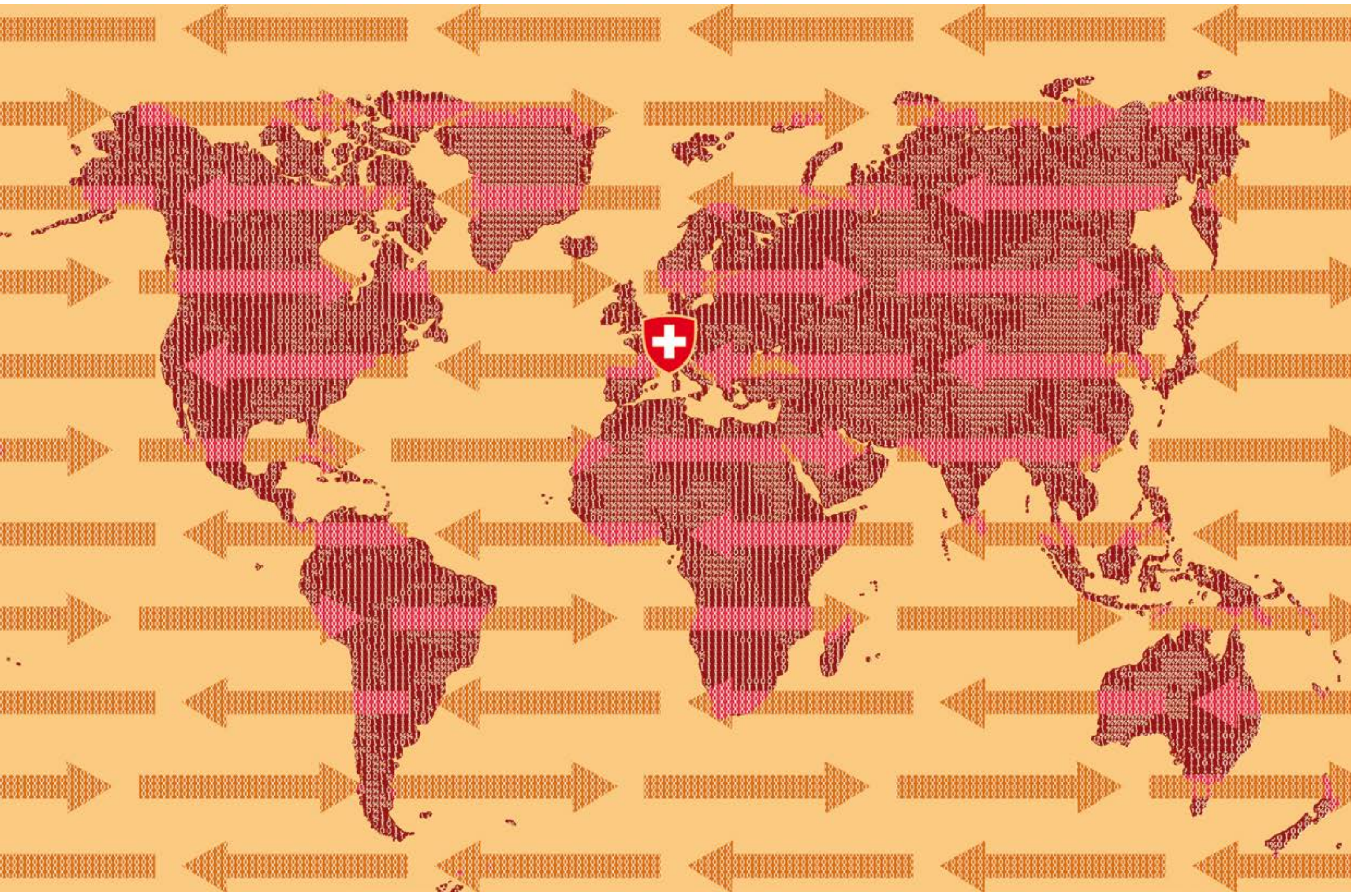
Switzerland’s Sixth National Communication and First Biennial Report under the UNFCCC

Third National Communication under the Kyoto Protocol to the UNFCCC



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Authors

1. Executive summary	**Authors**: Marjorie Perroud (FOEN)
2. National circumstances	**Coordinating author**: Marjorie Perroud (FOEN) **Authors**: Marjorie Perroud (FOEN, 2.1-2.4, 2.6-2.10, 2.12, 2.13), Simon Scherrer (MeteoSwiss, 2.5), Mischa Croci-Maspoli (MeteoSwiss, 2.5), Nele Rogiers (FOEN, 2.11)
3. GHG inventory information, national system, national registry	**Coordinating author**: Marjorie Perroud (FOEN) **Authors**: Marjorie Perroud(FOEN, 3.1, 3.2, 3.4), Nele Rogiers (FOEN, 3.3), Stefan Meier (FOEN, 3.5), Regine Röthlisberger (FOEN, 3.4), Paul Filliger (FOEN, 3.4)
4. Policies and measures	**Coordinating author**: Marjorie Perroud (FOEN) **Authors**: Laurence Mortier (FOEN, 4.1, 4.2, 4.3.3, 4.4.2), Isabel Junker (FOEN, 4.1, 4.2, 4.3.1, 4.3.3), Nele Rogiers (FOEN, 4.1, 4.4.2), Marjorie Perroud (FOEN, 4.3.2, 4.4.2), Jaqueline Echensperger-Hug (4.3.3), Pia Baumann (SFOE, 4.3.4), Franziska Borer Blindenbacher (ARE, 4.3.5), Theo Rindlisbacher (FOCA, 4.3.5), Urs Ziegler (FOCA, 4.3.5), Blaise Horisberger (FOEN, 4.3.6), Daniel Felder (FOAG, 4.3.7), Daniel Bretscher (ART, 4.3.7), Nele Rogiers (FOEN, 4.3.8), Michael Hügi FOEN, 4.3.9, Roger Ramer (FOEN, 4.4.1), Paul Filliger (FOEN, 4.4.2, 4.4.3), all (4.5, 4.6, 4.7)
5. Projections and the total effect of measures	**Coordinating author**: Regine Röthlisberger (FOEN) **Authors**: Regine Röthlisberger (FOEN, 5.1, 5.2, 5.4), Daniel Bretscher (ART, 5.1, 5.2, 5.4, Agriculture), Nele Rogiers (FOEN, 5.1, 5.2, 5.4 Forestry), Paul Filliger (FOEN, 5.3)
6. Impacts, vulnerability assessment and adaptation	**Coordinating authors**: Marjorie Perroud (FOEN), Roland Hohman (FOEN) **Authors**: Andreas Fischer (MeteoSwiss, 6.1.1, 6.1.2, 6.1.3), Mark Liniger (MeteoSwiss, 6.1.1, 6.1.2, 6.1.3), Christian Huggel (uzh, 6.1.3), Christoph Marty (WSL, 6.1.3), Jeannette Nötzli (uzh, 6.1.3), Frank Paul (uzh, 6.1.3), David Volken (FOEN, 6.1.4), Hugo Aschwanden (6.1.4, 6.1.11, 6.3.2), Petra Schmocker Fackel (FOEN, 6.1.5), Markus Stoffel (Unibe, 6.1.5), Gian-Reto Walther (FOEN, 6.1.6), Sabine Augustin (FOEN, 6.1.7), Pierluigi Calanca (ART, 6.1.8), Marc Vielle (EPFL, 6.1.9), Bruno Schädler (Unibe, 6.1.9), Rolf Weingartner (Unibe, 6.1.9), Charlotte Braun-Fährländer (Unibas,6.1.10), Marjorie Perroud (FOEN 6.1.12), Pamela Köllner-Heck (FOEN, 6.2), Roland Hohmann (FOEN, 6.3.1), Carolin Schärpf (FOEN, 6.3.2), Christoph Schmutz (MeteoSwiss, 6.3.2),Gian-Reto Walther (FOEN, 6.3.2), Christian Küchli (FOEN, 6.3.2), Daniel Felder (FOAG, 6.3.2), Beat Goldstein (SFOE, 6.3.2), Davide Codoni (SECO, 6.3.2), Thomas Probst (FOEN, 6.3.3)
7. Financial resources and transfer of technology	**Coordinating author**: Gabriela Blatter (FOEN), Stefan Schwager (FOEN) **Authors:** Anton Hilber (SDC), Stephan Kellenberger (SECO), Marco Lustenberger (SDC), Jacqueline Schmid (SDC), Stefan Schwager (FOEN)
8. Research and systematic observation	**Coordinating authors**: Fabio Fontana (MeteoSwiss), Gabriela Seiz (MeteoSwiss), Urs Neu (ProClim), **Authors**: Urs Neu (ProClim, 8.1.1, 8.2), Fabio Fontana (MeteoSwiss, 8.1.2, 8.3), Sebastian König (MeteoSwiss, 8.1.2, 8.3), Gabriela Seiz (MeteoSwiss, 8.1.2, 8.3)
9. Education, training and public awareness	**Coordinating author**: Marjorie Perroud (FOEN) **Authors**: Marjorie Perroud (9, 9.1, 9.3), Pia Baumann (SFOE, 9.2), Martina Schlaepfer (SECO, 9.4), Xavier Tschumi-Canosa (FOEN, 9.5), Ruchti Stefan (FDFA, 9.5)

Project management Marjorie Perroud, FOEN, Climate division, CH-3003 Bern.
Correspondence: climate@bafu.admin.ch

Project secretariat Infras consulting group, CH-8045 Zürich.

Review Jürg Heldstab, Mario Betschart, Madeleine Guyer (Infras), Christoph Reible (Unibe, 6.1)

Graphic designer Sebastien Morard Géographe-conseil, CH-3960 Sierre

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Foreword

Changes in climate leave visible signs on the environment and society, sometimes with dramatic consequences for territories already affected by an unfavorable climate. By committing to reducing its emissions of greenhouse gases below the 1990 level and taking national and international action in the search of solutions for these challenges, Switzerland, along with other nations, is contributing to the fight against global warming and is promoting cooperation for a more sustainable future.

Switzerland's 6th National Communication enables the tracking of the evolution of its greenhouse gas emissions, presents the measures that have been taken to reduce its emissions and demonstrates progress in its achievement of emission reduction targets for the first commitment period under the Framework Convention on Climate Change and the Kyoto Protocol.

While the first commitment period has ended, Switzerland has committed to continue its emission reduction efforts. Sustainable development, and in particular global warming, have been incorporated within the priority activities of the Swiss government. In addition, Switzerland strengthened its climate policy by setting new objectives to be reached by 2020 and has drafted a package of legislative measures within this policy. However, tackling emissions will, in the best case, only dampen the effects of climate change. Switzerland is therefore also preparing an adaptation strategy to adopt a coordinated course of action in responding to the expected changes.

Climate knows no borders; it is the duty and the responsibility of each nation, as well as of each human being, to create an environment that is healthy for our neighbours and healthy for our children. Simple but rigorous actions will in the end make the difference.

Bruno Oberle

Director

Federal Office for the Environment (FOEN)

December 2013

1 Executive Summary

1.1 Introduction

This is Switzerland's sixth national communication (NC6) under the UN Framework Convention on Climate Change and the third communication under the Kyoto Protocol. The report is in accordance with UNFCCC's reporting guidelines on national communications (FCCC/CP/1999/7) and the annotated outline for fifth national communications of Annex I parties under the UNFCCC, including reporting elements under the Kyoto Protocol.

Switzerland decided to present its biennial report as an annex to the NC6, with detailed reporting of the information on the similar topics in the NC6. The report is in accordance with UNFCCC biennial reporting guidelines for developed country Parties (decision 2/CP.17) and the required tables have been submitted in the common tabular format for "UNFCCC biennial reporting guidelines for developed country Parties" (decision 19/CP.18).

1.2 National circumstances

Political profile

Switzerland is a confederation, with a federal government, a bicameral parliament and a federal supreme court. The territory consists of 26 cantons (states), each of which has its own government, parliament and cantonal courts. Responsibilities are shared between the federal authorities and the cantons, however subsidiarity plays an important role in Switzerland. This is reflected in constitutional law, which states that unless legislative power is explicitly assigned to the confederation, the cantons are sovereign, i.e. entitled to legislate in an area of policy.

International relations

Switzerland is a member of several international organisations like e.g. the UN, OECD, the World Bank Group, and the European Environmental Agency. It is not a member of the European Union (EU), but most new and amendments to existing Swiss laws have been made compatible with EU legislation. Bilateral agreements coordinate a wide range of policy areas between Switzerland and the EU.

Population and urbanisation

At the end of 2012, the population of Switzerland accounted for 8.04 million with a density of 194.6 persons per km^2. Approximately 23% of the permanent residential population were foreign nationals. Population growth - more than 19% in the period 1990-2012 - results mainly from immigration and increasing life expectancy. More than two thirds of the Swiss population live in cities or metropolitan areas – half of which in the urban agglomerations of the five major cities. While the number of households is increasing, the number of persons per household is decreasing. The energy reference area in Switzerland has been increasing steadily since 1990 and accounted for over 712 million m^2 in 2012.

Geography and climate

Switzerland covers an area of 41'300 km^2, comprising 29% forest and grove, 39% cropland and pastureland, 8% built-up and 23% unproductive land. With the Alps acting as climatic divide, conditions such as average temperature and precipitation vary significantly across Switzerland, depending mainly on altitude and location. Long-term observations indicate a marked shift towards a warmer climate – particularly since 1970. Variable winter temperatures are an important control on energy consumption, and leave a strong imprint on annual CO_2 emissions. Changes in precipitation are not so clear, e.g. for annual mean precipitation no significant trends are found in the 20^{th} century.

Economic profile

Switzerland's economy is largely dependent on the tertiary sector, which contributes over 73% to the gross value added and employs 74% of Switzerland's workforce. Gross domestic production (GDP) per capita has increased by 49% since 1990 and accounted for over CHF 74'000 in 2011. The unemployment rate has been fluctuating since 1990 between 2% and 4.5%. Furthermore, the Swiss economy strongly depends on foreign trade, which represents a very high share of GDP. Main trading partners are the industrialised countriesaccounting for 73% of exports and 86% of imports.

Sector characteristics

Energy: Energy use in Switzerland totalled 882'280 TJ in 2012, i.e. 3.7% above the previous year. Main drivers for this increase were colder weather conditions, positive economic development and further increase in population. 77.5% of primary energy supply was imported whereas 22.5% was sourced domestically. 53.2% of total final energy consumption relied on oil, 24.1% electricity and 12.9% gas. The remaining 9.7% comprised wood, waste, coal and several renewable forms of energy. Electricity generation in Switzerland is dominated by hydroelectric power plants (58.7%) and nuclear power plants (35.8%). Switzerland is trading electricity with several western and central European countries. Energy productivity (energy consumption in relation to GDP) has remained constant in recent decades, however, since 2005, real GDP and final energy consumption started to diverge due to an increase in energy efficiency and outsourcing of production sites to other countries.

Transport: The share of road transport is still increasing (for passenger as well as for freight transport). However, public transport covered 21% of total passenger kilometres in 2011. In the freight transport sector, over 36% of total tonne kilometres were transported by rail in 20011. Both in the passenger and in the freight transport sector, the modal split between rail and road is rather high compared to other European countries.

Industry: Structural transformation is continuing in Switzerland, with the service sector growing faster than the industry sector. The secondary sector in Switzerland increased its production by 50% between 1990 and 2011, but greenhouse gas emissions decreased slightly, showing a decoupling of economic growth and greenhouse gas emissions. Manufacturing industries are the largest emitters among all economic activities (26% in 2008).

Agriculture and forestry: 27% of the area of Switzerland is used by farmers. Another 12% are alpine pastures (including cultivation of land and animal husbandry). Swiss agriculture has undergone profound structural changes. If the number of farms has fallen over the past two decades, the area per farm increased of 46%. Agriculture is responsible for roughly 10% of total GHG emissions in Swit-zerland, the most important sources being methane from digestion and rumination of animals followed by the emissions of nitrous oxide from agricultural soils. A third of Switzerland is covered by forests, and the forest area has increased by 0.5% per year since the third National Forest Inventory surveyed between 2004 and 2006. National programmes promote ecologically and economically effective wood use, with the intention to increase the use of wood as a substitute for fossil fuels rather than enhancing the forest sink capacity.

Waste: The total amount of waste generated in Switzerland increased by 33% between 1990 and 2011 and accounted for 5.47 million tonnes in 2011 (688 kg per person). Thereof, 2.73 million tonnes were incinerated and 2.74 million tonnes were recycled.

1.3 Information on GHG inventory, the national system and the national registry

Aggregated greenhouse gas emissions 2007

In 2011, Switzerland emitted 50.010 million t CO_2 eq (excluding LULUCF and international bunkers), or 6.32 t CO_2 eq per capita. With a share of 84% (Fig. 1), the largest contributor gas was CO_2, 41.856 million t (5.29 tonnes per capita), and the most important source was the energy sector with 39.864 million t CO_2 eq. Tab. 1 shows emissions by gas and sector in Switzerland for the year 2011. Fuel combustion within the energy sector was by far the largest source of emissions of CO_2 in 2011. Emissions of CH_4 and N_2O originated mainly from agriculture, and the F-gas emissions stemmed by definition from industrial processes.

Emission trends 1990-2011

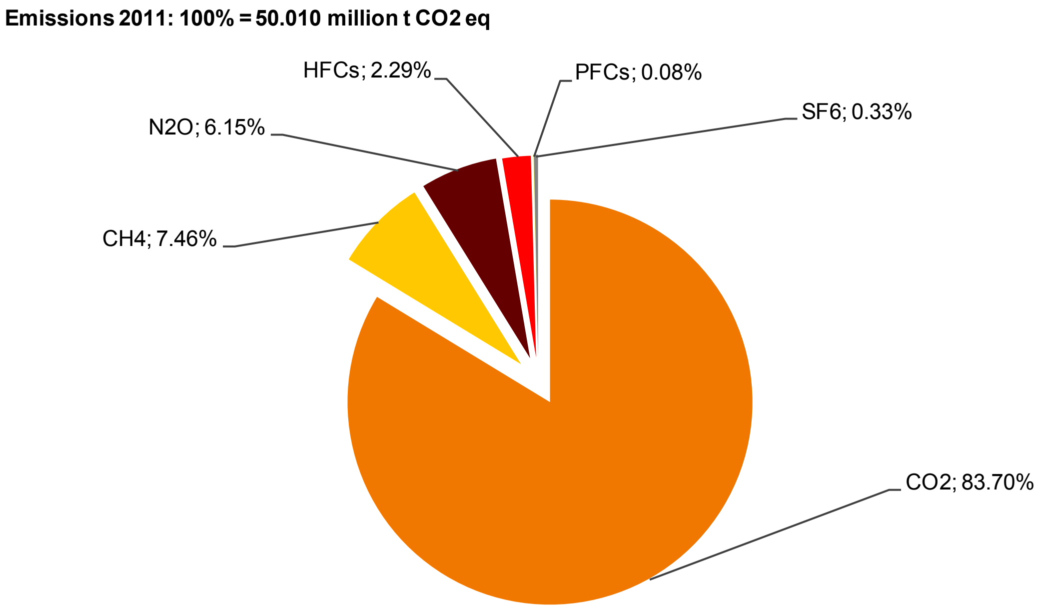
There is no significant trend in the total emissions over the period 1990–2007. Year-to-year variations of total emissions are mainly caused by changing winter temperatures and their effect on CO_2 emissions from fuel combustion. In 2011, total GHG emissions (excluding LULUCF) were 5.6% lower than in 1990, which is the minimum over the period. Including LULUCF, emissions decreased by 6.5% from 1990 to 2011. As CO_2 persistently forms the major part of total GHG emissions (1990: 84.2% and 2011: 83.7%, respectively), its relative trend between 1990 and 2011 runs largely parallel to total GHG emissions excluding LULUCF (Fig. 2).

