time. Thereby 'capacity' is understood as the ability of people, organizations and society as a whole to manage their affairs successfully. Essentially, capacity development is characterised by iterative and long-term learning and the exchange of knowledge that leads to better delivery or implementation or ability to address a specific problem.

[103] https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm

Underlying definition of technology development and transfer: Technology transfer involves the diffusion of technologies and technology cooperation across and within countries (not limited to the transfer of patented knowledge). It encompasses a broad set of processes covering the flows of technological knowhow and experiences, as well as of equipment, amongst different stakeholders (governments, private sector entities, financial institutions, NGOs, research/education institutions). In particular, it comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions and integrate it with indigenous technologies.

In due time, Switzerland will report comprehensively whether the support provided has capacity-building, technology-development and/or transfer objective(s). To date, Switzerland has reported on selected activities that support these objectives.

(l) The support as being climate-specific

Switzerland uses the OECD Rio-Marker methodology as well as the imputed share methodology to identify and account for climate-specific activities (see description under section IV.B, letter h).

(m) Information on the efforts taken to avoid double counting, including on:

i) How double counting among multiple Parties involved in the provision of support was avoided

Switzerland only accounts for the support it provides to developing countries bilaterally and multi-bilaterally on its own. Regarding the support provided multilaterally, Switzerland only accounts for the imputed share of its core contributions to MDBs and other international organizations as defined and determined by the OECD, thereby reducing any risk of double counting to an absolute minimum.

In order to avoid double counting, Switzerland only reports its inflows to MDBs and other international/multilateral institutions. Switzerland does not report on its share of the outflows (including investments) of multilateral institutions. However, multilateral institutions, in particular MDBs, have an important role to play in the provision of climate finance and their outflows should be measured, tracked and reported collectively, when accounting for climate finance internationally, for example as has been done to date in the context of the measuring of progress towards the goal of 100 billion US dollars per year.

(ii) How double counting was avoided among multiple Parties involved in the mobilization of private finance

Switzerland follows the OECD DAC statistical guidelines to avoid double counting among multiple Parties involved int the mobilization of private finance (DCD/DAC/STAT(2024)3/ADD1).

To account for the private finance mobilised through the climate specific insurances extended by SERV, Switzerland applies the OECD DAC methodology for guarantees. When SERV reinsures a project (or part of a project) which is insured by another official ECA, Switzerland reports only 50 per cent of the climate-relevant portion of the reinsured amount as mobilised private finance, provided the other official ECA has not accounted and reported the amount as mobilised private climate finance.

(iii) How double counting was avoided between the resources reported as provided or mobilised, and the resources used under Article 6

To implement Article 6 and in particular the bilateral or plurilateral cooperation as envisaged under Article 6.2, Switzerland has established a number of bilateral treaties, which set the cooperation framework and state the requirements for recognition of the international transfer of emission reductions by parties of the treaties.

Switzerland does not account for any of its investments under Article 6 as part of its international climate finance provided and/or mobilised through public intervention unless the related internationally transferred mitigation outcome is cancelled and not accounted towards the Switzerland's nationally determined contribution and/or the contribution claim of a Swiss company and applies a pro-rata approach, e.g. in Article 6 schemes, where multiple actors are involved and other actors use the scheme to provide or mobilize results-based climate finance.

(iv) How support is attributed between multiple recipient countries, in cases where a project involves multiple recipient countries and where this information is reported on a country-by-country basis

Switzerland reports projects, which benefit multiple countries at the same time as regional project and does no attribute the funds to individual countries of the group of beneficiaries, because often support is provided for multiple countries at the same time through coordinated approaches and a country-to-country attribution would not do justice to the support provided and/or mobilised.

(n) The definition of public and private finance, in particular where entities or funds are mixed

Underlying definition of public flows: Public flows are funding provided by government, national, sub-national/ municipal and state-owned entities that provide public funds from the public (national, sub-national, municipal) budget. The sources of these budget funds can vary and include tax revenue, government debt, and limited earmarked revenue.

Underlying definition of private flows: Private flows at market terms financed out of private sector resources (i.e. changes in holdings of private long-term assets[104] held by residents of the reporting country) and private grants (i.e. grants by non-governmental organizations and other private bodies, net of subsidies received from the official sector). In data presentations which focus on the outflow of funds from donors, private flows other than foreign direct investment are restricted to credits with a maturity[105] of greater than one year and are usually divided into:

- Foreign direct investment (FDI): Investment made to acquire or add to a lasting interest in an enterprise in a country on the DAC List of ODA Recipients[106]. 'Lasting interest' implies a long-term relationship where the direct investor has a significant influence on the management of the enterprise, reflected by ownership of at least 10 per cent of the shares or equivalent voting power or other means of control. In practice, it is recorded as the change in the net worth of a subsidiary in a recipient country to the parent company, as shown in the books of the latter;
- Private export credits;
- Securities of multilateral agencies[107]: This covers the transactions of the private non-bank and bank sector in bonds, debentures, etc., issued by multilateral institutions;
- Bilateral portfolio investment and other: Includes bank lending and the purchase of shares, bonds and real estate.