Energy (source category 1):

As shown in Fig. 3, the largest share of emissions originated from the energy sector (source category 1). Due to Switzerland's electricity production structure (largely hydroelectric and nuclear power plants), the energy industries sector (source category 1A1) plays only a minor role (8%), whereas emissions from the transport sector (source category 1A3) contribute 32%.

Industrial processes (source category 2): In line with economic development, overall emissions in the industry sector showed a decreasing trend in the 90s and a rebound between 1998 and 2011.

Fig. 1 > Contribution of gases to Switzerland's GHG emissions (excl. LULUCF) in 2007



FOEN (2013)

Solvent and other product use (source category 3): NMVOC emissions, the main source of indirect CO_2 emissions of the sector, have diminished between 1990 and 2004 due to their limitation brought by the Ordinance on Air Pollution Control and due to the introduction of the VOC tax in 2000. Emissions from solvent and other product use make up less than 0.4% of total Swiss greenhouse gas emissions in 2011.

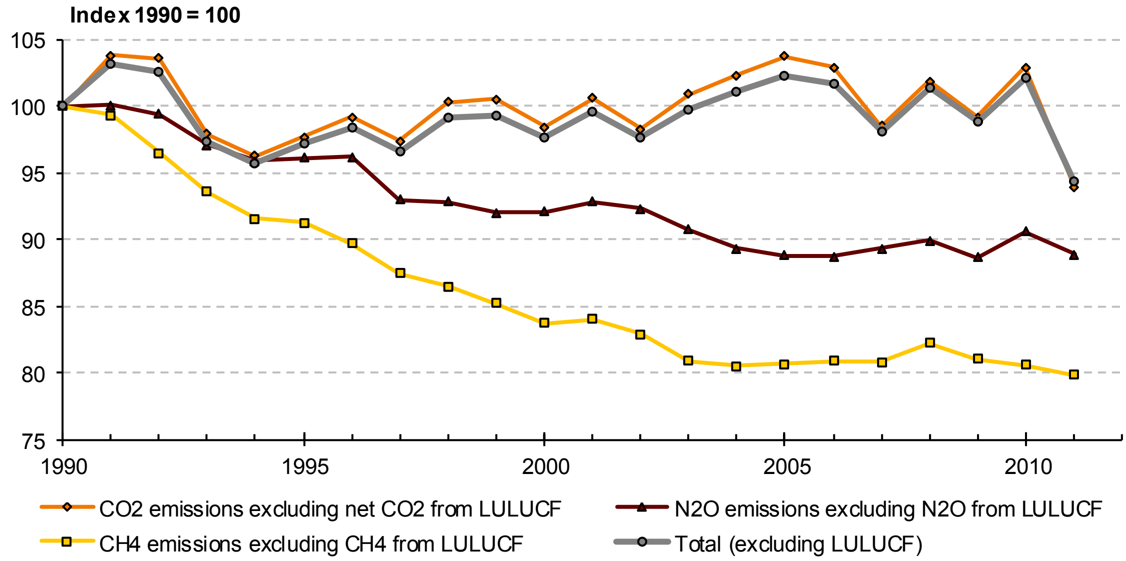
Agriculture (source category 4): Declining populations of cattle and swine and reduced fertilizer use have led to a decrease in greenhouse gas emissions from 1990 until 2004. Since then, CH_4 emissions have remained relatively stable. Agriculture contributed 11.24% to the total greenhouse gas emissions in 2011.

Tab. 1 > Switzerland's GHG emissions in CO_2 equivalent (million tonnes) by gas and sector in 2011

Emissions 2011		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total	Share
		CO_2 equivalent (million tonnes)							
1	All Energy	39.344	0.255	0.265				39.864	79.7%
2	Industrial Processes	2.332	0.009	0.054	1.144	0.039	0.164	3.742	7.5%
3	Solvent Use	0.155	0	0.044				0.199	0.4%
4	Agriculture	0	3.159	2.445				5.604	11.2%
6	Waste	0.012	0.309	0.265				0.587	1.2%
7	Other	0.013	0.001	0.001				0.014	0.0%
Total (excluding LULUCF)		41.856	3.732	3.074	1.144	0.039	0.164	50.010	100.0%
5	LULUCF	-3.417	0.001	0.004				-3.411	-6.8%
Total (including LULUCF)		38.439	3.734	3.078	1.144	0.039	0.164	46.599	93.2%
International Aviation Bunkers		4.689	0.001	0.0462				*4.737*	
International Marine Bunkers		0.031	$5.3*10^{-6}$	$303*10^{-6}$				*0.031*	

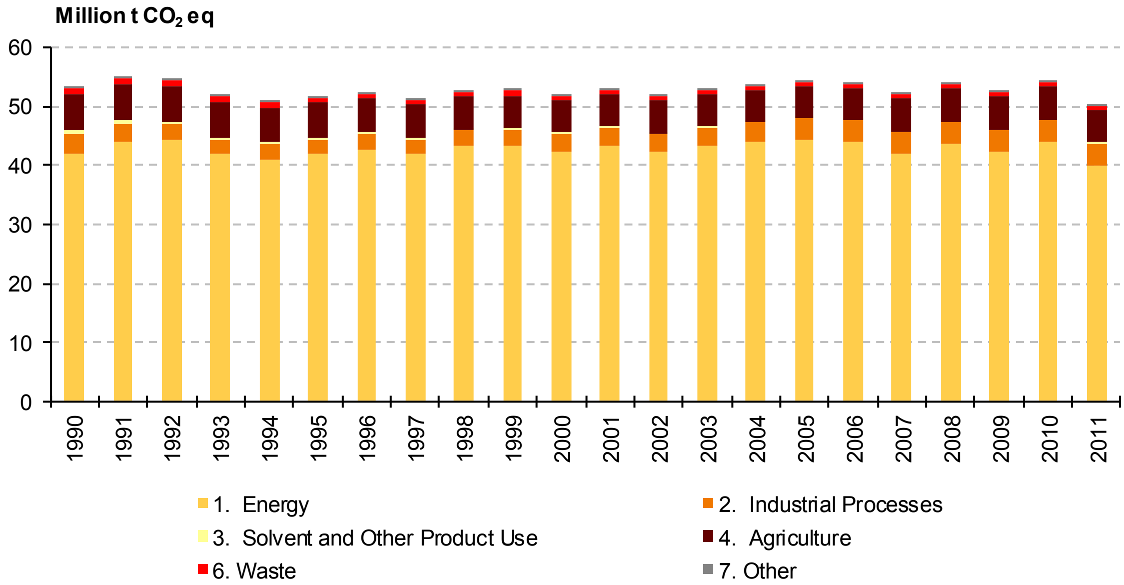
FOEN (2013)

Fig. 2 > Relative trend of GHG emissions by gas (excluding LULUCF), 1990–2011. The increase of F-gases amount to 553% in 2011 relative to 1990.



FOEN (2013)

Fig. 3 > Switzerland's GHG emissions (excluding LULUCF) in CO_2 equivalent by sectors between 1990–2011



OEN (2013)

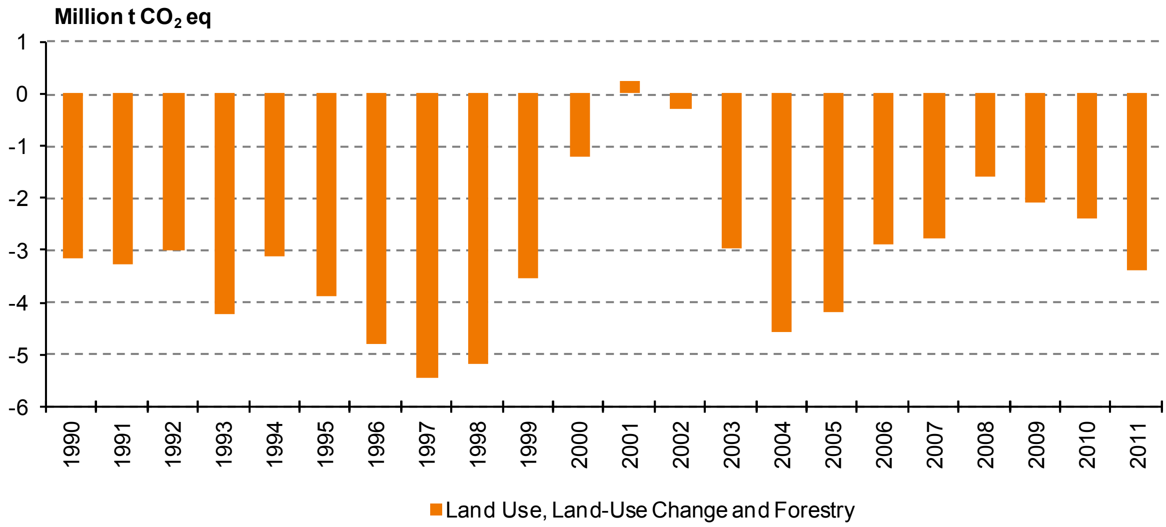
Land Use, Land-Use Change and Forestry (source category 5): The LULUCF sector in Switzerland is dominated by biomass dynamics in forests. As shown in Fig. 4, the removals in the LULUCF sector were higher than the emissions throughout the period 1990-2011, except for 2001. In 2011, the LULUCF sector was a net CO_2 sink of the order of 6.8% of total greenhouse gas emissions.

Waste (source category 6): Total emissions from the waste sector decreased steadily throughout the period 1990-2003. Since 2000, emissions have been reduced further by a change in legislation: disposal of combustible municipal solid wastes on landfills has been banned, leading to a decrease in methane emissions from landfill sites and an increasing amount of municipal solid waste being incinerated in waste incineration plants, with emissions reported under energy industries (source category 1A1) rather than waste (source category 6). Altogether, waste-related emissions including emissions from waste management activities reported in source categories 1A, 4D and 6 have increased since 1990 by 31.6%.

Emission trends for indirect greenhouse gases and SO_2: Emission trends for indirect greenhouse gases show a very pronounced decline. From 1990 to 2011, a strict air pollution control policy and the implementation of a large number of emission reduction measures led to a decrease of 48% to 75% in emissions of air pollutants. The main reduction measures were abatement of exhaust emissions from road vehicles and stationary combustion equipment, taxation of solvents and sulphured fuels, and voluntary agreements with industry sectors. The energy sector was by far the largest source of indirect greenhouse gas emissions, with the only exception being NMVOC, where solvent and other product use (source category 3) accounted for 23.2% of the total in 2011.

Fig. 4 > Net CO_2 equivalent balance of sector Land Use, Land-Use Change and Forestry (LULUCF).

Positive values refer to emissions, negative values to removals. The contributions of CH_4 and N_2O emissions are very small compared to the net CO_2 emissions and removals.



FOEN (2013)

Data for activities under article 3, paragraphs 3 and 4 of the Kyoto Protocol (KP-LULUCF)

Switzerland elected to account for forest management under the elective voluntary activities of article 3, paragraph 4 of the Kyoto Protocol. In accordance with decision 16/CMP.1 (FCCC/KP/CMP/2005/8/Add.3), credits from forest management are capped in the first commitment period. For Switzerland, the cap amounts to 1.83 million t CO_2 (0.5 million t C) per year, or 9.15 million t CO_2 for the whole commitment period. Tab. 2 provides an overview of sources and sink activities between 2000 and 2011.

Tab. 2 > Overview of net CO_2 equivalent emissions and removals (10^{-3}million tonnes CO_2 eq) for activities under article 3, paragraphs 3 and 4 of the Kyoto Protocol, 1999-2011

Positive values refer to emissions, negative values refer to removals

Greenhouse gas source and sink activities	1999	2000	2001	2002	2003	2004	2005
A. Article 3.3 activities	**228.20**	**228.19**	**227.28**	**225.85**	**224.10**	**222.61**	**177.08**
A.1. Afforestation and Reforestation	-6.40	-7.19	-8.23	-9.67	-11.41	-13.26	-15.60
A.2. Deforestation	234.60	235.38	235.51	235.52	235.51	235.87	192.67
B. Article 3.4 activities	**-3941.42**	**-801.22**	**-96.70**	**-297.06**	**-3256.69**	**-3938.76**	**-4142.46**
B.1. Forest Management incl. biomass burning	-3941.42	-801.22	-96.70	-297.06	-3256.69	-3938.76	-4142.46
gains living biomass	-12538.67	-12548.99	-12558.14	-12567.19	-12576.31	-12586.43	-12602.52
losses living biomass	9955.69	12833.46	13232.16	13075.27	10612.85	10272.12	10719.66
litter	-183.95	55.92	310.98	236.12	-202.74	-442.97	-941.39
dead wood pool	-1114.46	-1079.98	-1025.80	-1009.55	-1062.07	-1115.30	-1226.30
soil C min. soils	-69.07	-71.80	-66.09	-57.11	-60.11	-75.71	-102.55
soil C org. soils	8.68	8.69	8.70	8.70	8.71	8.71	8.73

Greenhouse gas source and sink activities	2006	2007	2008	2009	2010	2011	
A. Article 3.3 activities	145.24	119.76	77.43	207.07	202.07	200.66	
A.1. Afforestation and Reforestation	-17.99	-20.99	-23.02	-25.15	-30.35	-32.55	
A.2. Deforestation	163.22	140.75	100.45	232.23	232.43	233.22	
B. Article 3.4 activities	-3339.56	-2200.43	-1374.82	-2178.56	-2884.02	-2936.20	
B.1. Forest Management incl. biomass burning	-3339.56	-2200.43	-1374.82	-2178.56	-2884.02	-2936.20	
gains living biomass	-12707.70	-12805.29	-12904.16	-12915.75	-12920.06	-12924.49	
losses living biomass	10298.16	10749.27	10856.07	10447.87	10211.58	10188.90	
litter	-194.38	224.17	650.77	275.94	-125.54	-146.81	
dead wood pool	-628.87	-278.80	93.99	58.94	-11.42	-21.71	

FOEN (2013)

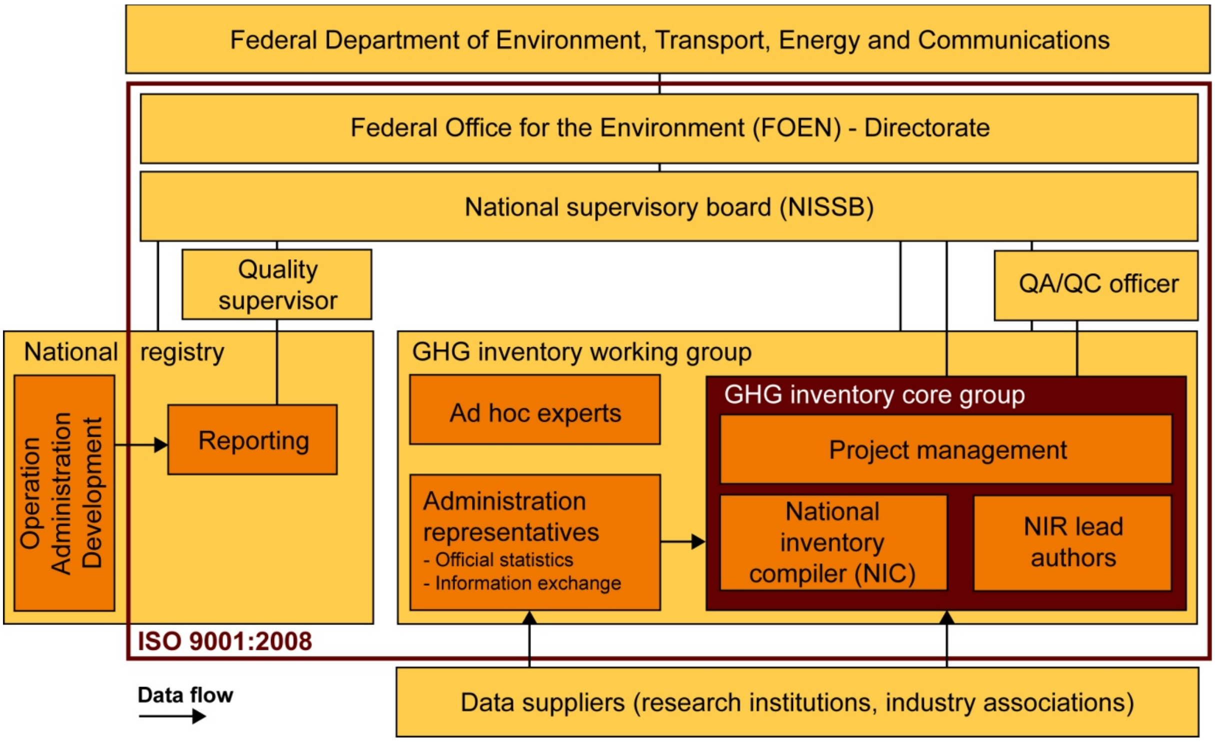
National inventory system

The Swiss national inventory system (NIS) is developed and managed under the auspices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC). It is hosted by a DETEC agency, the Federal Office for the Environment (FOEN). As stipulated in the CO_2 Act of 23. December 2011 (Art. 39), the FOEN has the lead within the federal administration regarding climate policy and its implementation. Fig. 5 provides a schematic overview of the institutional setting of the NIS.

Key category analyses (KCA)

The key category analyses are performed according to the IPCC good practice guidance. Level and trend assessments are made using tier 1 and tier 2 methods. For 2011, 31 out of a total of 135 categories (without LULUCF) have been identified as key. 18 of the key categories are in the energy sector. Including LULUCF categories in the KCA, five additional categories out of the LULUCF sector are key categories.

Fig. 5 > Institutional setting of the national inventory system



FOEN (2006b, 2013b)

Recalculations

The inventory has been improved continuously and reached a consolidated state. Recalculations that further improve the inventory or that implement recommendations and encouragements from the various review procedures are considered (and approved) by the inventory core group. Substantial recalculations that impact the national total are presented to the National Inventory System Supervisory Board for approval.

Quality management system

The GHG inventory is managed according to an inventory-specific quality management system (QMS) that was established in 2004. The QMS is designed to comply with the quality objectives of the good practice guidance of IPCC (2000), to ensure and continuously improve transparency, consistency, comparability, completeness, accuracy, and confidence in national GHG emission and removal estimates. Furthermore, Switzerland adopted timeliness as a quality criterion. Switzerland's inventory system is designed to produce a high quality inventory that ensures full compliance with the reporting requirements of the UNFCCC and the Kyoto Protocol.The NIS quality management system complies with the ISO 9001:2008 standard and has been certified by the swiss association for quality and management systems.

Procedures for official consideration and approval of the inventory

The inventory project management submits the national inventory report (NIR) and the CRF tables to the NIS supervisory board for consideration. The chair of the NIS supervisory board presents the inventory to the FOEN directorate for official approval.