Switzerland uses the OECD definition of public and private finance flows.[108]

(o) How private finance was assessed as mobilised through public interventions, including by:

(i) Identifying a clear causal link between a public intervention and mobilised private finance, where the activity would not have moved forward, or moved forward at scale, in the absence of the Party's intervention; (iii) Providing information on the boundaries used to identify finance as mobilised by public intervention

Where applicable Switzerland follows the OECD Reporting Directives and annexes including the instructions for reporting on amounts mobilised from the private sector (DCD/DAC/STAT(2024)3/ADD1). The document describes, the methodologies for calculating amounts mobilised from the private sector through guarantees, syndicated loans, shares in collective investment vehicles (CIVs), direct investment in companies (DICs) / special purpose vehicles (SPVs), credit lines, simple co-financing arrangements and project finance schemes extended for development purposes. The instrument-specific methodologies seek to ensure that only private finance with a clear link to the public intervention is accounted for and to establish clear boundaries. However, as noted above the largest share of Swiss support is provided in the form of grant and technical assistance activities. Thus, the actual use of the methodologies cited above by Switzerland is very limited.

104 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#LongTerm

105 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Maturity

106 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#DAC_List

107 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Multi_Agencies

108 https://web-archive.oecd.org/temp/2024-02-22/66749-dac-glossary.htm#Private_Flows

Switzerland was actively involved in developing the guidance for reporting on mobilisation through technical assistance activities. The guidance was finalized in 2021 and made available for testing during a two years pilot period. Thereafter it was integrated in the regular OECD instructions for reporting on amounts mobilised from the private sector (DCD/DAC/STAT(2024)3/ADD1). However, the data collected in the pilot phase on TA mobilisation has not been included in the statistics on mobilised private finance neither by the OECD Secretariate nor by Switzerland.

(ii) Providing information on the point of measurement (e.g. point of commitment, point of disbursement) of the private finance mobilised as a result of the public intervention, to the extent possible in relation to the type of instrument or mechanism used for the mobilization

While Switzerland accounts public climate finance amounts at the point of disbursement, as stated above, private finance is measured at the point of commitment, where commitment is understood at the time of the signature of the respective legal document(s), such as the memorandum of understanding (MoU), loan agreement, commitment letter etc.

(p) How it seeks to ensure that support provided and mobilised through public interventions effectively addresses the needs and priorities of developing country Parties for the implementation of the Paris Agreement, as identified in country-driven strategies and instruments, such as biennial transparency reports, NDCs and national adaptation plans

Switzerland's bilateral support for climate action is based on a cooperative, bilateral dialogue with the various partner countries. Every four years, the Swiss Cooperation Offices engage in a demand driven planning dialogue, where, based on the available resources, the needs and priorities of the partner country (as reflected in their nationally determined contributions and national adaptation plans among others) are assessed with stakeholders. This programmatic procedure ensures country ownership and provides increased predictability for the partner countries.

Country-specific adaptation initiatives which are supported by the Swiss Agency for Development and Cooperation are guided by national plans and vulnerability assessments, focusing on resilience at the community level. As far as mitigation is concerned, the Swiss State Secretariat for Economic Affairs also supports middle-income countries in reducing CO_2 emissions in various sectors, such as energy, urban development, public and private finance and agricultural and industrial supply chains.

(q) How it seeks to ensure that support provided and mobilised through public interventions is in line with the long-term goals of the Paris Agreement

With its mobilization and provision of international climate finance, Switzerland focuses on supporting developing countries in their climate mitigation and adaptation action in order to increase global adaptation and resilience and/or effectively reduce greenhouse gas emissions in developing countries and to contribute to holding the increase in the global average temperature to 1.5 degrees Celsius above pre-industrial levels.

(r) An indication of what new and additional financial resources have been provided, and how it has been determined that such resources are new and additional

Switzerland's climate finance efforts have continuously been strengthened and show a progression over time. The activities reported and associated with financial contributions have not been reported previously. Therefore, Switzerland considers its effort for climate finance reporting to be new and additional.

(s) How the information provided reflects a progression from previous levels in the provision and mobilization of finance under the Paris Agreement

Please refer to the CTF-FTC tables 1, 2 and 3 for 2021 and 2022. The numbers provided reflect a clear progression over the years overall.

(t) Information on reporting on multilateral finance, including:

(i) Whether the multilateral finance reported is based on the Party's inflow contribution to a multilateral institution and/or on the Party's share in the outflow of the multilateral institution; (ii) Whether and how multilateral finance has been reported as climate-specific and how the climate-specific share was calculated, including by, for example, using existing international standards; (iii) Whether multilateral finance has been

reported as core/general, with the understanding that the actual climate finance amount it would transfer into depends on the programming choices of the multilateral institutions; (iv) Whether and how multilateral finance has been attributed to the reporting Party.

The reported amount is based on Switzerland's inflow contribution to a multilateral institution. As mentioned above Switzerland uses international standards (of the OECD) to calculate the climate specific share.

IV.C Financial support provided

Information on financial support provided and mobilised under Article 9 of the Paris Agreement

IV.C.1 Bilateral, regional and other channels

Switzerland provides the relevant information on bilateral and financial support provided in line with the MPGs, in a CTF-FTC table 1, for the reporting years 2021 and 2022. Regional support is reported as bilateral support but recognizable as regional support in CTF-FTC table 1 (first column).

IV.C.2 Multilateral channels

Switzerland provides the relevant information on financial support provided through multilateral channels in CTF-FTC table 2, for the reporting years 2021 and 2022.

IV.C.3 Information on finance mobilised through public interventions

Switzerland provides the relevant information on finance mobilised through bilateral public intervention in CTF-FTC table 3, for the reporting years 2021 and 2022. Switzerland also provides information on finance mobilised through multilateral public intervention (estimate) for the reporting years 2021 and 2022.

IV.D Support for technology development and transfer provided

Information on support for technology development and transfer provided under Article 10 of the Paris Agreement

IV.D.1 Strategies employed to support technology development and transfer

Switzerland's understands technology development and transfer in the context of climate finance as described in section IV.B (k).

One of the main goals of Switzerland's development and economic cooperation is the transfer of modern technology and know-how to recipient countries in order to better enable them to upgrade their production facilities to meet the requirements of world markets, to become more resource and energy efficient and to become more climate resilient.

In general, technology needs may vary from country to country. Therefore, technology needs should mainly be identified through national self-assessments. Nevertheless, financing for fossil fuel and nuclear energy projects are not considered 'climate finance' by Switzerland, except in limited circumstances. Gas power plants as well as mid-stream & down-stream projects are generally not supported; however they can be supported in exceptional case if a number of cumulative criteria (need, efficiency, additionality, and transition) are met.

Switzerland's International Cooperation Strategy 2021–2024 aims to make greater use of private sector innovation and expertise to promote sustainable development. It is committed to putting in place framework conditions that promote technological innovation while reducing the associated risks.

IV.D.2 Support provided at different stages of the technology cycle

Switzerland's activities and incentives regarding technology transfer aim to increase the flow of technology to developing countries and to build up capacities which enable beneficiary countries to assess, adopt, manage and apply transferred technologies. The activities supported by the Swiss Government embrace projects at the regional and multilateral levels.

For Switzerland, technology transfer includes the transfer of complete systems or components, including know-how, procedures, goods (equipment) and services, organizational and managerial procedures. Some of the crucial components of technology transfer are soft skills, human capital and the policy framework (trade and investment framework).

New technologies present many opportunities, particularly in the climate field: satellite or drone data for crop-damage insurance, energy production using solar technologies in humanitarian contexts. For example, Tech4Good brings together initiatives that harness technological innovations to improve public services and the lives of the most disadvantaged, an intrinsically Swiss approach. In addition to technological innovations, the Swiss International Cooperation integrates other innovations, such as entrepreneurial, financial, social and organizational innovations, to meet the challenges of the future.

IV.D.3 Support for the development and enhancement of endogenous capacities and technologies

Switzerland supports the development and enhancement of endogenous capacities and technologies in various areas related to climate change. For instance, it supports programmes in the field of energy efficiency which aim at mitigating CO2 emissions globally and decrease air pollution locally. These projects are related to the traffic and transportation sector and to small and medium-sized industries (e.g., foundry, glass, and brick industries). The main objective is to strengthen local partners (capacity building) and pool international expertise in order to develop locally adequate solutions (technology packages). These pilot programmes are then evaluated, documented and disseminated at the national level. For example, Switzerland, through the Paul Scherer Institute has developed a unique real-time source apportionment technology to measure air pollution in collaboration with the Chinese Academy of Science and piloted it in 6 Chinese cities. The technology is available open source. In addition, Switzerland supports transfer of know-how, training and infrastructure in the field of environment monitoring and chemicals management.

IV.D.4 Private sector activities

Switzerland promotes technology transfer to developing countries by supporting small and medium-sized enterprises (SMEs) in several ways. For instance, it provides technical advice on energy and resource efficiency to SMEs domiciled in developing countries.