National registry

Switzerland uses the Seringas™ registry software (developed by the French Caisse des Dépôts et Consignations). Further developments, updates and releases of the software are undertaken in cooperation with all Seringas™ licensees. As of today, the same software is used by Belarus, Kazakhstan, Monaco and Russia. In addition, Switzerland cooperates with Monaco and hosts its registry of Monaco on Swiss servers.

The Swiss national registry conforms to the technical standards for data exchange as specified in the UNFCCC data exchange standards (DES) for registry systems under the Kyoto Protocol. It is connected to the ITL and fully operational since December 2007. The daily reconciliations confirm the integrity of the database.

1.4 Policies and measures

General policy context

The overarching context for environmental and climate policy is the federal constitution of the Swiss Confederation where, prominently in the opening paragraphs, sustainable development is listed as one of the main objectives of the country. In pursuit of this commitment, Switzerland has established an Interdepartmental Sustainable Development Committee (ISDC), which defined the priorities for action and oversees implementation and monitoring of progress. The intention is to make sustainability assessments an integral part of decision making and policy evaluation. The Federal Council has set out its main policy focus areas for sustainable development in its "Sustainable Development Strategy 2012-2015", adopted as part of the Swiss government's regular legislative planning cycle. One of the Federal Council's overarching objectives for the incorporation of the sustainable development principle into the activities of the federal government is to combat global warming, in particular by reducing energy consumption and increasing the use of renewable energies. By ratifying the United Nations Framework Convention on Climate Change (UNFCCC), Switzerland committed to contribute to the stabilization of GHG emissions at a level that would prevent dangerous anthropogenic interference with the climate system. To deepen its commitment, Switzerland ratified the Kyoto Protocol in 2003, which entered into force in 2005. Switzerland has also committed to continue its emission reduction efforts under the Kyoto Protocol for the years 2013-2020.

Implementation of measures to reach the national emission targets are divided between different authorities. While the strategic decisions and the overall framework are made by the federal authorities, the concrete legislation and its implementation remain within the competences of the cantons. This is reflected in the complex and diverse cantonal and federal legislative frameworks that are relevant to the overall Swiss climate policy. Consequently, also the funding of measures is divided between federal, cantonal and private entities, depending on the individual measures.

International and national contexts of Switzerland's commitments to emission reduction targets

By ratifying the Kyoto Protocol, Switzerland committed to quantified emission reductions for the first commitment period (2008-2012), with a national GHG emission target set at 8% below the emissions of 1990. Switzerland is continuing its emission reduction efforts under the Kyoto Protocol with a new target set at 20% below 1990 levels by 2020 for the second commitment period (2013-2020). In parallel to an emission reduction commitment under the Kyoto Protocol for the second commitment period, Switzerland has committed to the corresponding emission target under the Convention under its system of "pledge and review".

The corresponding national legislation has been set in place. The CO_2 Act that entered into force on 1st May 2000 had set emission reduction objectives and instruments, in view of achieving the Kyoto commitment of the first period. In the meantime, this Act has been revised to allow for a continuation of the climate policy beyond 2012. The revised CO_2 Act covering the period 2013-2020 was approved by the Parliament on 23rd December 2011 (entry into force on 1st January 2013).

Whereas the CO_2 Act in its former version that was in force until the end of 2012 translated Switzerland's objective under the Kyoto Protocol into national targets related to CO_2 emissions only, Switzerland's quantified economy-wide emission reduction target by 2020 under the national legislation covers all gases and sectors covered under the Kyoto Protocol for the same period (2013-2020). Contrary to the international commitment, the 20% reduction target for 2020 stipulated in the national legislation is to be achieved by domestic measures only.

Nonetheless, the Swiss national legislation provides the basis for the implementation and the use of the flexible mechanisms of the Kyoto Protocol, so that Switzerland's participation in these mechanisms is possible. Switzerland will use carbon credits generated from the flexible mechanisms under the Kyoto Protocol (Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) and Emission Reduction Units (ERUs) from Joint Implementation (JI)) and from the new market-based mechanisms under the Convention to offset its emissions over the period 2013-2020. On the basis of activities under Article 3, paragraph 3, Afforestation and Reforestation and elective voluntary activities under Article 3, paragraph 4, Forest Management, of the Kyoto Protocol, Switzerland issued removal units that can be used for meeting its commitment.

SwissFlex, the national secretariat for the flexible mechanisms (Designated National Authority (DNA) under the CDM and Designated Focal Point (DFP) under JI) was established in 2004 and announced to the UNFCCC in 2007. Activities relating to the implementation of the flexible mechanisms as well as enquiries concerning the mechanisms and the examination and approval of project proposals are coordinated by an interdepartmental working group called IDA-Klima, HF6. By April 2013, the Swiss DNA had issued some 2500 letters for CDM projects, 40% of which were letters of approval to Swiss or Swiss-based entities and 60% were letters of authorization for participation in already registered projects, mainly to foreign entities. The issuance of authorizations to foreign entities is mainly due to the early connection of the Swiss registry to the international transaction log (ITL) of the UNFCCC. By April 2013, the Swiss DFP had issued some 150 letters of approval for JI projects to Swiss or Swiss-based entities.

Progress in achieving the quantified economy-wide emission reduction target

Switzerland verified every year whether it is on track to meet its emission reduction target of 8% below 1990 over the period 2008-2012 (48.6 million tonnes CO_2 as annual mean over the first commitment period) and whether national measures are effective (Tab. 3). Based on data from the national inventory report of Swizerland 2013, the mean emissions over the period 2008-2012 (estimation for 2012) are of the order of 52.3 million t CO_2 eq per year. Removal units that Switzerland can use for meeting its commitment (net carbon sequestration effect of forests) are estimated at 1.7 million t CO_2 eq per year. Emissions reduction certificates acquired abroad from CDM and JI projects, by the Climate Cent Foundation, an entity mandated by the Swiss government to invest revenues from the levy on transport fuels into projects aimed at reducing CO_2 emissions in Switzerland and abroad, will be in the range of 2.8 to 3 million t CO_2 eq per year. Emission allowances (AAUs) in the range of 0.4 and 0.6 million t CO_2 eq per year will be carried over to the second commitment period (banking by private entities subject to the Swiss emission trading scheme). According to the current estimation, the objective of the Kyoto Protocol will be achieved, as the deviation from the target is slightly negative (Tab. 3).

Tab. 3 > Realization of the Kyoto Protocol objectives (yearly values for the period 2008 - 2012)

	Greenhouse gases emissions (million tonnes CO_2 equivalent)
Estimated emissions 2008 – 2012 (according to a first estimate of 2012 emissions)	52.3
Emissions reduction certificates acquired abroad (Climate Cent Foundation)	-3.0 to -2.8
Carbon sequestration effect of Swiss forests	-1.7
Carry over to the second commitment period (Banking by companies)	0.4 to 0.6
Net emissions 2008 – 2012	48.0.to 48.4
Kyoto Protocol target (according to the allocation of emission rights)	48.6
Shift (a negative value means that the objective is achieved)	-0.6 to -0.2
FOEN (2013b)	

Sectoral and Cross-sectoral policies and measures

Policies and measures presented in the fifth national communication have been upheld and further developed over the past years. Some of the planned policies have been implemented in the meantime as part of the Swiss policy portfolio to comply with the Kyoto Protocol.

- Revised CO_2 Act coming into force in January 2013 covering the period until 2020, stipulating the reduction target to reduce GHG emissions by 20% by 2020 compared to 1990 levels. Reductions are to be achieved domestically only;
- Start of a ten year subsidy programme in the buildings sector for 2010-19 to promote refurbishment and the use of renewables, financed via one-third of CO_2 levy revenues. The cap was liftet from CHF 200 to 300 million per year with the new legislation. The program is partly co-funded out of cantonal budgets and co-managed by the federal government and the cantons;
- Replacement of the Climate Cent on fuels for transport (0.015 CHF/litre), a private sector initiative running from 2005 to 2012, by an obligation for transport fuel importers to offset 5-40% of transport-related CO_2 emissions as of 2013, wheras the cost of the offset program must not exceed 0.05 CHF per litre;
- Second term of the SwissEnergy programme 2011-2020 (following the Energy 2000 and the first term SwissEnergy programme 2006-2010); with new energy strategy 2050, the SwissEnergy programme was further reinforced for the period 2013-2020;
- Decision of the Federal Council for nuclear phase-out after the accident at the Fukushima Daiichi nuclear power plant, approved by the parliament in September 2011. The energy strategy 2050 launched by the Federal Council in April 2012 was submitted to parliament in September 2013 and is expected to enter into force earliest by 2015.

Environmental policy

Swiss environmental policy is addressing a wide spectrum of issues within Switzerland, ranging from pollution of air, water and soil, exposure to noise, to protecting stratospheric ozone or to reducing and managing waste. Some of these policy areas are linked directly or indirectly to Swiss greenhouse gas emissions. The main instruments for implementation are the definition of legally binding emission limits, introduction of levies on potentially damaging substances or practices, as well as the obligation of environmental compatibility assessments for particular facilities and installations.

Climate policy

The centrepiece of Swiss climate policy is the CO_2 Act that came into force in May 2000. It forms the legal framework for implementing Switzerland's international commitment. Apart from the objectives, it contains the policies and measures to reach the set targets. The first CO_2 Act covered the period from 2008-2012, whereas the fully revised CO_2 Act covers the period from 2013-2020.

The first CO_2 Act limits CO_2 emissions from fossil fuel use for heating and transport to 10% below 1990 levels over the period from 2008-2012. The overall target is further divided into a reduction target of 15% on heating and process fuels and 8% on transport fuels.

On one hand, the CO_2 Act obliged the Federal Council to propose further reduction targets beyond 2012, on the other hand, the popular initiative "For a healthy climate" asking for a 30% reduction target by 2020 was submitted in February 2008. The Federal Council put forward a climate policy proposal for parliamentary discussion in August 2009. The fully revised CO_2 Act, which covers the period from 2013-2020, was adopted by parliament in December 2011. The stipulated reduction target demands a reduction of domestic GHG emissions by at least 20% by 2020 compared to their 1990 level. The corresponding CO_2 ordinance translates this overall target into sectoral targets for the buildings, transport and industrial sectors as well as reduction pathways for each of these sectors. The revised CO_2 Act sets incentives to increase the use of renewable energies, to develop new, innovative technologies and creates new working places in promising areas.

The measures of Switzerland's climate policy implemented in the first CO_2 Act, that have proven most effective, were continued or improved and completed with new additional measures over the second period:

- The CO_2 levy on heating and process fuels sets an incentive to use fossil fuels more efficiently, to invest into low carbon technologies and to switch to low-carbon or carbon-free energy sources. If interim targets for CO_2 emissions are not met, the CO_2 levy is increased in three steps to a maximum tax rate of CHF 120 per t. The CO_2 Act provides for the exemptions from the CO_2 levy of energy intensive industries either participating in the Emissions Trading Scheme or committing to emission reductions.
- Switzerland introduced its Emissions Trading Schemes in 2008 in order to give companies, especially those industries with substantial CO_2 emissions from the use of heating fuels, the possibility to avoid the CO_2 levy. The emissions trading system for companies has been enlarged and aligned with the European Emissions Trading Scheme for the period 2013-2020.
- Companies of certain sectors with substantial CO_2 emissions not participating in the Emissions Trading Scheme may apply for exemption from the CO_2 levy, provided the company commits to emission reductions.
- The building programme promotes the refurbishment of buildings and the use of renewable energies in the buildings sector. The amount available to the programme was augmented in the revised CO_2 Act from a maximum of CHF 200 million to 300 million per year.
- CO_2 emission limits for the fleet of newly registered vehicles in line with EU regulations were included in the CO_2 Act in 2011 and continued under the revised CO2 Act. In addition, new objectives for passenger cars as well as the introduction of new CO_2 emission standards for some vehicles by 2020 are currently under parliamentarian discussion.
- New fossil fuelled power plants are obliged by law to fully compensate their emissions. Compared to the first CO_2 Act, the share of offsets abroad by the use flexible mechanisms as foreseen by the Kyoto Protocol was increased to 50 percent.
- The Climate Cent levied by the mineral oil industry on all petrol and diesel imports was invested into offset projects within Switzerland and abroad. The Climate Cent, introduced in 2005 under the first CO_2 Act, was replaced by an obligation for fossil fuels importers to compensate part of the transport-generated CO_2-emissions.
- As a new instrument, the revised CO_2 Act establishes a technology fund, financed with a maximum of CHF 25 million a year from the revenue of the CO_2 levy. The fund provides for loan guarantees to innovative companies, in order to ease access to debt capital dedicated to develop new low-emission technologies.

- In order to increase the impact of various legal measures, rise public awareness and encourage voluntary climate protection, the revised CO_2 Act sets out measures in the areas of communication, education and guidance.

Even if global warming can be limited to 2°C, Switzerland will face major impacts. Adapting to the effects of climate change is therefore becoming increasingly important. The federal government has been entrusted to coordinate adaptation efforts starting in 2013.

Energy policy

The federal constitution obliges the federal government and the cantons to use their competences to ensure an adequate, broad-based, secure, economical and ecological energy supply, and the economical and efficient use of energy. The policies and measures in the energy sector are addressing, as priority areas, energy efficiency (buildings, industry and services, mobility, electric appliances, energy supply companies), renewable energies, energy fees, fossil power plants, R&D facilities and beacon projects, exemplary function of the federal government and SwissEnergy programme.

Due to the accident at the Fukushima Daiichi nuclear power plant, the Federal Council decided to decommission the existing nuclear power plants at the end of their life time as well as to redefine the Swiss energy policy. The planned amendment of the Swiss Energy Act aims at the proposed targets of -16% energy consumption per person and -3% electricity consumption per person until 2020 and of -43% energy consumption per person and -13% electricity consumption per person until 2035 compared with 2000. An Energy Strategy 2050 has been elaborated setting a number of priorities to cover the shortfall in the electricity supply, such as reduction in energy consumption, broadening of electricity supply, energy supply, expansion and restructuring of electricity transmission grid and energy storage. The increase in energy savings, the expansion of hydropower and the new renewable energies are the relevant areas of the Energy Strategy 2050 for ensuring the security of supply.

In addition to the security of supply, the government, as part of its new Energy Strategy 2050, is placing emphasis on increased energy savings (energy efficiency), the expansion of hydropower and new renewable energies, and, if necessary, on fossil fuel-based electricity production (mainly in gas-fired combined-cycle power plants for peak supply, but also combined heat and power production for baseload in winter) and imports.

Policies and measures are allocated to various interlinked programmes and frameworks, both at federal and cantonal level. Most relevant are:

- The SwissEnergy programme represents a major policy instrument to increase energy efficiency and the use of renewable energy, with the effect that the use of fossil fuels is reduced in line with the CO_2 Act. It contains targets for electricity generation and heat production from renewable sources;
- A reform in the electricity market is under way. The opening of the market takes place in two stages, with a full market opening planned for 2015. A bilateral agreement with the European Union on electricity is being negotiated since 2007;
- The building codes of the cantons provide minimum energy standards in buildings, valid throughout Switzerland. The building programme does also have a share in the energy policy;
- Cleantech Masterplan is a strategy to promote resource efficiency and renewable energies.

Transport policy

Switzerland has developed an integrated strategy for transport policy, focusing on better coordination between transport modes, spatial planning, and paying greater attention to environmental problems. This strategy has been strengthened in recent years with a broader integration of transport policy into spatial development and the general sustainability context. The main thrust of the adopted policies lies in promoting a shift towards more sustainable modes of transport, planning and providing infrastructure that supports such a shift, and by passing legislation that reduces emissions and promotes low-emission technologies.

- **Passenger transport**: Switzerland has an excellent rail infrastructure that is permanently maintained, modernized and improved. The first phase of a major expansion of rail transport capacity RAIL 2000 was completed in 2004. It marked a milestone for Swiss public transport, as rail service levels increased by 12%. At the same time, work is progressing on the New Rail Link through the Alps. A first tunnel (Lötschberg) opened in 2007, the second is expected to open in 2016 (St. Gotthard) and a third in 2018 (Ceneri). The tunnels are increasing the capacity and attractiveness for both transalpine freight and passenger transport from Switzerland and northern Europe to Italy.
- **Funding for development and maintenance of road infrastructure** is provided through the infrastructure fund, which has been launched in 2007. Amongst others, Switzerland runs an agglomeration programme aimed at providing financial resources for infrastructure projects that promote public and non-motorized transport in suburban regions and agglomerations out of this fund. Switzerland has developed further programmes aimed at specific parts of the transport sector like leisure transport, non-motorized transport, traffic telematics and a service centre for innovative mobility. These programmes are complemented with regulations and recommendations at the technical level, such as emission standards, energy label for motor vehicles, compensation of CO_2 emissions from transport fuel use, promotion of biofuels and measures at the cantonal and communal level.
- **Freight/heavy goods transport:** Switzerland's freight transport policy rests on article 84 of the federal constitution, which requires that transalpine freight transport shifts from road to rail. The central policy element to reach this target is the heavy vehicle fee (HVF) combined with measures to improve competitiveness of international rail transport. The HVF is applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight. The fee is calculated according to three criteria: the kilometres travelled on Swiss roads, the highest authorized gross weight, and the pollutants emitted by the vehicle, according to EURO classes. Additional measures to support modal shift of freight traffic from road to rail include for example the modernisation of rail infrastructure, the further increase of the productivity and competitiveness of rail transportation or bringing down slot prices and providing additional intermodal services.
- **Aviation:** With respect to climate change, Swiss aviation policy is focused on international aviation, as the share of Switzerland's domestic aviation emissions is very small. Switzerland joined the International Civil Aviation Organization (ICAO), the European Civil Aviation Conference (ECAC), and the European Aviation Safety Agency (EASA). Switzerland adopted European civil aviation legislation within the framework of the bilateral transport agreement between Switzerland and the EU and regularly adapts this agreement to new legislation entering into force in the EU. Within the ECAC, EASA and ICAO, Switzerland strives for internationally coordinated measures to limit gaseous emissions from aviation. Switzerland applies and promotes airport emissions charges systems and works towards stricter internationally accepted emission standards for new aircraft engines. Switzerland is also actively supporting work towards introduction of a new aircraft engine emission certification requirement and subsequent standard for particulate matter (PM). Switzerland is also fully supportive of the development of CO_2 standard for airplanes.With respect to market based measures, the revised CO_2 Act provides the basis to integrate aviation into the Swiss Emissions Trading System (ETS). Because such integration is only feasible if the Swiss system is linked to the European ETS, Switzerland is currently negotiating an agreement with the EU on the linking of the two systems.

Industry

Switzerland has not developed specific policies in the industry sector, apart from the policies related to synthetic gases (described below). Industrial emissions of CO_2 are covered by the CO_2 Act, with the main instruments being the CO_2 levy, the conditional exemption from the CO_2 levy, and the emissions trading scheme.

The Ordinance on Chemical Risk Reduction provides for measures to control emissions of persistent substances with a high global warming potential (HFCs, PFCs, SF_6, NF_3, HFEs) in almost all sectors. The use of synthetic gases has strongly increased, and in 2011 they represented around 2.7% of anthropogenic GHG emissions in Switzerland. The effort made since 2003 to control synthetic GHG emissions under the generic name of "substances stable in the atmosphere" has shown its first positive effects. HFC emissions are still increasing, however at a lower rate than until 2005. The regulation limits the use of substances stable in the air to applications without viable alternatives (e.g. high voltage industry). Where their use is unavoidable, emissions are to be avoided as far as possible and binding agreements by the industry required.