Switzerland supports private participation in infrastructure in developing countries through the Private Infrastructure Development Group (PIDG[109]). PIDG has an infrastructure focus only and is active along the entire infrastructure cycle (concept, early-stage development, construction as well as operation). Climate change is a strategic priority of PIDG. Climate action together with sustainable development is the main purpose of PIDG's infrastructure financing and capital market development efforts. PIDG invests in innovative low carbon and climate resilient infrastructure projects to help countries transition in a just and equitable way towards a global net zero carbon economy by 2050 and to demonstrate the technical and financial viability of such infrastructure investments.

Furthermore, Switzerland supports the Climate Investment Fund for Emerging Markets (CIF[110]) for low-income countries, which finances capacity-building measures and infrastructure projects. The latter also includes technology transfer for renewable energy technologies.

Through contribution to the World Bank's Initiative for Sustainable Forest Landscape (ISFL[111]) Switzerland contributes to assisting countries around the world to reduce emissions from the land sector through innovation in land-use planning, policies, and practices. The ISFL is working with the private sector to achieve transformational change to low-carbon, climate-resilient development pathways as this requires more than public funding from bilateral sources, multilateral development banks, and climate funds. The ISFL has worked with five participant countries to develop private sector strategies that aim to work with and through existing platforms, thereby allowing the ISFL to serve as a convening force, crowding in private sector funding.

109 https://www.pidg.org/

110 https://www.cif.org/

111 https://www.biocarbonfund-isfl.org/who-we-are

Switzerland contributes to the Energizing Development (EnDev[112]) Programme, a multi-donor strategic partnership to support access to modern energy (including thermal energy). EnDev works through a market-based approach, which aims to develop energy markets systematically and comprehensively at three levels: (i) interventions at the supply side, (ii) demand side, and (iii) enabling environment. EnDev is committed to supporting the private sector in expanding supply chains and promoting consumer adoption. Awareness raising, behavioural change campaigns, innovative financing mechanisms including carbon finance and digitalisation all play an integral role in accelerating the uptake of energy solutions.

IV.D.5 Accelerating, encouraging and enabling innovation

Switzerland promotes and incentivizes technology transfer to developing countries in domains in which it has special expertise and where its support can trigger innovation. In order to do so, an interdepartmental platform (REPIC[113]) was established. The mission of this platform is to support innovative, practice- and market-oriented projects by Swiss know-how carriers in the areas of renewable energy and energy and resource efficiency.

Switzerland also encourages Swiss SMEs and entrepreneurs to invest in developing countries in order to enhance technology transfer, including technologies relevant to tackle climate change. The SECO Start-up Fund (SSF[114]) is a loan instrument established by the Swiss State Secretariat for Economic Affairs in 1998.

Research related to climate change has been supported through a 'solution-oriented research for development' (SOR4D[115]) that has been launched. In addition, the successful collaboration with the Swiss Federal Institute of Technology in Lausanne (EPFL, Tech4Dev[116]) and the Swiss Federal Institute of Technology in Zurich (ETH Zurich, ETH4D[117]) has been extended.

Swiss CALAC+ programme supports clean air strategies in Latin American metropolises fostering normative and technological changes towards application of soot-free engines in public urban transport systems and off-road machinery. The reduction of air pollutants that are both an important impediment to sustainable development and a key contributor to climate change was achieved by means of targeted capacity building, sharing experiences and curbing private sector engagement in clean air issues. It has reported over 770 million US dollars on public funds mobilised and a cut of 30 thousand tonnes of CO_2 equivalents, and 280 tonnes of black carbon so far.

Switzerland has also supported the development of scientific observation networks for high mountain glaciers, snow and permafrost (cryosphere) in Central Asia (project CROMO-Adapt) and India (SCA Himalaya) with the aim of improving water management (e.g., through improved short-term, seasonal and long-term forecasts) and natural hazard risk management (e.g., through early warning systems for avalanches and glacial lake outburst floods). These projects involve the deployment of state-of-the-art technologies and the development of locally adapted technologies (i.e., lower cost, easier maintenance).

Another kind of technology transfer which Switzerland is engaged in is collaborating with international organizations and/or with developing countries directly in research, particularly in public health and cross-cutting issues in the agriculture domain. As the negative effects of climate change are becoming increasingly noticeable in these two areas, research is being called upon to find new and innovative ways of solving climate-related problems.

IV.D.6 Knowledge generated

The Global Eco-Industrial Parks Programme (GEIPP) for example, established and initiated in 2019, which aims to demonstrate the viability and benefits of greening existing industrial parks by improving the resource productivity and economic, environmental and social performance of businesses, possesses a global component on knowledge

112 https://endev.info/

113 https://www.repic.ch/

114 https://www.secostartupfund.ch/de/index-de.html

115 https://www.admin.ch/gov/en/start/documentation/media-releases.msg-id-100838.html

116 https://www.epfl.ch/innovation/domains/tech4dev/

117 https://eth4d.ethz.ch/

development. Its objective is to generate and disseminate knowledge from present and past endeavours, which can be used to tackle the required preconditions for EIP, including in LDCs.