Agriculture

Agricultural policy influences both prices of agricultural products and subsidies, and is therefore an important factor determining the amount of greenhouse gas emissions of this sector.The revision of Swiss agricultural policy since the beginning of the 1990s gradually reduced financial aid for agriculture and decoupled support from production. As compensation, direct payments decoupled from production volume and tied to ecological standards, have been considerably increased. Since the income of most farmers depends on direct payments, the farmers are eager to reach the required ecological performance to be eligible for payment. Lately, a new instrument has been launched which subsidizes measures for more efficient use of natural resources in the agricultural sector and go beyond legal requirements, or the criteria for other funding programs such as direct payments.

Greenhouse gas emissions from agriculture have dropped by around 8% since 1990, mainly as a result of the reduced livestock and mineral nitrogen fertilizer application. However, emissions remained quite constant over the last century, a tendency also observed in other ecological indicators. In order to ensure that the agricultural policy and the direct payments system in particular, are as effective and efficient as possible, concrete aims have been addressed in the agricultural policy 2014-17. There is no aim concerning climate mitigation, but the intended increase in nutrient efficiency and the reduction of ammonia emissions, as well as the desired trend in the ecological set-aside areas will indirectly affect the agricultural greenhouse gas emissions in a positive way. The key element is the further development of the direct payments system. The current subsidies for livestock will be converted into subsidies for ensuring food security. New direct payment types for environmental-friendly production systems and for the efficient use of resources are introduced in addition to the existing resource program.

In parallel to the elaboration of the agricultural policy 2014-17, a climate strategy for the agriculture sector has been developed. This strategy addresses both the mitigation and adaptation potential. It covers actions aimed at reducing the greenhouse gas intensity of agricultural production and possible measures to adapt agricultural production to climate change.

Land-use change and forestry

Switzerland has a long-standing tradition of preserving both forest area and forest as a natural ecosystem. The Forests Act 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.

The Swiss Confederation's Forest Policy 2020, which replaces the Swiss National Forest Program of 2004, aims to ensure sustainable forest management and to create favourable conditions for an efficient and innovative forestry and wood industry. Eleven policy objectives have been specified:

- wood harvesting potential;
- climate change;
- protective forest;
- biodiversity;

- forest area;
- the economic efficiency of the forestry sector;
- forest soil (including drinking water and tree vitality);
- protection against harmful organisms;
- the forest-wildlife balance;
- the leisure and recreational use of forests;
- and education and research (including knowledge transfer).

Swiss forest policy aims at reducing CO_2 emissions by substituting fossil fuels rather than enhancing sink capacity in the forests. The sink potential of Swiss forests is dwindling, largely because large fractions of the Swiss forest are mature for harvesting (advanced forests age). Consequently, the levels of harvesting should continue increasing in the near future. The objective of increasing harvesting levels is on one hand to avoid episodic large quantities of GHG emissions originating from decay, should these excessive accumulations of C stocks be disturbed by drought, fires, storms, or insects, and on the other hand to increase the adaptive capacity and stability of future forests.. Switzerland accounts for forest management under article 3.4 of the Kyoto Protocol. However, parliament rejected a proposal that would have allowed forest owners to trade carbon credits based on the sink capacity of their forests.

Waste management

In Switzerland, combustible waste, (municipal solid waste, combustible construction waste and sewage sludge) is incinerated in the 29 Swiss municipal solid waste incinerator plants (MSWI), almost all producing heat and/or electricity. As these plants have to guarantee waste disposal, they cannot control the waste input in order to reduce their CO_2 output. Therefore, their only possibilities of indirectly reducing CO_2 emissions are increasing the energy efficiency of the incineration plants and optimising the metal recovery from the incineration residues.

1.5 Projections and the total effect of measures

The projections of greenhouse gas emissions in Switzerland have been fully revised over the past year. A central part of the emission projections are projections of future energy consumption. In 2012, a revised set of energy scenarios has become available, which take into account that the Swiss government decided to gradually phase-out nuclear power generation. For consistency reasons, the greenhouse gas emission projections use the same key parameters (e.g. population growth, economic development, industrial production) as are underlying the energy scenarios. Independent scenarios for the agriculture and the LULUCF sector complement the energy scenarios. As recommended by the UNFCCC, three scenarios are established: a "with measures" scenario, a "with additional measures"scenario and a "without measures" scenario. Key variables such as population, economic development and industrial production are identical for all three scenarios, meaning that some of the main drivers of energy consumption remain the same. However, the scenarios are different in terms of energy efficiency, technology availability and use of different energy sources.

Scenario "with existing measures"

The "with existing measures" scenario (WEM) is designed to reflect the current state of legislation as closely as possible. However, the underlying energy scenario was developed at the time when the revision of the CO_2 Act had not been finalized yet, so that it does not fully reflect all the measures implemented in the final version of the CO_2 Act.

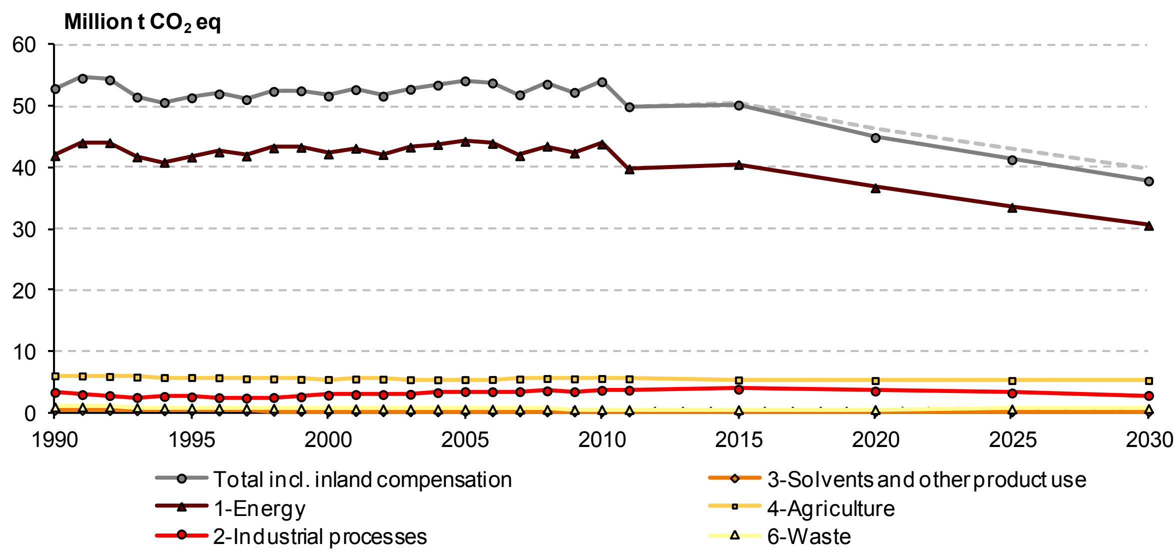
The main measures and instruments to mitigate emissions in the energy sector are the continuation and intensification of the building programme and building codes, the CO_2 levy on heating and process fuel,

CO_2 emission standards for new vehicles, incentives for improving electric efficiency, the continuation of the programme SwissEnergy and the feed-in tariff for renewable electricity. In addition to these measures, a couple of supporting measures in the transport sector are for instance also considered. Emissions from fossil fuel use in the transport sector need to be partially compensated according to the revised CO_2 Act. In the industry sector, the evolution of emissions is assumed to decrease due to progress in energy efficiency and due to a structural change towards less energy-intensive branches (reduction in energy consumption). The evolution of process-related GHG emissions in industry follows assumptions from the industrial production and the reinforcement of legislation. Emissions of GHG in the waste sector continue to decrease as a result of a ban on landfilling. In the agricultural sector, subsidies are decoupled from the area of land cultivated and the livestock numbers but rather tied to ecological standards, thus reducing incentives for intensifying agricultural production. With regard to forest management, the scenario follows the objectives given in the Swiss forest policy 2020, aiming at constant living biomass levels in forest and long-term stability in forest stands.

Fig. 6 present an overview of the sectoral greenhouse gas emissions of the „with existing measures“ scenario. Total emissions will decrease by approximately 15% between 1990 and 2020 (Fig. 6, Fig. 7). While the national total is taking domestic compensation projects into account, the compensation effort is not assigned to a particular sector. The energy sector is by far the most important sector for total emissions. Currently, the transport sector makes the largest sectoral contribution, followed by the emissions from households and services. Therefore, these two sectors are targeted particularly with the revised CO_2 act. The emission standards for new cars and the obligation to partially compensate emissions from fossil fuel use in transport on the one hand, and the CO_2 levy and the building programme on the other hand are considered key for a future reduction of emissions in these two pivotal sectors.

Fig. 6 > Aggregate emissions in the „with existing measures“ scenario

Total greenhouse gas emissions in CO_2 eq, shown by sector. Emissions from LULUCF and international bunkers are not included in the national total. The grey dashed line corresponds to emissions without taking domestic compensation into account.



Scenario "with additional measures"

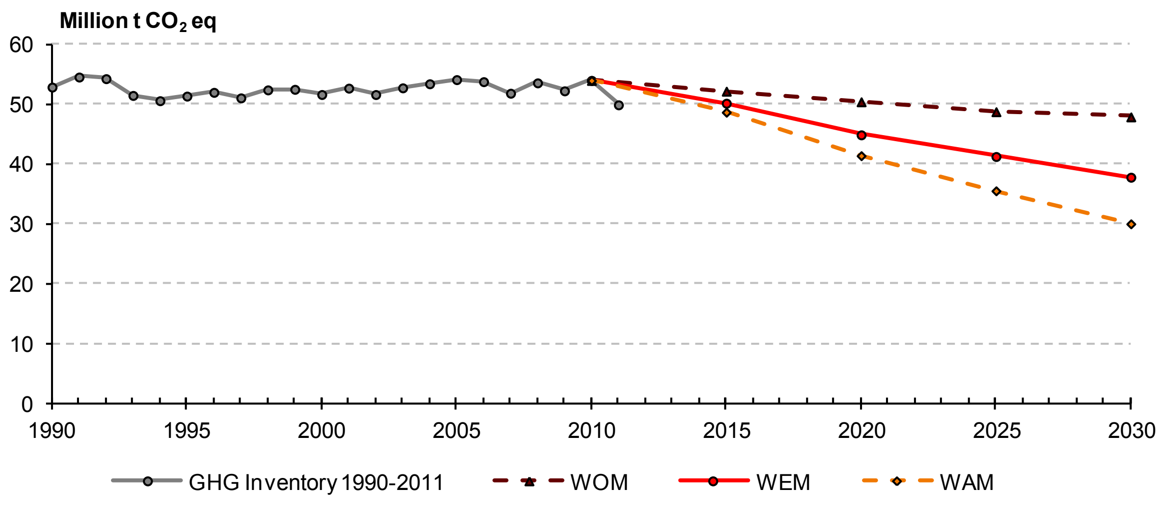
The "with additional measures" scenario (WAM) is considered as long-term target scenario of the Swiss government. Policies and measures have not yet been put in concrete terms but are assumed to be developed in order to reach the set target. This scenario relies in particular on substantial energy efficiency gains in all sectors. In this context, total emissions are projected to decrease by approximately 22% between 1990 and 2020, a target in accordance with Switzerland's commitment under the second commitment period of the Kyoto Protocol (Fig. 7).

Scenario "without measures"

The "without measures" scenario (WOM) assumes that measures currently implemented are continued at the present level with technological advances diffusing autonomously, leading to a slow gradual improvement of CO_2 intensity and energy efficiency. Thus the emission projections in this scenario take all measures implemented before 2010 into account and provide only an outlook on future evolution without any further policy development (Fig. 7).

Fig. 7 > Projections of total greenhouse gas emissions for all three scenarios

The total greenhouse gas emissions are shown in CO_2 equivalents. LULUCF and international bunkers are not included.



1.6 Impacts, vulnerability assessment and adaptation

Observed and expected impacts

In recent decades, natural assets have modified in response to the changes in the climate and, in particular, the increase in air temperatures. The recently released report Swiss Climate Change Scenarios "CH2011" provides an assessment of how climate may continue to change in Switzerland over the 21st century. A subsequent national assessment initiative is currently underway focusing on ecologic, economic and social impacts based on the CH2011 scenario. In addition, a multitude of scientific studies provides an assessment of these impacts on the Swiss environment as well as of the vulnerability of various ecological and socio-economic systems.

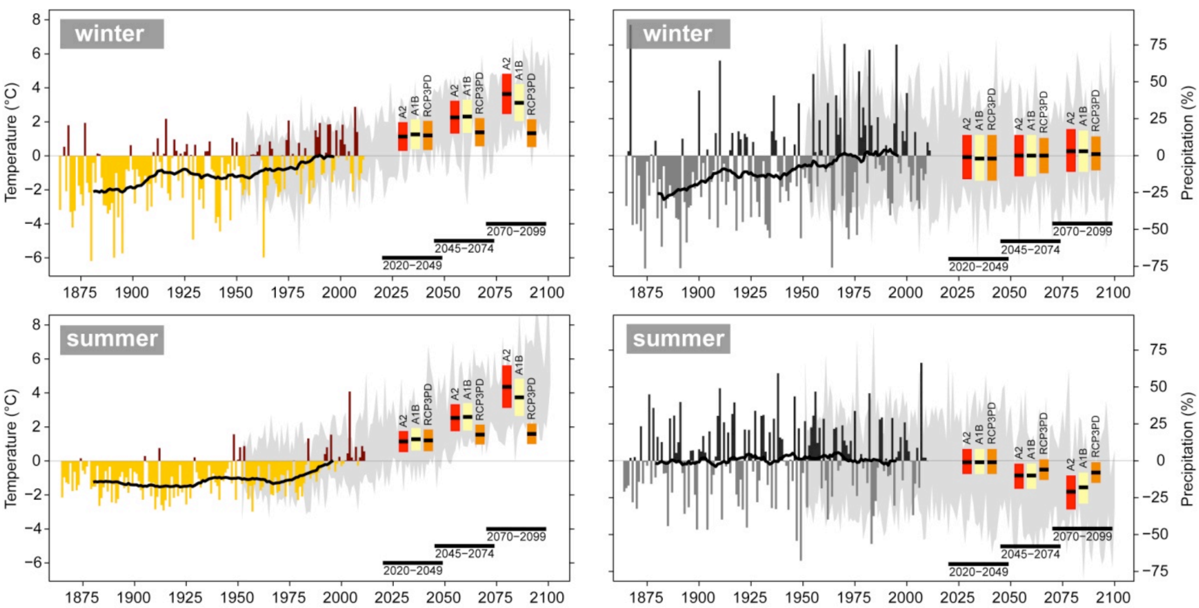
Recent data confirms a warming trend with an observed increase in mean annual temperature of 1.75°C between 1864 and 2012 (Fig. 8). Over the last 100 years, mean annual temperatures increased by 0.13-0.20°C per decade, with a substantially accelerated warming in recent decades. According to the non-intervention scenarios (A2, A1B), seasonal mean temperatures will rise by another 2.7 °C to 4.8 °C by the end of this century compared to the period 1980-2009. Under the climate stabilization scenario (RCP3PD), Swiss climate would still change over the next decades, but is projected to stabilize at an annual mean warming of 1.2-1.8°C.

The observed trends in precipitation are less distinct than in temperature (Fig. 8). For the last 100 years, most stations show no significant trends in annual precipitation (1913-2012). For a number of stations significant increases in precipitation are found in winter. For spring, summer and autumn no significant trends are detectable. Over the last 30 years annual precipitation trends are similar, but seasonal trends diverge. Precipitations are predominantly decreasing in winter and spring, but increasing in summer. No clear tendencies are found for autumn. According to the Swiss Climate Change Scenarios, summer mean precipitations are projected to decrease all over Switzerland, by 21-28% for the A2 scenario, by 18-24% for the A1B scenario, by 8-10% for the RCP3PD scenario. In winter, precipitation will likely increase in Southern Switzerland, compared to the period 1980-2009. The frequency, duration and intensity of summer warm spells and heat waveswill increase significantly. Snowfall as well as snow cover duration are expected to reduce in the coming decades.

The most visible change in the Alps resulting from global warming is the retreat of glaciers, which showed a volume loss of 12% since 1999. The area covered by alpine glaciers continuously diminishes. From the ca. 2'900 km^2 of Alpine glacier area in the mid-1970s, only about 2'100 km^2 remained in 2003 and an estimated 1'900 km^2 in 2013. A strong future area loss of 50-90% by 2100 has recently been modelled for a temperature increase between 2°C and 6°C for Switzerland. While systematic monitoring is quite recent, warming in high mountains regions also affect the permafrost. The frequency of large rock falls with starting zones in high elevations has increased in the past ca. 20 years and it is expected that frequency and magnitude of rock fall increase further with the warming of permafrost.

Fig. 8 > Past and future changes in seasonal temperature (°C) and precipitation (%) over northeastern Switzerland

The changes in temperature and precipitation are relative to the reference period 1980–2009. The thin colored bars display the year-to-year differences with respect to the average of observations over the reference period, the heavy black lines are the corresponding smoothed 30-year averages. The grey shading indicates the range of year-to-year differences as projected by climate models for the A1B scenario (specifically, the 5–95 percentile range for each year across the available model set). The thick colored bars show best estimates of the future projections, and the associated uncertainty ranges, for selected 30-year time-periods and for three greenhouse gas emission scenarios



CH2011 (2011)

Change in precipitation patterns will have a marked impact on the hydrological cycle by the end of the century. The seasonal distribution of runoff (runoff regime) will shift almost everywhere in Switzerland. Catchments with a glacial and snowmelt driven runoff regime will only be found in isolated areas and the seasonal distribution of runoff will follow the rainfall distribution. In the not glacierized regions, runoff is expected to be higher in winter but lower in summer. An impact on seasonal hydrological reserves is also expected, notably due to the increase in evapotranspiration (less runoff) and to the rise in the snow line (less snow for melting). In addition, change in precipitations might have serious consequences for the natural enrichment of groundwater and water supply. A further rise of the temperature in swiss waters, especially at times of low flows, could probably also lead to a detoriation of the chemical water quality in the future. Water management will be effected by the changes in runoff and in groundwater tables. The existing flood protection measures must for instance be reviewed whereas legal provisions in various areas (inlet of cooling water or waste water, lake control regulations, residual flows) must be reviewed.

The warming trend and changing precipitation patterns are expected to have significant effects on ecosystems. Species will certainly move towards higher elevations, and new species will colonise Switzerland. Some species will probably disappear at the regional scale, partly in high mountains because of the decreasing area of the alpine and nival belts, partly in the lowlands because of the increasing summer droughts and existing obstacles to dispersal (landscape fragmentation). Moreover, disruptions in species interactions caused by individual migration rates or phenological shifts are likely to have consequences for biodiversity. Conversely, the inertia of the ecosystems (species longevity, restricted dispersal) and the local persistence of populations will probably result in lower extinction rates than expected with some models. In the forest, as the tree line is mainly determined by summer temperatures, warmer conditions will induce an upward shift of its limit. A substantial shift in the tree species composition might occur, favouring more drought tolerant trees like oak species, whereas trees adapted to colder and wetter climate like the Norway spruces will be restricted to more feasible sites at higher elevations.

For agriculture, a moderate warming of 2°C to 3°C and a longer vegetation period might increase productivity. However, the increase in heat waves and drought periods could threat agriculture and prove problematic for the cultivation of land and for livestock husbandry. In extreme years water demand could easily exceed the supply, suggesting that conflicts concerning the utilization of water resources (ex: for irrigation) are likely to arise more frequently in the future. Implications of increasing daytime temperatures and high humidity levels also have the potential to considerably affect animal performance and health.

Various sectors of the Swiss economy are likely to be affected by progressing climate change. In particular, the tourism industry will be hard hit. Winter sports will lose their appeal to tourists in the absence of snow and destinations dependent on glaciers as tourist attractions will be affected as glacier retreats. . The number of ski resorts with current guaranteed snow in Switzerland may drop by at least a fifth for a temperature rise of 2 °C. Milder winter will decrease the heating energy demand by the end of the century, and therefore the energy consumption. On the contrary, the increase of space cooling demand will boost electricity consumption. From an economic point of view, the effect of decreasing heating energy consumption strongly outweighs the effect of increasing cooling energy demand. Changes in runoff and runoff regime will imply a change on hydraulic power production. Winter runoff and hence electricity production will increase, whereas in summer even with slightly lower runoff, production will not or only slowly decrease because the water flow will mostly still be higher than the capacity of the turbines. In highly glacierized regions, electricity production will decrease in summer with the reduction in runoff.

Natural hazards and extreme weather events potentially pose a growing risk to infrastructure and human health. Heat waves and elevated tropospheric ozone levels are cause for serious concern, as evidenced by the impacts of the heat wave in 2003. The start of flowering has shifted to earlier periods of the year. This poses problem to people sensitized to pollen since they may suffer earlier from hay fever or asthma symptoms and for a prolonged period. Additionally, it remains to be seen to what extent vector-borne diseases spread due to changing climatic conditions.

Swiss national adaptation strategy

During the last years, awareness has risen that adaptation to climate change is vital and needs to be better implemented in an integrated approach involving all relevant stakeholders on all institutional levels. This has triggered work on a national adaptation strategy.The first part of the strategy, adopted by the Federal Council on 2 March 2012, describes the goals, challenges and fields of action in adapting to climate change in Switzerland. In the second part, adaptation measures are going to be presented in anaction plan. It will be completed by the end of 2013 and is expected to be adopted in early 2014. Lately, in order to anchor adaptation activities of the Federal government in the legislation, adaptation has been included as complementary to mitigation in the revised CO_2 Act.

First part of the strategy: The overall goals of adaptation are to make the most of the opportunities that arise as a result of climate change and to minimize the risks of climate change, protect population, public assets and natural life support systems and improve the adaptive capacity of society, economy and environment.

Based on the analysis of the direct and indirect impacts of climate change on humankind, society and economy, nine sectors were identified as seriously affected by climate change in Switzerland. Actions that can thus be taken by the Confederation concerns water management, natural hazard management, agriculture, forestry, energy, tourism, biodiversity management, health, and spatial development. For each of these sectors, sectoral sub-strategies were developed, fields of action for adapting were identified, sectoral adaptation goals were formulated and possible ways of achieving these goals were outlined. Challenges that arise from the effects of climate change and from efforts to improve the bases for the planning and implementation of adaptation measures were also identified. In Switzerland, the most important challenges are:

- greater heat stress in agglomerations and cities;
- increasing levels of summer drought;
- greater risk of flooding;
- decreasing slope stability and more frequent mass wasting;
- rising snowline;
- impaired water, soil and air quality;
- change in habitats, species composition and landscapes;
- spread of harmful organisms, diseases and alien species.

Second part of the strategy: In the second part of the adaption strategy, adaptation measures are going to be presented in a joint action plan. As key elements, the action plan contains (1.) a summary of the Federal Offices' measures to achieve the sectoral adaptation goals as defined in the first part of the strategy, and (2.) an outline of coordinated approaches to tackle the cross-sectoral challenges.

1.7 Financial resources and transfer of technology

According to the Swiss Federal Constitution Switzerland is committed to the long term preservation of natural resources and to a just and peaceful international order. It shall in particular promote the conservation and sustainable use of natural resources and assist in the alleviation of need and poverty in the world. Regarding international climate financing, three government entities – the Swiss Agency for Development and Cooperation (SDC), the State Secretariat for Economic Affairs (SECO), and the Federal Office for the Environment (FOEN) – have specific roles while cooperating closely to assure effectiveness and coherence in Switzerland's activities related to international climate related financial support for developing countries and countries with economies in transition. Over the last few years all three institutions have adapted their respective structure with the aim to better respond to the increasing challenges related to climate change. They have also strengthened the inter-ministerial cooperation and coordination as well as cooperation with non-governmental stakeholders.

Through its multilateral and bilateral cooperation and as a member of the main multilateral institutions (such as MDBs, GEF, UNDP, UNIDO, etc.) Switzerland strives to ensure a more coherent implementation of policies and strategies and to promote synergies in the international division of labor. At bilateral level, Switzerland supports activities in mitigation and adaptation in a number of focal countries/ regions (refer to sections 7.2, 7.3 and 7.4 for further details).

In February 2011, the Swiss Parliament decided to increase the level of ODA to 0.5% of GNI by 2015. This decision took into consideration the need for Switzerland to honor its UNFCCC Fast-Start-Finance commitment. New and additional resources were provided thereby increasing Swiss ODA.

Switzerland has made financial contributions to the UNFCCC and its Kyoto Protocol; to multilateral institutions such as the Global Environment Facility (GEF) and to various international financial institutions that fund climate change adaptation, mitigation and technology cooperation programs in developing countries. To the GEF's fifth replenishment (2010-2014) Switzerland contributed 124.8 million Swiss francs. Between 2009 and 2012, Switzerland contributed a total of 6.65 million Swiss francs to the LDCF and the SCCF, and 3.4 million to the Adaptation Fund. From 2010 to 2012, Switzerland's contribution towards the Climate Investment Funds (CIFs) amounted to 23.46 million Swiss francs.

The bilateral climate change related cooperation is concentrated on selected focal countries. SDC focuses on forest and land use, energy, vulnerability/adaptation, and desertification. From 2009 to 2012 SDC spent 268.6 million Swiss francs for bilateral and regional programs in climate change. Additional 23.7 million Swiss francs were provided for humanitarian aid interventions as direct adaption response measures to natural disasters. The various projects and programs of SECO focus on energy efficiency and renewable energy sources, sustainable management of natural resources, and framework conditions and new market and financing mechanisms. SECO provided 158.64 million Swiss francs between 2009 and 2012 for its global, regional and bilateral programs and projects.

Switzerland has undertaken a broad range of activities to promote climate resilient development especially in the most vulnerable developing countries. It seeks to create awareness on adaptation at different levels. Switzerland's overall goal in adaptation is to support developing countries in reducing their susceptibility to unavoidable climate change and minimizing the associated social and economic costs. The adaptation activities are linked to sustainable management of soils, water and forests and target the most vulnerable countries and communities. In total Switzerland provided 213.35 million Swiss francs between 2009 and 2012 for adaptation activities (205.9 million CHF bilateral; 7.45 million CHF multilateral).

Several bilateral projects contribute positively to climate change adaptation although they are not specifically designed for this purpose. Mostly, these projects are aimed at sustainable resource management. Swiss development cooperation works on climate change mitigation as a cross-cutting issue. The focus is on access to modern energy infrastructure, including renewable energies, rural electrification, energy efficiency in the industry and in the buildings/construction sector, as well as on reducing deforestation. Overall Switzerland provided 245.0 million Swiss francs between 2009 and 2012 for climate change mitigation activities (202.0 million CHF bilateral; 43.0 million CHF multilateral).

As far as energy efficiency in buildings is concerned, Switzerland has developed leading technological and scientific expertise. A transfer of this knowledge to developing and emerging countries makes it possible to save large amounts of energy.

From 2009 to 2012, Switzerland's official development assistance (ODA) amounted to 10.442 billion Swiss francs (between 2.4 and 2.83 billion CHF per year), whereof approximately 25% have been provided through multilateral assistance (core contributions and programs) and 75% through bilateral or regional assistance projects. The climate component within Switzerland's development cooperation has steadily increased over the last years. Tab. 40 and Tab. 41 give an overview on multilateral and bilateral climate related contributions.

Alongside public sector activities, the Swiss private sector plays an important role in terms of technology transfer. In many fields of environmentally sound technologies, Swiss companies are leading in the development, diffusion and implementation of state-of-the-art solutions and pursue climate-related activities in the order of several billion Swiss francs per year.

1.8 Research and systematic observation

Climate research is spread over many institutions and funded through national and international funding bodies. Swiss researchers actively participate in various international research programmes, for a total of about 290 ongoing research projects in 2011. About 160 projects received funding from the National Science Foundation, with an average funding of CHF 140'000 per project and year, and about 46 projects from the EU.

Switzerland has established two National Centres of Competence in Research (NCCR), which are or have been concerned with climate change issues over the last decade. NCCR Climate, created in April 2001 with an intended duration of 12 years, stopped officially its activities in October 2012. It addressed issues of natural climate variability, predictability, and resulting impacts on biological and socio-economic systems by combining the contributions from relevant disciplines into an integrated network of competence. Two national centres for climate research have emerged from the NCCR Climate initiative: The Oeschger Centre for Climate Change Research (OCCR) at the University of Bern and the Centre for Climate Systems Modelling (C2SM) at the ETH Zürich. NCCR North South focuses on international research cooperation. It contributes to an improved understanding of different syndromes of global change, of the pressures these syndromes exert on different resources, and of the responses of social groups and society as a whole.

Research that is directly funded by government institutions falls into one of the federal research programmes. These programmes provide the conceptual framework and set research priorities in the relevant policy area. Energy research policy is laid down in the four-year Federal Energy Research Masterplan developed by the Federal Energy Research Commission (CORE). The focus for the years 2013-2016 lies on energy-efficient buildings and near emissions-free housing stock, on reduced fuel consumption in the transport sector and on an intelligent network to ensure that energy supply is secure and sustainable. Energy research continues to be guided by the vision of a 2'000 Watt per capita society. National priorities in transport research are external costs, sustainable modes of transport and road infrastructure. Agriculture research is focusing on farming practices that contribute to climate change mitigation or that are more adaptable to future climate conditions. Forest research targets sustainable forest management and the preservation of the protective function of forests against natural hazards.

Switzerland has a long tradition of systematic climate observation. Temperature and precipitation series of more than 150 years, the world's longest total ozone series and glacier measurements dating back to the end of the 19th century are only a few of the highlights of Switzerland's contribution to global and regional climate monitoring. The implementation of systematic climate observation in accordance with the requirements of the UNFCCC and the Kyoto Protocol (Global Climate Observing System GCOS), is coordinated by the Swiss GCOS Office at the Federal Office of Meteorology and Climatology MeteoSwiss. It includes all climate-relevant measurements that are made by federal offices, research institutes and universities in Switzerland. Furthermore, the Swiss GCOS Office ensures communication with the corresponding international bodies. Switzerland hosts international data and calibration centers, therefore contributing to data quality and global standardization of observations. Itcontributes also to the GCOS Cooperation Mechanism (GCM) in order to enhence the quality of climate-related observations globally, in particular in developing and emerging countries.

In the atmospheric domain, observation networks include surface, upper air and atmospheric composition measurements. The Swiss National Basic Climatological Network (NBCN) which follows the GCOS Climate Monitoring Principles, is the core of the climatological observation network for surface-based atmospheric observations. These national networks are linked to international programmes and observing systems such as for example the Baseline Surface Radiation Network (BSRN), the GCOS Upper Air Network (GRUAN), the WMO Global Atmosphere Watch (GAW) programme, or the Integrated Carbon Observing System (ICOS). In the terrestrial domain, continuous measurements of the hydrosphere (river discharge, lakes, water use, isotopes, groundwater, and soil moisture), cryosphere (glacier, permafrost, snow cover), and the biosphere (land use, forest ecosystem, forest fires, and phenology) provide a basis for assessing the impacts of climate change on the environment and its consequences (e.g. for agriculture, energy production, ecosystems).

1.9 Education, training and public awareness

Switzerland has a long tradition on raising public awareness for environmental issues. According to a study on the public perception and knowledge with regard to environmental issues, climate change was listed as the second most important concern, outweighed by air pollution and exhaust fumes. The prominence of climate change issues may be related to the concerted effort of leading climate researchers in communicating their results to the general public.

Federal, cantonal, and local authorities as well as the private sector contribute to various activities related to education, training and public awareness. Information platforms and websites are maintained by the Federal Office for the Environment, the Swiss Federal Office of Energy, MeteoSwiss, ProClim, OcCC and various cantonal environmental authorities. The platforms either provide information on climate change related topics or deal with climate-related enquiries from the general public. These channels are supplemented by a wide spectrum of magazines, reports and newsletters published by federal agencies, media releases as well as talks and public appearances at exhibitions and meetings.

Education, training and public awareness is in the energy sector is one of the main priorities of the SwissEnergy programme. SwissEnergy wants to involve all relevant target groups in an educational campaign, in close collaboration with industry associations, professional organizations and the providers of education and training courses. Information about all voluntary measures and the networking of actors within the the SwissEnergy programme can be found on the new information portal of SwissEnergy, www.energieschweiz.ch. The website is the Central communication hub, but TV, training, information materials, special events etcetera are also used as means of communication.

The scientific advisory bodies ProClim (www.proclim.ch) and OcCC (www.occc.ch) are prominent organisations that regularly publish the latest information on climate change research. The aim of ProClim is to provide a holistic view on climate change, including the physical climate system, biogeochemical processes and the human dimensions of global change. Furthermore, it is an important platform for nationwide networking amongst people and institutions. OcCC's role is to formulate recommendations on questions regarding climate and global change for politicians and the federal administration. The two bodies are involved in translating and distributing the summaries of the IPCC reports. Various other initiatives are supported by federal agencies mostly in collaboration with research groups of Swiss universities such as the freely available e-learning environment based on the hiking trail in Engadine, developed by the Swiss Federal Institute of Technology in Zürich (www.klimaweg.ethz.ch).

Private sector initiatives Swiss companies are undertaking voluntary efforts to reduce the carbon footprint of production processes and products. The Energy Agency for the Economy assists companies in reducing CO_2 emissions, increase energy efficiency and tap the potential of cost-efficient and climate-friendly measures. Furthermore, the Commission for Technology and Innovation CTI launched in 2010 an initiative to promote research and development in the Cleantech sector (resource efficiency and renewable energies). An ever increasing number of activities and events aimed at increasing public awareness and consciousness towards climate change, its challenges and potential measures for mitigation or adaptation are sponsored by various companies and associations.

2 National circumstances

2.1 Political profile

Administrative structures

Switzerland is a confederation, with a federal government, a bicameral parliament and a Federal Supreme Court. The territory consists of 26 cantons (states), each of which has its own government, parliament and cantonal court. Responsibilities are shared between the federal authorities and the cantons.

The federal government consists of the seven members of the Federal Council, together with the Federal Chancellor, and is elected by the United Federal Assembly for a four-year term. The federal administration comprises the Federal Chancellery and seven Federal Departments (for details, see *http://www.bk.admin.ch/dokumentation/02070/index.html?lang=en)*.

The Swiss parliament has two chambers which, when in joint session, are known as the United Federal Assembly. This is the country's legislative authority. The National Council, through its 200 members, represents the population of the country as a whole – the individual cantons are represented in proportion to the number of their inhabitants. The Council of States represents the 26 cantons – 20 cantons are represented by two members while six half-cantons each send one representative to the 46-strong chamber.

Subsidiarity plays an important role in Switzerland. This is reflected in constitutional law, which states that unless legislative power is explicitly assigned to the confederation, the cantons are sovereign, i.e. entitled to legislate in an area of policy. This fundamental principle helps to protect minority interests, above all those of the French-, Italian- and Romansh-speaking parts of Switzerland. Another important aspect is fiscal federalism. Each canton has its own budget and sets its own level of direct taxation. Despite a system of financial equalization amongst cantons, substantial differences remain in the level of taxation of both households and companies.

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 harmonized, effective implementation in a number of policy areas.

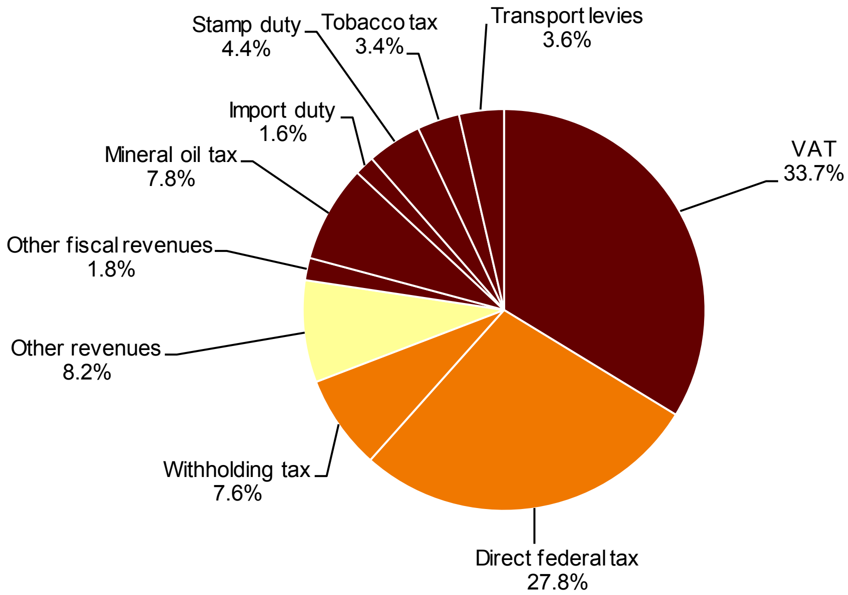
The legislative system comprises several hierarchical levels. All legislation must ultimately comply with the constitution. Laws of different kinds (federal acts and federal decrees) implement constitutional matters. Regulation at both of these levels is subject to the approval of the electorate, which is not the case for ordinances, through which the government alone implements the contents of laws.

Federal revenue and expenditure

Fig. 9 and Fig. 10 show the present structure of federal revenue and expenditure. Total federal revenue accounted for around CHF 64 billion in 2011 whereof 56% derived from indirect taxes (highlighted in brown) and 35% from direct taxes (highlighted in orange). Federal expenditure accounted for CH 62 billion in 2011. The transfer expenditure represents 76.4% of the total expenditure, whereas 19.5% goes for operating expenditure.