Another example, the AgriPath project aims to bring sustainable agriculture to scale by identifying, evaluating, and promoting promising pathways for digitally supported agricultural advisory services. 500 million smallholder farmers need to increase their agriculture productivity, income and climate resilience. There is a lack of scientifically validated evidence on the effectiveness and cost efficiency of digital agriculture services. The Consortium embraces current concepts of climate resilient agriculture, climate smart agriculture, sustainable land management and agro-ecology.

Finally, Switzerland is a longstanding partner and contributor of the Climate and Clean Air Coalition. The Coalition creates scientific knowledge on short-lived climate pollutants and provides the 91 member States with a platform for exchanging information and learning on solutions.

IV.E Capacity-building support provided

Information on capacity-building support provided under Article 11 of the Paris Agreement

Switzerland defines and uses the definition for capacity building in the context of capacity-building support as described in section IV.B (k).

IV.E.1 Strategies employed to provide capacity-building support

Capacity building is an integral part of Swiss International Cooperation (IC) programmes. These programmes are designed to improve policies and strengthen capacities of institutions and people through the provision of capacity-building support tailored to partners' needs. Skills development programmes are an important part of the capacity-building support provided by Swiss IC, as they are dedicated to strengthening specialised skills, in particular by investing in the establishment of dual vocational training education systems.

The Swiss International Cooperation maintains close ties with the authorities of the countries where it is present. Areas of activity where it can provide added-value while meeting the needs of host countries are agreed with host countries. Capacity building of local stakeholders is an integral part of any project, recognised as essential to achieve sustainable results. It can take the form of short-term or long-term, theoretical or practical "hands-on" trainings (e.g. on how to operate new infrastructure), or knowledge exchanges (e.g. with relevant Swiss institutions or professionals). In the frame of skills development programmes, Swiss International Cooperation programmes may also support the development of new curricula or strengthen capacities of relevant educational institutions. Examples of programmes with climate-relevant capacity-building activities include:

- GLECOP contributes to low-emission, energy-efficient and resilient development at a global scale. It supports two multilateral initiatives, the Energy Efficiency in Emerging Economies (E4) Programme implemented by the International Energy Agency and the Global Alliance for Buildings and Construction. Through its support, Switzerland aims to enhance knowledge and capacities, to leverage successful practices and to strengthen policies on energy efficiency with a focus on the construction sector;
- Another example is the support of Switzerland to the Global Water Security and Sanitation Partnership (GWSP) of the World Bank, which addresses sustainability and resilience in the water sector through analytics and has adopted a "knowledge-into-implementation" model that contributes to capacity strengthening in partner countries;
- Plant variety protection legislation in accordance with the International Union for the Protection of New Varieties of Plants (UPOV) is gaining importance in developing countries. This kind of legislation often neglects the existing informal seed systems and farmers rights. Switzerland supports APBREBES, a network of civil society organizations, to raise awareness and contribute to capacity building on alternative legislation that better reflect smallholders needs and practices;
- The Swiss International Cooperation's Renewable Energy Skills Development (RESD) programme in Indonesia aims to increase the availability of qualified professionals for the planning, design, installation, operation, and maintenance of renewable energy technologies. It supports the development of new formal and informal

education programmes to equip civil, mechanical and electrical engineers with the required know-how. Private sector stakeholders have been involved in the programme, as well as Swiss universities of applied sciences;[118]

- Switzerland hosts, supports the development of and feeds global databases of solutions for CCA (WOCAT, Adaptation@Altitude) as a basis for capacity development. A regional approach was chosen to capitalize 25 years of support to DRR and CCA in Central America[119], with the generation of a compendium, brochures and factsheets that were disseminated in the region. Ad-hoc capacity development took place for example by training and joint computer programme development of a data portal for hydrological forecasts in Central Asia (regional SAPPHIRE project workshops).

IV.E.2 Responding to the existing and emerging capacity-building needs, priorities and gaps

Swiss International Cooperation programmes frequently integrate flexible, demand-based mechanisms for the provision of capacity-building support, which helps address emerging or changing needs and priorities. For instance, the Regional Capacity Development Network in the Western Balkans funded by Switzerland grants support to associations of local governments and of public water utilities to strengthen their institutional capacities, training offer for their members, and policy dialogue activities, including in relation to climate mitigation and adaptation where relevant. A participatory, iterative grant proposal development process was implemented in order to ensure that the scope of work would address relevant needs and priorities of the associations, which can play an important role in promoting energy efficiency and climate-smart management practices in the water sector. Workplans are reviewed regularly and updated as needed. Another example is the Utility of the Future – Centre of Excellence, funded by Switzerland and implemented by the World Bank, which provides support to interested water and sanitation utilities based on their applications to calls for expressions of interest and continuously optimises support tools to integrate new areas of interest (e.g. green management, digitalisation).

The BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL) offers another example of how the Swiss International Cooperation responds to existing and emerging capacity-building needs. Its work to date has focused on building the technical capacity of governments from the participating recipient countries. Forest monitoring systems and their associated measurement, reporting and verification (MRV) systems are necessary to track implementation and performance of REDD+ activities in general, and ISFL activities in particular. By extension, MRV systems are also necessary for the disbursement of funds from results-based Emission Reductions programmes. The ISFL has been helping programme countries increase their capacity for greenhouse gas accounting through workshops, needs assessments, and the provision of technical advice to programmes as they implement their grants and prepare for their Emission Reductions programmes.

IV.E.3 Policies that promote capacity-building support

As mentioned above, Swiss programmes are developed in the countries of intervention and include participation of government officials in the planning. During the different planning stages (feasibility study, planning workshop etc.), the stakeholders (being national, local or non-governmental) are consulted on the proposed interventions and have the possibility to express their priorities and needs. Efforts are made to ensure that identified priorities and needs of the partners are addressed adequately in the design of Swiss International Cooperation programmes. The use of standard indicators to measures results associated with capacity and skills development measures is promoted.

IV.E.4 Involvement of stakeholders

Swiss programmes are in general developed in participatory processes with the aim the involve the stakeholders and respond to the needs of the counterparts. An example is the Somalia Resilience Programme (SomReP) as described in the following.

Given the fragile and conflict-affected context of Somalia, the Swiss Agency for Development and Cooperation's contribution to the Somalia Resilience Programme Consortium (SomReP) enables pastoral, agro-pastoral, displaced persons and peri-urban poor to increase their ability to prepare for, adapt to and live through shocks without eroding their livelihoods. Focusing on capacity building, livelihood diversification and the elaboration of early warning systems, this

118 https://shorturl.at/wvv3T

119 https://www.sdc-regions.ch/en/thematic-capitalisations#Disaster-Risk-Reduction

initiative is complementary to ongoing efforts of the government of Somalia and the international community to build resilience of communities to climate shocks.

The livelihoods of pastoralists and agropastoralists in Somali National Regional State are increasingly threatened by environmental, socio-economic, and political upheavals. The implementing partner in cooperation with local government partners, aims to build the resilience of vulnerable pastoralist communities through proven land rehabilitation measures, the promotion of livelihood activities, and capacity development of government and private sector institutions.

The Swiss Agency for Development and Cooperation is helping to strengthen the resilience of more than 700,000 people, including internally displaced persons, affected by the security crisis and climate change in Burkina Faso. Drawing on Switzerland's wealth of experience in pastoral livestock farming in the Sahel, the programme supports pastoralists and agropastoralists in adapting their livestock farming practices and means of subsistence to the climatic challenges and improving their living conditions, while promoting peace in Burkina Faso.

IV.E.5 Promoting the sharing of lessons learned and best practices

Swiss International Cooperation projects are evaluated either internally or by an independent, external evaluator. Lessons learnt – including recommendations for improvement and identified good practices – are documented in an internal completion note for each project and integrated in new phases or new projects. External evaluation reports are systematically shared with relevant stakeholders and published.

Projects that have been successful and have shown potential for replication are capitalised on. The promotion and sharing of lessons learnt and best practice includes the production of communication material in the form of videos, factsheets, reports, etc. For example, a successful intervention on air quality in Mongolia has published different products that were made available to a wide public[120]. Another project, strengthening capacities for energy efficiency in buildings in Latin America (CEELA) also developed videos and communication materials promoting examples of sustainable construction and energy efficiency in Latin America, and its website includes a library of useful guidance and operational documents based on the project's experiences for interested stakeholders.[121] Projects' partners are also invited to participate in events organised internally or with a broader audience to share their experience. For example, CALAC+ (mentioned above) was invited to present at the Asian Pacific Economic Cooperation (APEC) workshop organised in Lima on electromobility.[122]

[120] *https://www.youtube.com/watch?v=8eIX4HqHkJo&t=25s* https://www.youtube.com/watch?v=MGFKmhKh09A
Air Pollution Community Health Worker: https://www.youtube.com/watch?v=3iJfpYm-nX0
The truth about the Air Pollution: https://www.youtube.com/watch?v=VLcgN2Inyd0&t=32s
Youth Engagement on Air Pollution: https://www.youtube.com/watch?v=FV7dpNYI0k4&t=52s

[121] *https://proyectoceela.com/index.php/biblioteca/*

[122] Zero Emissions Mobility (in Spanish, Swiss Ambassador to Colombia appears): *https://www.youtube.com/watch?v=ZcCAmLK8myA*
Machinery Seminar in Lima (September 2023 when Janine visited Lima in Spanish and English): *https://www.youtube.com/watch?v=pf4LfxxADLo*

V Support needed and received

Information on financial, technology development and transfer and capacity-building support needed and received under Articles 9–11 of the Paris Agreement

V.A General information

Switzerland is a high-income economy and therefore considers itself to be a developed country Party rather than a developing country Party. Accordingly, Switzerland does not report any further information on support needed and received under chapter V.