Fig. 9 > Breakdown of federal revenue in 2011

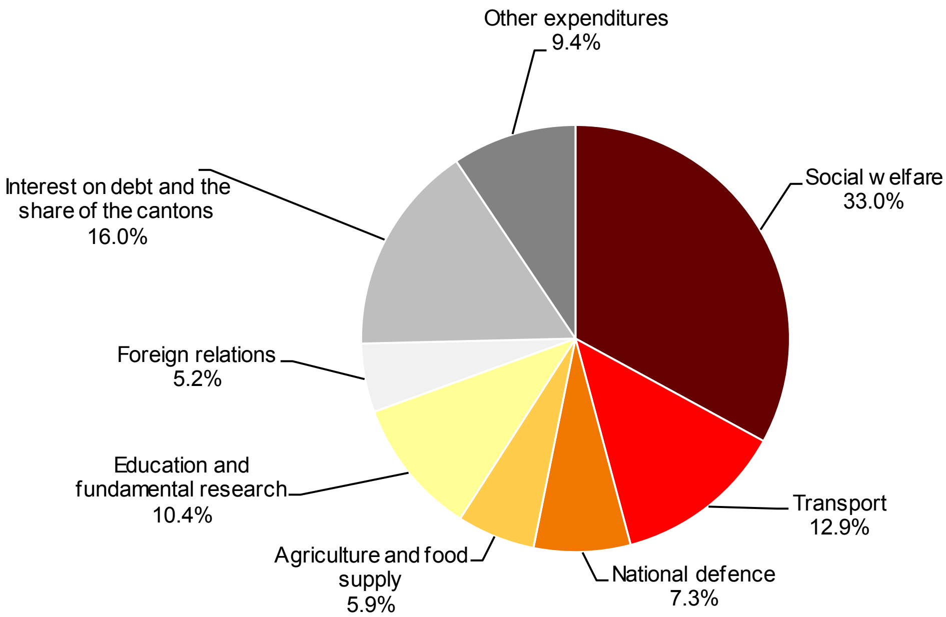
Direct taxes are shown in brown, indirect taxes in orange.



FCh (2012)

Fig. 10 > Breakdown of federal expenditure in 2011

Federal expenditure by task area.



FCh (2012)

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, the Swiss people are sovereign and ultimately the supreme political authority. Virtually all important decisions have to be approved by the electorate. This includes all Swiss adults who are eligible to vote – some 5.2 million citizens in 2012, i.e. around 65% of the resident population. Those under the age of 18 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 longstanding 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 all across Switzerland.

Every four years, the people **elect** the 200 members of the National Council. All Swiss citizens over the age of 18 may take part in elections, both actively and passively. In other words, they may cast their votes and stand for election themselves. Federal civil servants standing for election are required to choose between their position in the federal administration and elected office.

The electorate is regularly asked to cast their **vote** in popular ballots. Voters are generally called on four times a year to vote on federal proposals. On average these votes involve three to four proposals that may be adopted or rejected; although in exceptional cases, there may be more than twice that many. Votes are held on people's initiatives and referendums. Often, cantonal and communal ballots are held at the same time.

By means of a **popular initiative**, citizens can seek an amendment to the constitution (at the cantonal level also an amendment to a law). Popular initiatives may comprise a general proposal or contain detailed regulations. In most cases, a proposal must be accepted by a majority of the electorate and of the cantons if it is to become part of the constitution. This requirement for a "double" majority (population and cantons) mainly serves to protect the interests of less populous rural cantons.

The second formal instrument of direct democracy is the **referendum**. This allows citizens to veto decisions made by parliament. The referendum may be mandatory or optional. It is possible to have a referendum concerning regulations at the level of the constitution, 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.

The cantons and other interested parties (e.g. business, trade unions, NGOs etc.) are included in a consultation process whenever government (the Federal Council) proposes a significant change in the constitution, in a law 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 process 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 policy-making and of political culture in Switzerland. However, this political participation process also leads to a relatively prolonged policy-making process which needs to be appreciated in the context of the policies and measures described in section 4.

International relations

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

Although not a member state of the European Union (EU), Switzerland has a strong relationship with the EU and European policy is a high priority of Swiss foreign policy. The legal basis of this close cooperation is formed by bilateral agreements (Integration Office FDFA/FDEA 2009), and most new and amendments to existing Swiss laws have been made compatible with EU legislation. Relations between Switzerland and the EU have developed over decades. The bilateral agreements have been extended step by step. Important stages of this European policy have been assessed and approved by the people in referendums. Switzerland became a member of the European Environmental Agency (EEA), one of the most important agencies for European cooperation in environmental issues.

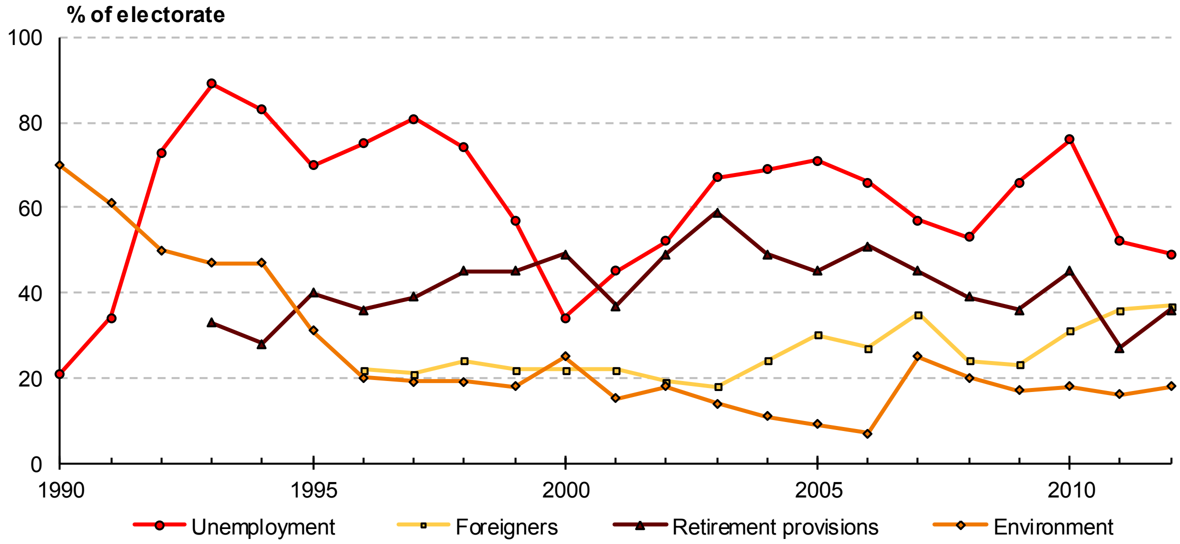
2.2 Perceptions of political problems

In the year 2012, 49% of the Swiss considered unemployment as one of the five major problems Switzerland is facing, followed by concerns regarding foreigners (37%) and retirement provisions (36%). Fig. 11 shows the development of these three issues and the concern about environmental issues from 1993 until 2012. Due to structural and cyclical changes in national and international labour markets, unemployment began to rise at the beginning of the 1990s and became a major public concern during that decade. Development of unemployment rates are shown in section 2.6.

In relation to the three major concerns, environmental issues are perceived to be less important. However, respondents asked about their fears for future generation listed the environment and the climate as their top concerns along with unemployment. While environmental awareness abruptly increased in 2007, it is maintained at a level rather stable and reached 18% in 2012. However, concerns about energy have been clearly identified since 2003 (not shown). This trend increased over the last years due to the continuing debate on phasing-out nuclear energy.

Fig. 11 > **Perception of political problems**

"What do you consider the five most important problems of Switzerland? " Multiple answers were possible.



GfS (2012)

2.3 Population, building stock and urban structure

According to the Swiss Federal Statistical Office, Switzerland had a population of 8.04 million permanent residents with a density of 194.6 persons per km^2, and more than two thirds of the Swiss population living in cities or metropolitan areas at the end of 2012 (SFSO 2013a). Fig. 12 shows the increase in population from 1960 to the end of 2012.

Population growth is mainly the effect of immigration and increasing life expectancy. 27% of children born in Switzerland in 2012 were foreign nationals.

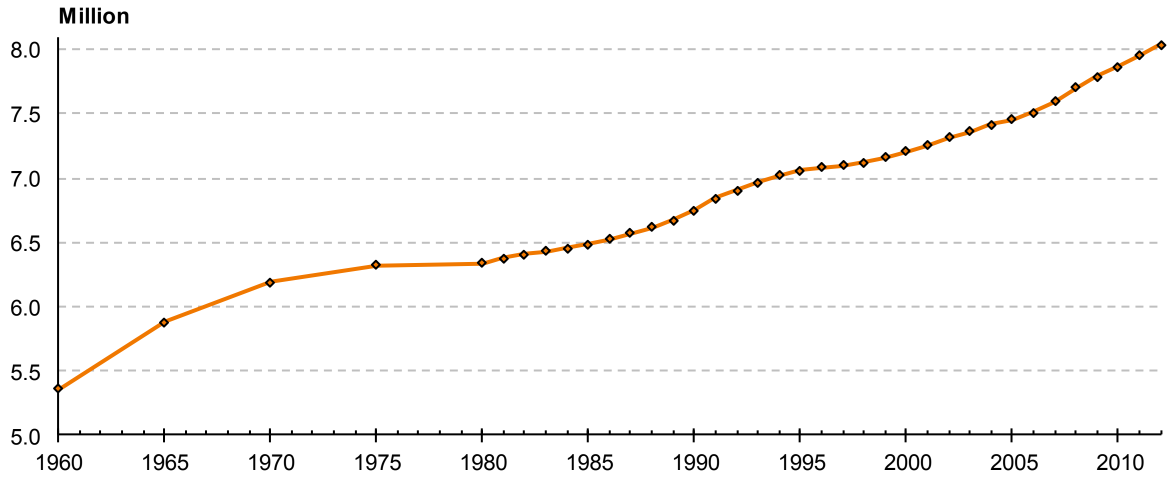
Age structure: Fig. 13 shows the demographic structure of Switzerland in 2011 by age, sex and nationality. Foreign nationals account for about 23% of the permanent Swiss residential population. A growing proportion of the population is of retirement age, while the share of persons below the age of 20 has been declining since the 1970s.

Languages: Switzerland has four official languages (German, French, Italian, and Romansh). In 2010, German was spoken by 65.6%, French by 22.8%, Italian by 8.4% and Romansh by 0.6% of the inhabitants (based on population aged over 14 and living in a private household). The most common foreign languages are English (4.5), Portuguese (3.1), Serbo-Croatian (2.6%), Albanian (2.5), Spanish and Turkish (SFSO 2013a).

Expansion of urban areas: More than one third of the Swiss population lives in the urban agglomerations of the five major cities of the country (Zürich, Geneva, Basel, Bern and Lausanne). Another third lives in smaller urban areas, while the remaining share has settled in rural areas. Since the early 80's, the population living in urban areas slightly declined from 74.5% to 73.7% (SFSO 2013a).

Fig. 12 > Population

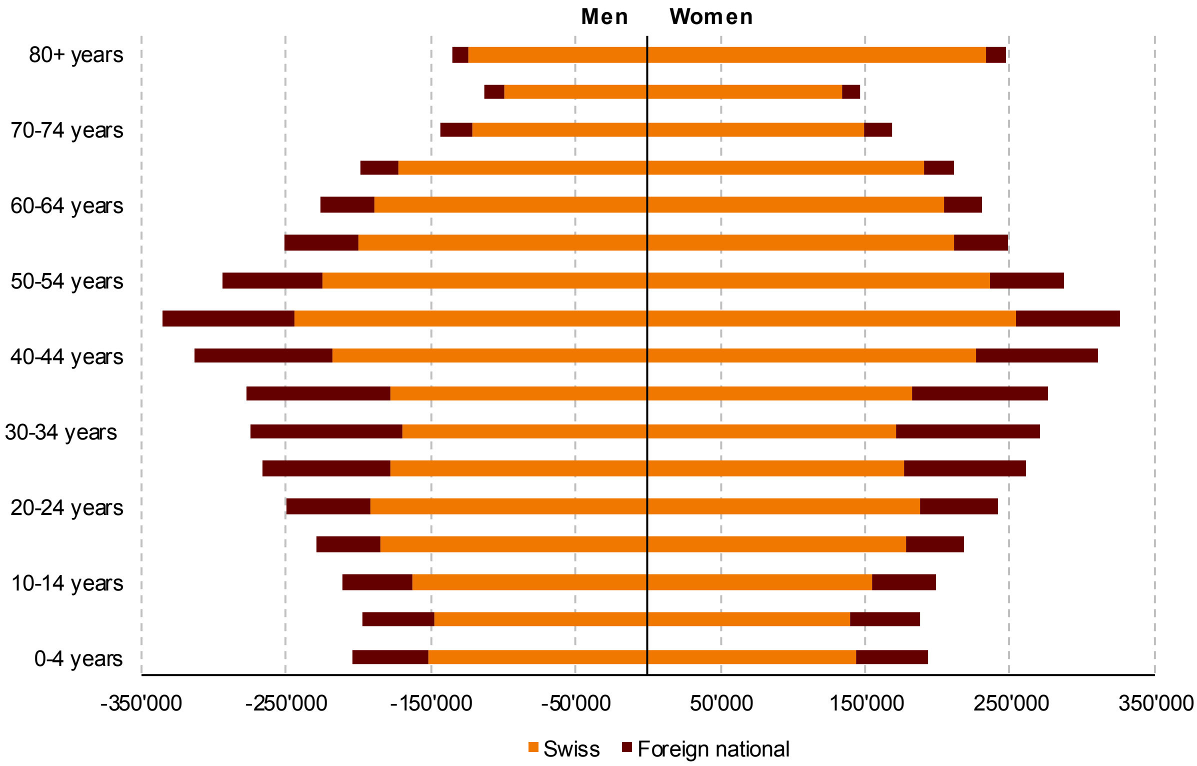
Permanent residential population at year end between 1960 and 2012. At the end of 2012, Switzerland had 8.04 million permanent residents, of which 3,97 million men and 4.07 million women.



SFSO (2013a)

Fig. 13 > Age structure in Switzerland in 2011

Data are segregated by age, sex and nationality.



SFSO (2013a)

Homeownership rates: Homeownership rates in Switzerland stay relatively low. Only 36.8% of the permanent residents in Switzerland live in their own apartments (data for 2010), the majority stays in rented accommodation. Since 1970, the percentage of homeowners has increased of 9% (SFSO 2013b), however, it still represents the lowest rate in all European countries. With regard to modernising of buildings, the low homeownership rates represent a significant hurdle.

Household size and housing: The number of households which amounted to 3'534 thousands in 2011, has been continuously increasing (+54% between 1970 and 2000[1]), while the number of persons per household is decreasing (2.2 persons in 2011, SFSO 2013c). In the time between the land use survey periods of 1979 to 1985 and 2004 to 2009, the settlement and urban area increased by 24%. This represents an increase of 375 m^2 to 395 m^2 per resident, a value close to the limit desired by the Federal Council (SFSO 2013n).

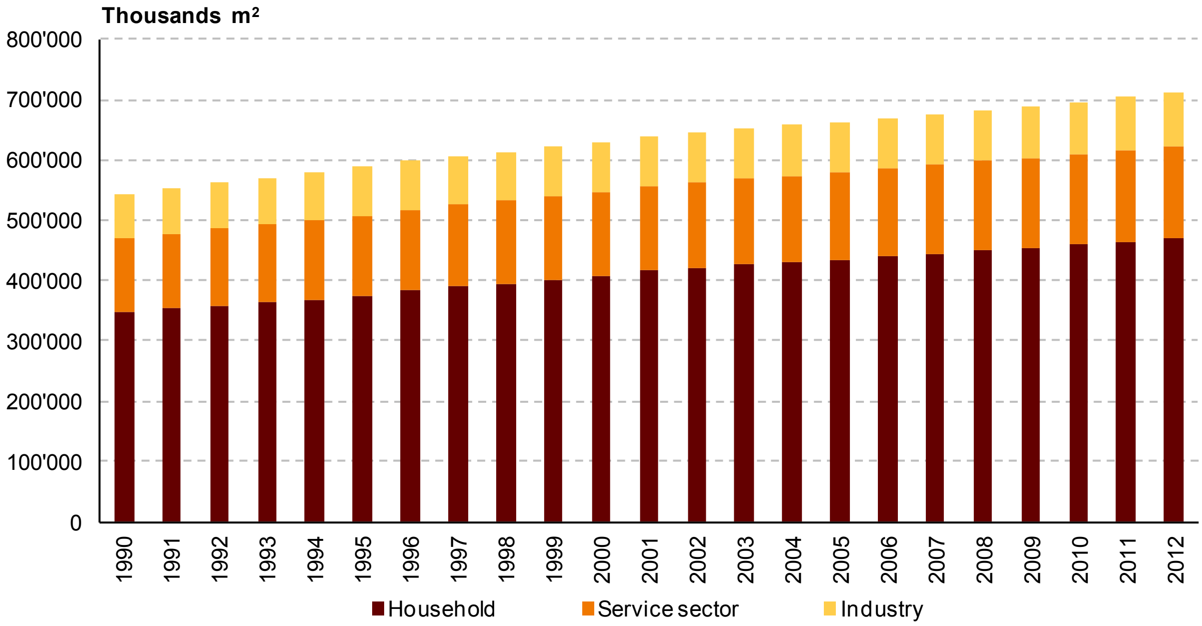
Development of energy reference area: Total energy reference area in Switzerland is steadily increasing since 1990 and accounted for over 712 million m^2 in 2012 (Fig. 14). Residential buildings account for the major share of energy reference area. In comparison, industry accounts for only around 12% of heated floor area.

The increase and structure of the Swiss population, building stock as well as urban structure also influence parameters such as for example, mobility behaviour, income, or land consumption discussed in the following sections 2.6 - 2.13.

[1] Data from 1970 to 2000 are taken from a census that provides important information every 10 years on the structure of the population in Switzerland. In 2010, a fundamental change took place: the census is now conducted and evaluated on an annual basis in a new form by the Federal Statistical Office (FSO).

Fig. 14 > Energy reference area in Switzerland between 1990 and 2012

Energy reference area of households increased by around 30% between 1990 and 2012.



Wüest and Partner (2012) on behalf of SFOE

2.4 Geography

Switzerland is located between 45°49' and 47°48' north and from 5°57' to 10°30' east. It covers an area of 41'300 km^2, comprising 29% forest and grove, 39% cropland and pastureland, 8% built-up and 23% water and unproductive land (situation in the mid to late-2000s) (Fig. 15). The size of the built-up area more than doubled between 1950 and 1990 and has continued to expand ever since, mainly at the expense of agricultural land (Fig. 16). Over the last 30 years (1980 and 2007), the degree of landscape fragmentation has risen by 26%. Total settlement area in Switzerland increased by 1.1 m^2/s between 1983 and 1995 and by 0.9 m^2/s between 1995 and 2007 (FOEN 2010). In 2012, nearly 3.9% of the total surface area of Switzerland was strictly protected (SFSO 2013m).

Fig. 15 > Types of land use

Land use types in Switzerland between 2004 and 2009.

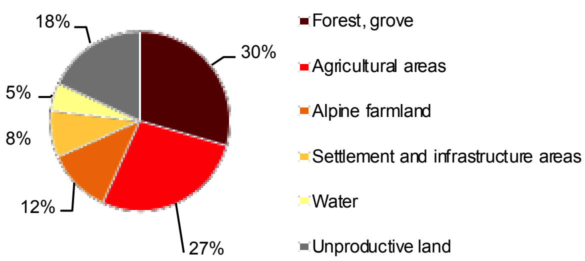
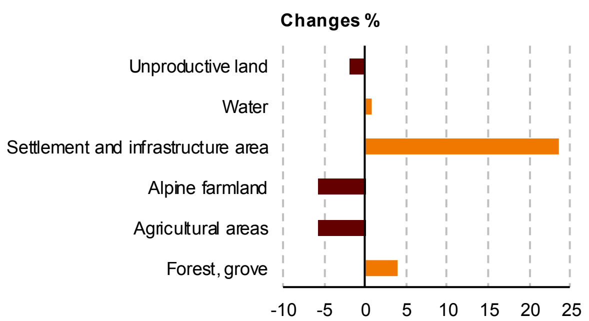


Fig. 16 > Land use change

Changes in land use between 1979/85 and 2004/09.