VI Information relevant for national communications

Information to be reported when national communications and biennial transparency reports are submitted jointly every four years

VI.A Vulnerability assessment, climate change impacts and adaptation measures

When national communications and biennial transparency reports are submitted jointly every four years, this chapter will include updated information on vulnerability assessment, climate change impacts and adaptation measures (see also explanation in chapter III). Most recent information related to climate change impacts and adaptation can be found in Switzerland's first adaptation communication submitted to the UNFCCC on 9 December 2020 (for more details see *www.bafu.admin.ch/submissions-unfccc-2020*) as well as in chapter 6 of Switzerland's eighth national communication and fifth biennial report submitted to the UNFCCC on 16 September 2022 (see *www.bafu.admin.ch/nc-br*).

VI.B Research and systematic observation

When national communications and biennial transparency reports are submitted jointly every four years, this chapter will include updated information on research and systematic observation. Most recent information related to research and systematic observation can be found in chapter 8 of Switzerland's eighth national communication and fifth biennial report submitted to the UNFCCC on 16 September 2022 (see *www.bafu.admin.ch/nc-br*).

VI.C Education, training and public awareness

When national communications and biennial transparency reports are submitted jointly every four years, this chapter will include updated information on education, training and public awareness. Most recent information related to education, training and public awareness can be found in chapter 9 of Switzerland's eighth national communication and fifth biennial report submitted to the UNFCCC on 16 September 2022 (see *www.bafu.admin.ch/nc-br*).

VII Information on flexibility

VII.A General information

Switzerland is a high-income economy and therefore considers itself to be a developed country Party rather than a developing country Party. Accordingly, Switzerland does not apply any flexibility and does not report any further information on flexibility under chapter VII.

VIII Improvements in reporting over time[123]

VIII.A Areas of improvement identified by the Party and technical expert review team

Areas of improvement identified by the Party and technical expert review team in relation to Party's implementation of Article 13 of the Paris Agreement (para. 7(a) of the MPGs)

As this is the first reporting cycle under the enhanced transparency framework, no review has yet been conducted. For transparency reasons, Switzerland is nevertheless reporting information on areas of improvement identified under the previous transparency regime. As indicated in Tab. 32 and Tab. 33, Switzerland did not receive any recommendations or encouragements in the latest review report, i.e. in the 'report on the technical review of the eighth national communication and the technical review of the fifth biennial report of Switzerland' (FCCC/IDR.8/CHE–FCCCC/TRR.5/CHE). In the future, the tables will provide a brief response to each of the recommendations and encouragements, with reference to the respective section in Switzerland's biennial transparency report where the recommendations and encouragements have been addressed.

Tab. 32 > Responses to recommendations of previous reviews.

Recommendation	Response	Reference to chapter/section of Switzerland's first biennial transparency report
Assessment of adherence to the reporting guidelines for the **eighth national communication** of Switzerland (according to Annex I of the 'report on the technical review of the eighth national communication and the technical review of the fifth biennial report of Switzerland' (FCCC/IDR.8/CHE–FCCCC/TRR.5/CHE).		
No recommendations were made by the expert review team.		
Assessment of adherence to the reporting guidelines for the **fifth biennial report** of Switzerland (according to Annex II of the 'report on the technical review of the eighth national communication and the technical review of the fifth biennial report of Switzerland' (FCCC/IDR.8/CHE–FCCCC/TRR.5/CHE).		
No recommendations were made by the expert review team.		

Tab. 33 > Responses to encouragements of previous reviews.

Encouragement	Response	Reference to chapter/section of Switzerland's first biennial transparency report
Assessment of adherence to the reporting guidelines for the **eighth national communication** of Switzerland (according to Annex I of the 'report on the technical review of the eighth national communication and the technical review of the fifth biennial report of Switzerland' (FCCC/IDR.8/CHE–FCCCC/TRR.5/CHE).		
No encouragements were made by the expert review team.		
Assessment of adherence to the reporting guidelines for the **fifth biennial report** of Switzerland (according to Annex II of the 'report on the technical review of the eighth national communication and the technical review of the fifth biennial report of Switzerland' (FCCC/IDR.8/CHE–FCCCC/TRR.5/CHE).		
No encouragements were made by the expert review team.		

Areas of improvement identified by the Party are either immediately addressed or, in case more time is needed to consider the suggestion, recorded in a comment directly in the report as a reminder for the next reporting cycle.

[123] For this chapter, the outline in Annex IV to Decision 5/CMA.3 also contains a heading for section 'E. Parties domestic plans and priorities with regard to improved reporting pursuant to paragraph 7 of the MPGs are not subject to technical expert review, but the information may inform discussions on areas of improvement and identification of capacity-building needs between the technical expert review team and the Party concerned (para. 8 of the MPGs)'. Switzerland reports all relevant information with regard to improvements in reporting over time in the sections VIII.A to VIII.D and thus did not include a section VIII.E.

VIII.B Addressing areas of improvement

How the Party is addressing or intends to address areas of improvement as referred to in paragraph 7(a) of the MPGs (para. 7(b) of the MPGs)

Switzerland welcomes comments and suggestions and is committed to continuously improve its reporting and adherence to the reporting guidelines, be it in terms of completeness or transparency. In the past reporting cycles, Switzerland has had very good experiences with submitting an amendment to the original submission within two weeks of the review week. In this way, the additional text, figures or tables as well as necessary corrections could be discussed between the international and Swiss experts. With regard to issues that cannot be resolved immediately, Switzerland is committed to address them in the course of the next reporting cycle whenever possible (the tables as shown in section VIII.A serve as a guidance for the Swiss experts).

VIII.C Areas of improvement related to flexibility

Areas of improvement that are related to the flexibility provisions used (para. 7(c) of the MPGs)

Switzerland is a high-income economy and therefore considers itself to be a developed country Party rather than a developing country Party. Accordingly, Switzerland does not apply any flexibility and does not report any further information on areas of improvement related to flexibility under chapter VIII.C.

VIII.D Reporting-related capacity-building support needs

Reporting-related capacity-building support needs identified, including those referred to in chapter VI above and any progress made, including those previously identified as part of the technical expert review in chapter VII of the MPGs (para. 7(d) of the MPGs)

Switzerland is a high-income economy and therefore considers itself to be a developed country Party rather than a developing country Party. Accordingly, Switzerland is providing capacity-building support (see chapter IV) and does not report any further information on reporting-related capacity-building support needs under chapter VIII.D.

IX Any other information

Any other information the Party considers relevant to the achievement of the objective of the Paris Agreement, and suitable for inclusion in its biennial transparency report

IX.A General information

Switzerland reported all information relevant to the achievement of the objective of the Paris Agreement in the chapters I to VIII and in the annexes of its first biennial transparency report. There is no relevant other information to be reported.

Annex I REDD+

Technical annexes for REDD+, as applicable

Switzerland is a high-income economy and therefore considers itself to be a developed country Party rather than a developing country Party. Accordingly, Switzerland does not report any further information on technical annexes for REDD+ in Annex I.

Annex II Common reporting tables

Common reporting tables for the electronic reporting of the national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

The latest version of Switzerland's common reporting tables for the electronic reporting of the national inventory report of anthropogenic emissions by sources and removals by sinks of greenhouse gases is available on the website of the UNFCCC as well as on the following website:

- *www.bafu.admin.ch/latest-ghg-inventory*

Previous versions of Switzerland's common reporting tables (or common reporting format tables) are available on the following website:

- *www.bafu.admin.ch/previous-ghg-inventory*

Annex III Common tabular formats

Common tabular formats for the electronic reporting of:

- ***Information necessary to track progress in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement***
- ***Information on financial, technology development and transfer and capacity-building support provided and mobilised under Articles 9–11 of the Paris Agreement***
- ***Information on financial, technology development and transfer and capacity-building support needed and received under Articles 9–11 of the Paris Agreement***

Switzerland's common tabular formats accompanying Switzerland's first biennial transparency report are available on the website of the UNFCCC as well as on *www.bafu.admin.ch/nc-btr*. Switzerland reports two sets of common tabular formats, namely the CTF-NDC tables and the CTF-FTC tables[124].

[124] The CTF-FTC tables include information on financial, technology development and transfer and capacity-building support provided and mobilised; the information on financial, technology development and transfer and capacity-building support needed and received is not relevant for Switzerland.

Annex IV Participation in cooperative approaches

Information in relation to the Party's participation in cooperative approaches, as applicable

Switzerland provides all relevant information on its participation in cooperative approaches, the underlying authorizations and project documentation on the website of the Swiss Federal Office for the Environment.[125] The bilateral agreements that set the framework for the cooperation under Article 6.2 with the partner countries are available on the same website.[126] Switzerland has already submitted its initial report[127] under Article 6 to the UNFCCC Centralized Accounting and Reporting Platform (CARP)[128] and will submit its agreed electronic format (AEF) and regular information on its cooperative approaches as mandated under decision 2/CMA.3[129] as soon as the format has been agreed by the conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

[125] www.bafu.admin.ch/projects-abroad

[126] www.bafu.admin.ch/bilateral-climate-agreements

[127] https://unfccc.int/sites/default/files/resource/230517_InitialReport_Switzerland.pdf

[128] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement/cooperative-implementation/centralized-accounting-and-reporting-platform

[129] https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf#page=11

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