SFSO (2013e)

Swiss topography is defined by the Alps. According to the snow and avalanche research institute SLF (*http://www.slf.ch*) around 50% of the Swiss surface area is higher than 1'000 meters above sea level and around 25% higher than 2'000 meters above sea level. This means, that around one third of the precipitation occurs as snow. Furthermore, around 5% of the surface area of Switzerland is covered by water bodies. Due to its abundant water resources Switzerland is sometimes referred to as water tower of Europe. With a water availability of 5'300 m^3 per year and capita, it is in a highly favoured condition. Although it covers only 0.4% of the surface area of Europe, the amount of water stored in this area corresponds to 5% of the total European water resources. Switzerland plays an important role in the water supply of its neighbouring, mostly drier countries downstream. Both topographic attributes are influencing climate patterns in Switzerland (section 2.5). Observed and expected changes of the richness of Swiss biodiversity and its vulnerability are outlined in section 6.1.6.

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 through Switzerland. However, the Alps serve as a natural barrier to traffic moving in the north-south direction, i.e. between northern Europe and Italy. A number of tunnels thus allow for large-scale road and rail traffic to cross the Alps. Three new railway tunnels designed to facilitate transalpine traffic and increase transit capacity have been under construction over the past years – the Lötschberg base tunnel which opened in December 2007, the Gotthard base tunnel which is expected to open in December 2016 and the Ceneri tunnel, scheduled for December 2019.

2.5 Climate trends

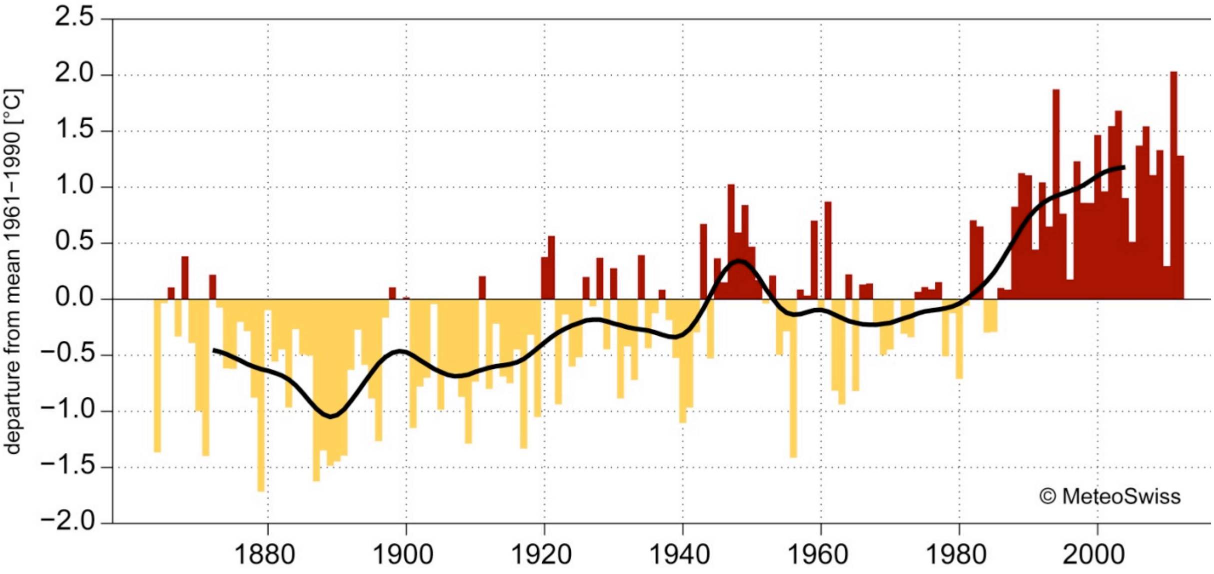
Climatic conditions of temperature and precipitation patterns vary significantly across Switzerland, depending mainly on altitude and location. The Alps – running from south-west to east – act as a climatic divide. Measurements indicate a marked shift towards a warmer climate – particularly since the 1970s. Changes in precipitation are less clear, e.g. for annual mean precipitation no significant trends are found in the last 100 years. For expected future developments and impacts thereof see section 6.1 (CH2011 2011).

Temperature

Fig. 17 shows the annual temperature anomaly in Switzerland with respect to 1961-1990 average conditions. Annual temperature has increased by +1.75°C between 1864 and 2012, which corresponds to a linear temperature trend of about +0.12°C per decade. Temperature trends have accelerated substantially for more recent time periods (Fig. 18). Over the last 100 years (1913-2012), annual temperature has increased by about 0.13-0.20°C 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 autumn (up to 0.24°C per decade). Annual temperature trends for the last 70 years (1943-2012) are 0.15 to 0.24°C per decade, for the last 50 years (1963-2012) between 0.34 and 0.47°C per decade and for the last 30 years (1983-2012) between 0.28 and 0.55°C per decade. This is roughly two (last 100 years) to three (last 30 years) times the globally averaged temperature trend (IPCC 2007) and in agreement with the trends in other parts of western and central Europe. In the last 30 years, the trends were largest (highly significant) in spring (0.68 to 0.99°C per decade) and summer (0.28 to 0.59°C per decade) whereas less pronounced and mostly insignificant in autumn (0.00 to 0.51°C per decade) and in winter (-0.24 to +0.31°C per decade).

Fig. 17 > Mean annual temperature anomalies in Switzerland 1864-2012

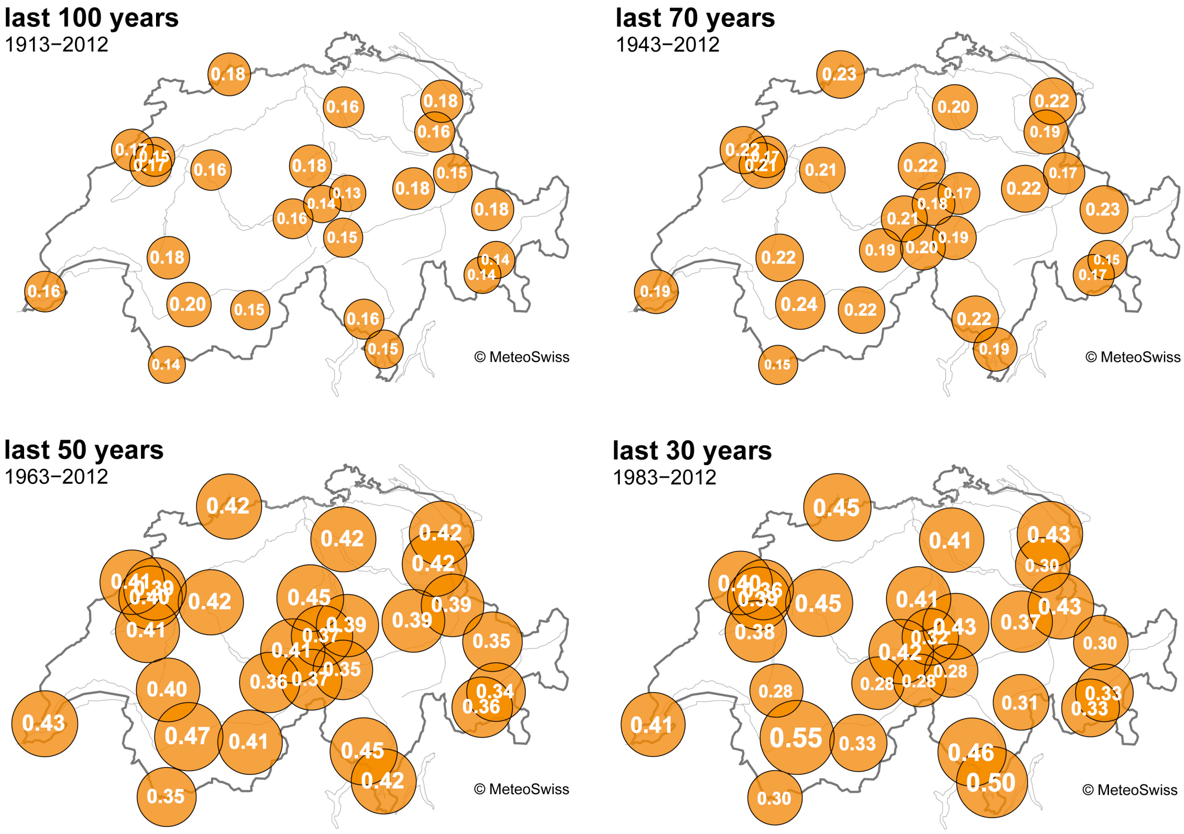
Annual temperature anomalies in Switzerland shown as deviation from the mean of 1961-1990. The years with positive anomalies (warmer) are shown in red and those with negative anomalies (cooler) in blue. The black line represents 20-year Gaussian low pass filtered data.



MeteoSwiss (2013)

Fig. 18 > Observed annual temperature trends in Switzerland

Observed annual temperature trends in Switzerland for homogenized station data. Shown are trends in °C/decade of the last 100 (1913-2012, top left), last 70 (1943-2012, top right), last 50 (1963-2012, bottom left) and last 30 years (1983-2012, bottom right). All trends are statistically significant (5% significance level).



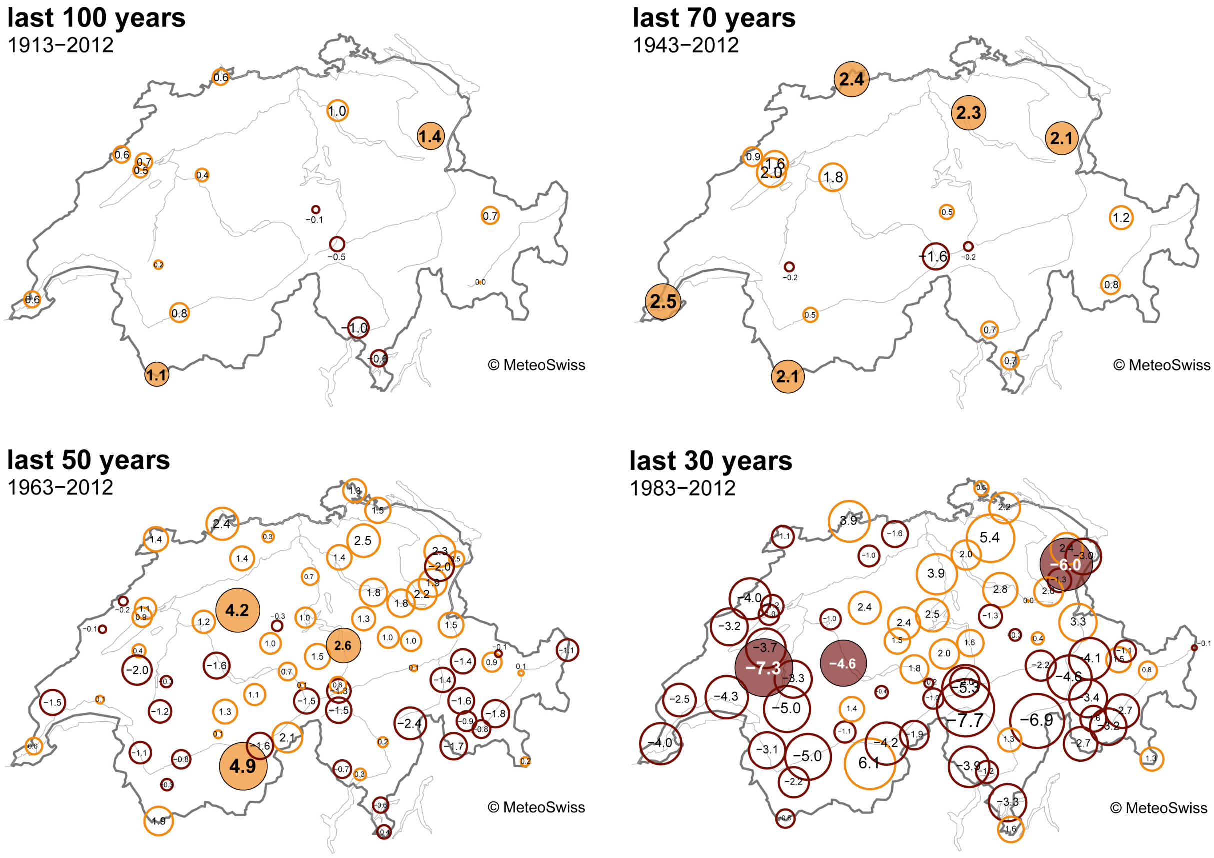
MeteoSwiss (2013)

Precipitation

Fig. 19 shows the annual precipitation trends in Switzerland for the last 100 (1913-2012), 70 (1943-2012), 50 (1963-2012) and 30 (1983-2012) years. In contrast to temperature, there is no consistent picture of the trends. They are insignificant for most stations and time periods considered. A few significantly positive trends are found in northern Switzerland and the Alps considering the longer time periods (50-100 years). For the vast majority of the stations, the trend magnitudes are insignificant. Also on the seasonal scale, most trends are insignificant or not consistent over time (not shown). For example: Some stations show significant precipitation increases in winter for the last 100 years but predominantly precipitation decreases in the last 30 years. This shows that internal decadal variability can still be larger than any underlying long term trend.

Fig. 19 > Observed annual precipitation trends in Switzerland

Observed annual precipitation trends in Switzerland for homogenized station data. Shown are trends in percent/decade of the last 100 (1913-2012, top left), last 70 (1943-2012, top right), last 50 (1963-2012, bottom left) and last 30 years (1983-2012, bottom right).Positive trends (i.e. more precipitation) are coloured in orange, negative trends (i.e. less precipitation) are shown in red. Filled circles: Trends that are statistically significant (5% significance level), open circles: non-significant trends.



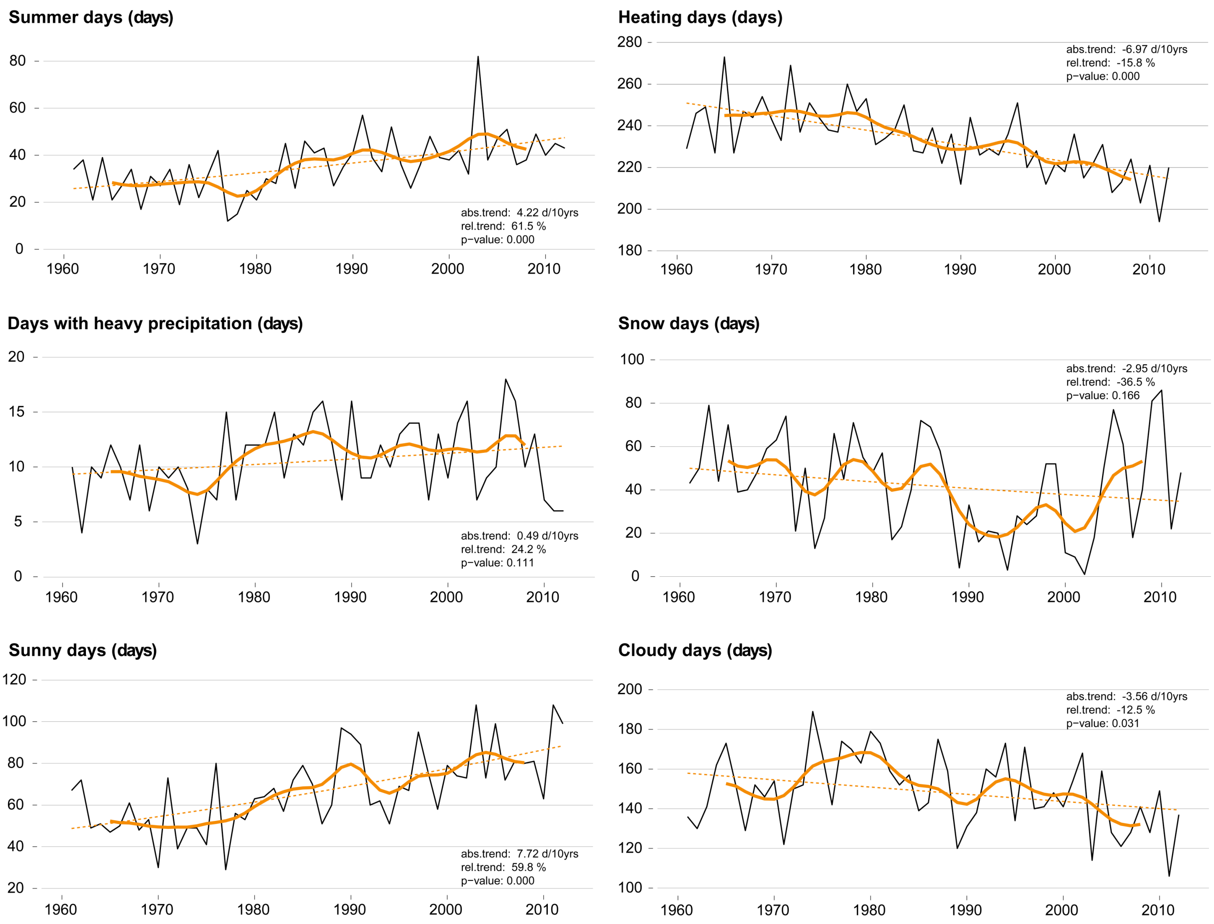
MeteoSwiss (2013)

Climate change indicators

Fig. 20 shows the evolution of some important climate indicators at the station Bern/Zollikofen for the time period from 1961-2012. This station can be seen as representative for the Swiss Plateau. The average number of summer days increased from roughly 25 days in the 1960s to about 45 days today per year (Fig. 20, top left). This increase is highly significant and very similar trends are found for most stations on the Swiss Plateau. In contrast, the number of heating days decreased by about 15-20% in the same time period (Fig. 20, top right). The number of days with heavy precipitation (Fig. 20, middle left) increased somewhat, although the trend is not statistically significant. Similar insignificant increases are found for most stations on the Swiss Plateau. A decrease (although insignificant) is also found for the number of snow days (Fig. 20, middle right). In the last 10 years, a change towards more snow days at low lying Swiss stations can be observed. The number of very sunny days (rel. sunshine duration >80%, Fig. 20, bottom left) shows very significant increases whereas the number of very cloudy days (rel. sunshine duration <20%) is decreasing (Fig. 20, bottom right). Also these trends are found on most stations on the Swiss Plateau.

Fig. 20 > Climate change indicators 1961-2012

Observed annual number of summer days (days with maximum temperature ≥25°C, top left), heating days (days with a daily average temperature below 12°C, top right), days with heavy precipitation (daily precipitation >20 mm, middle left), snow days (days with snow depth ≥1 cm, middle right), sunny days (days with relative sunshine duration >80%, bottom left) and cloudy days (days with relative sunshine duration <20%, bottom right) in the period 1961-2012 at the station of Bern/Zollikofen. Homogenized station data is used for the temperature and precipitation based indicators. The thick red line represents 11-year Gaussian low pass filtered data, the dashed red line the linear fit (logistic-regression).



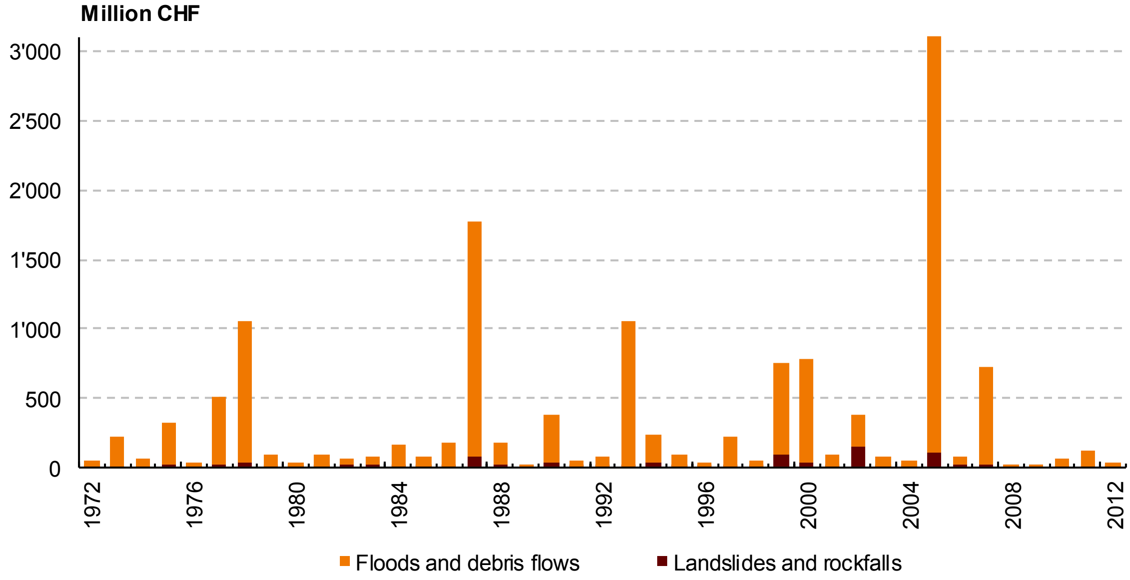
MeteoSwiss (2013)

Damage due to extreme events

Occurrence numbers of floods, debris flows and landslides did not show any significant tendency over the past decades. Flooding was the most frequent type of extreme event occurring since 1972 (60–95% of all loss events). However, despite comparable occurrence rates, damages due to extreme weather events have been growing in recent years (Fig. 21). Although, the increasing damages are mainly due to an increase in values and assets in hazardous zones, it is highly likely that impacts of climate change contribute to increased intensity and wider geographical and annual distribution of meteorological extreme events. However, the contribution of climate change to extreme weather events is not yet sufficiently understood (PLANAT 2007). Analysis of impacts due to extreme weather events, such as e.g. damaged wood is discussed in section 6.

Fig. 21 > Total annual losses arising from natural events between 1972-2012

Total annual losses arising from floods, debris flows, landslides and rockfalls (adjusted for inflation, basis 2011).



WSL (2013)

2.6 Economy

Main characteristics

Switzerland's economy is largely dependent on the tertiary sector, which is contributing over 73% to the gross value added (Fig. 22). Since the 1960s, the proportion of the total workforce employed by the industrial and commercial sector has fallen from half to less than a quarter. Since 1960 the proportion employed in the primary sector had dropped from 14.5% to 3.5% in 2011. At the same time, almost 74% of employees make their living in the services and administration sector (Fig. 23).

Switzerland's key economic data

Switzerland's real GDP remained constant in the early 1990s, but has been increasing since 1995, mainly as a result of foreign trade. However, the slowdown in the global economy in 2009 resulted in trade deficit in Switzerland and contributed to the decline in its GDP (SFSO 2012). Since then the economic climate became again more favourable for economic activities. In 2010 and 2011, the GDP increased by 3% and 1.9% compared to the previous year, respectively. Fig. 24 shows real GDP trends in relative terms for the period from 1990 to 2011. GDP per capita (in current prices) is also steadily increasing (49% since 1990) and accounted for over CHF 74'000 in 2011 (Fig. 25).

Traditionally a country with low unemployment (< 1%), Switzerland experienced a dramatic increase in unemployment from the beginning of the 1990s, basically as a consequence of the overall economic slowdown. Apart from foreign nationals (both male and female), the category most affected by this development was Swiss women and young people (aged 15- 25). As Fig. 26 shows, the total rate of unemployment has peaked three times since 1991 – at 4.2% in 1997, at 4.5% in 2005 and 2010. In parallel with rising unemployment, aggregate government spending of all three administrative levels has exceeded revenues since 1990, which has led to increasing debt (Fig. 27). Following a relatively stable period between 1998 and 2003, the revenues have exceeded the expenditures since 2004.

During the 1990s low economic growth and the worldwide recession increased public spending ratio in Switzerland. Since then, public spending ratio has been stabilized and in 2011 Switzerland's public spending ratio amounted to 32.9 being one of the lowest in the OECD area (Fig. 28).

Fig. 22 > GVA contribution of economic sectors.

The value for 2011 is tentative.

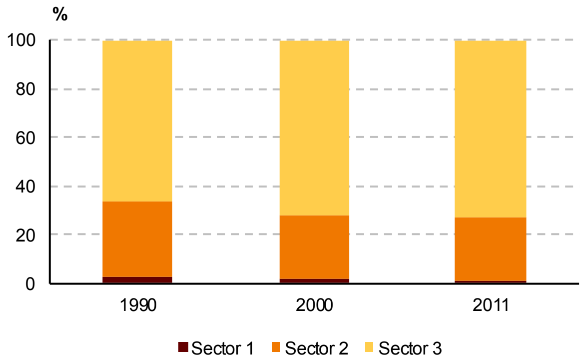
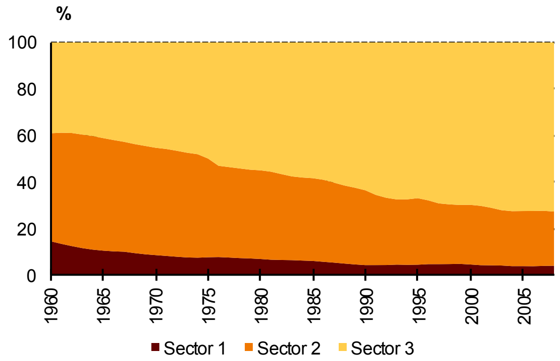


Fig. 23 > Workforce by sector



SFSO (2013d, 2013f)

Fig. 24 > Percentage change of real GDP.

The value for 2010 and 2011 is tentative.

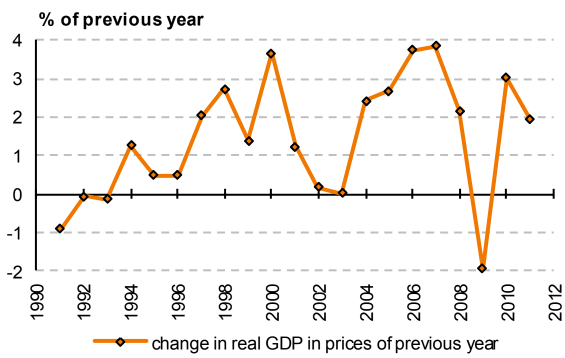
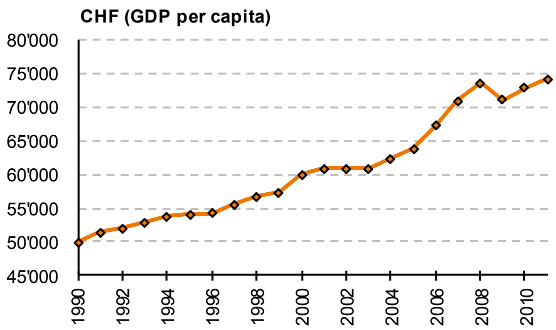


Fig. 25 > GDP per capita between 1990 and 2011.

The value for 2011 is tentative.



SFSO (2013a, 2013g)

Fig. 26 > Unemployment rate

Rates of unemployment between 1991 and 2012.

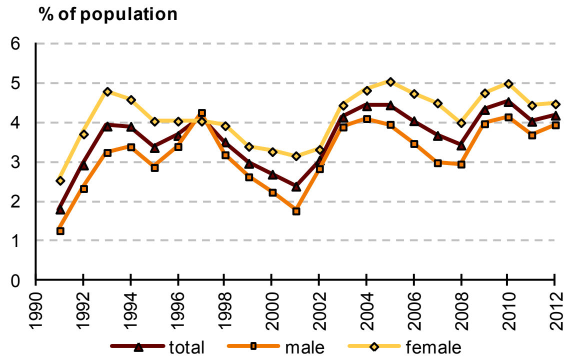
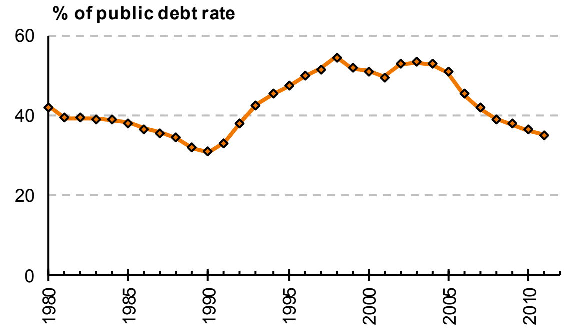


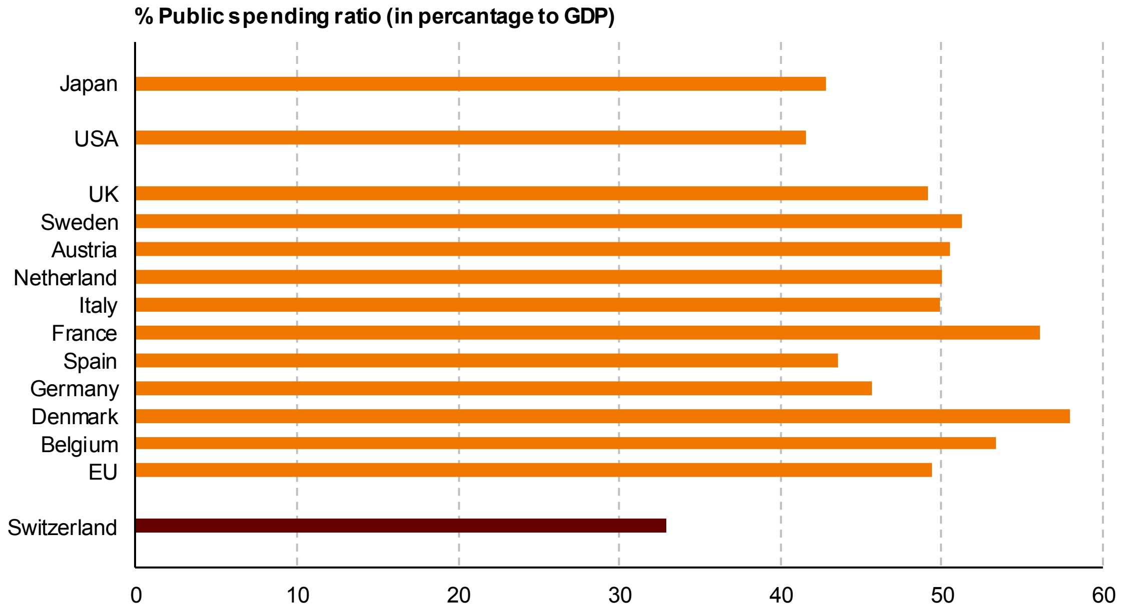
Fig. 27 > Public dept quota

Public debt of all administrative levels in percentage of the Swiss GDP between 1990 and 2012. Values for 2011 are partially estimated.



SFSO (2013h), FDF (2013c)

Fig. 28 > Public spending ratio (general government expenditure/GDP in current prices) in OECD countries in 2011



OECD (2010, 2012)

Industry Sector

Switzerland has virtually no mineral resources. Furthermore, the country historically has no heavy industry. The country's economy is dependent on foreign trade, representing a very high proportion of GDP. Fig. 29 shows development of trade balance in % of GDP (10.8% in 2011). The major trading partners are the industrialised countries which accounted for 73% of Swiss exports and 86% of its imports in 2011. Germany is by far the most important trading partner for Switzerland, accounting for CHF 58 billion imports and CHF 40 billion exports in 2011 (Fig. 30). Trade volumes with Italy and France are substantial, with slightly higher amounts of imports than exports. Trade with the United States is heavily biased towards exports.

Switzerland imports bulk raw materials and exports high-quality goods. In 2011, the value of one tonne of exported goods was up to three times higher than that of the same amount of imports. The relatively small size of its domestic market is another factor which has encouraged Swiss manufacturers to look to foreign markets to make investments in research and development worthwhile. Most important import and export goods are chemicals, machines and electronics, and instruments and watches (Fig. 31).

Fig. 29 > Trade balance in % of GDP

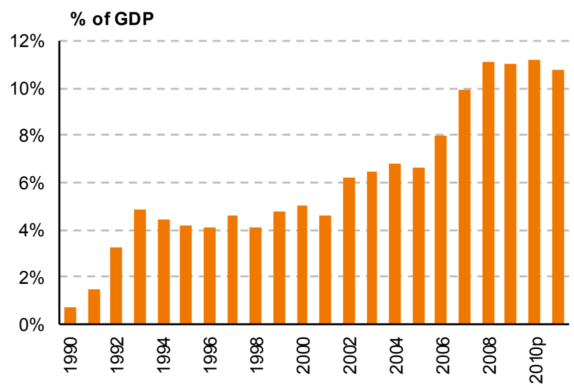
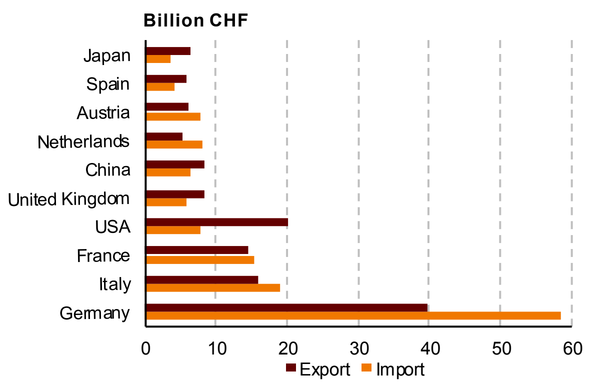


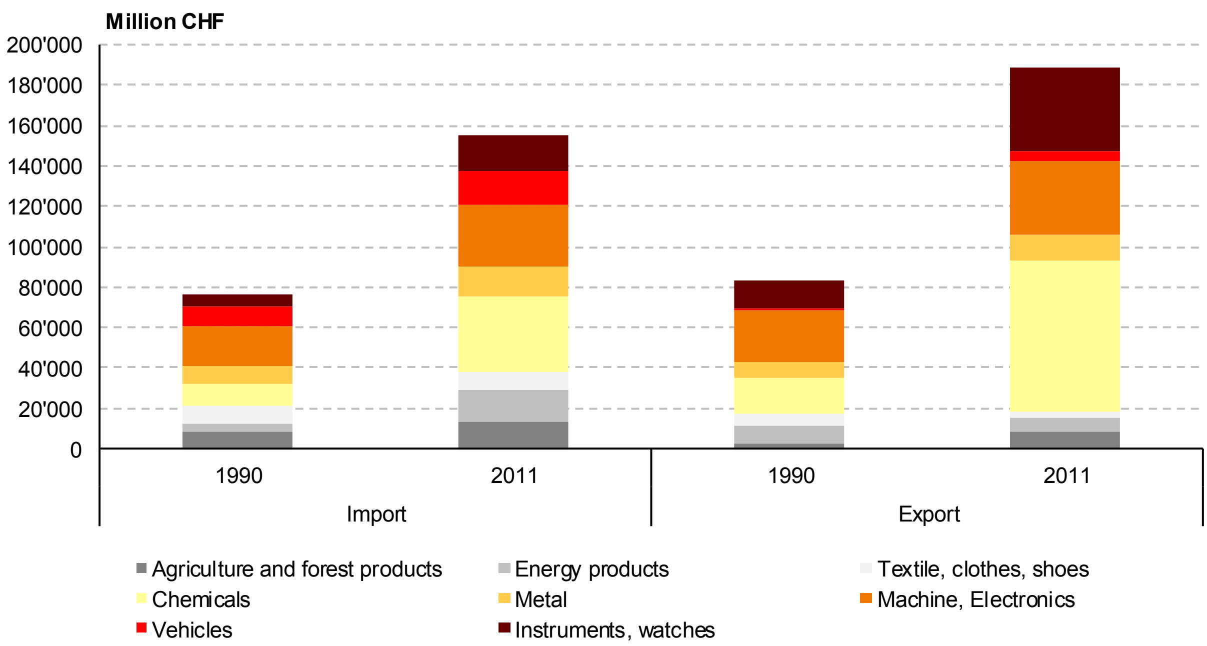
Fig. 30 > Foreign trade – important partners 2011



SFSO (2013g), FDF(2013a)

Fig. 31 > Foreign trade – most important goods in million CHF

Machines and chemicals remain the most important export and import goods in comparison with the year 1990. Export of instruments and watches increased since 1990.



FDF (2013b)

2.7 Energy

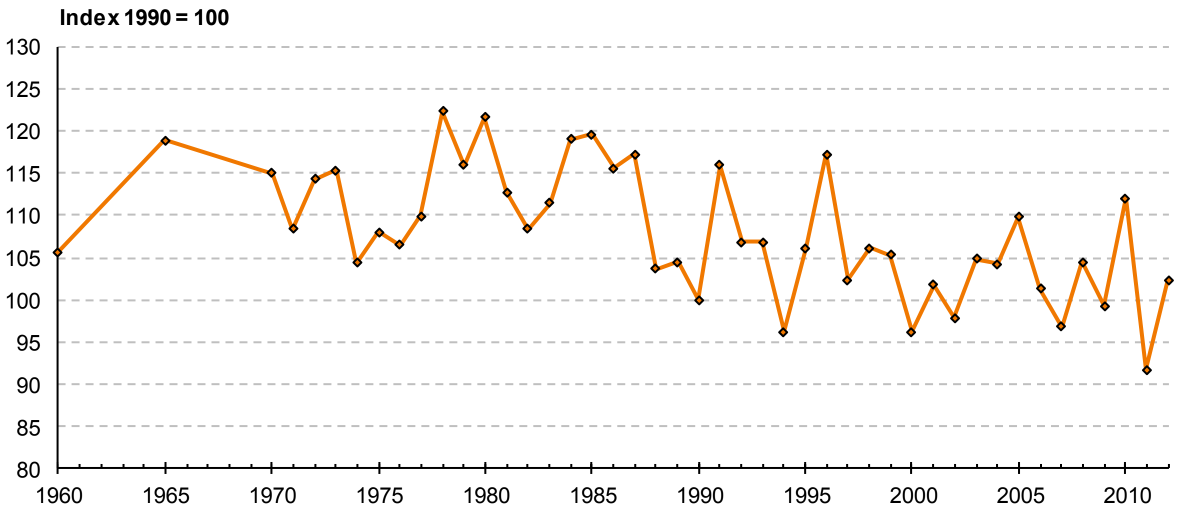
Having no oil or gas resources of its own, Switzerland depends on imported energy for 77.5% of its primary energy supplies, whereas 22.5% was sourced domestically (more than 12% hydropower). 53.2% of total final energy consumption was oil, 24.1% electricity and 12.9% gas. The remaining 9.7% comprised wood, waste, coal and several renewable forms of energy.

Energy supply and final energy consumption

In 2012, total energy supply (gross consumption) was 1'149'030 TJ. Compared to 2011, total final energy consumption increased by 3.7% and totalled at 882'280 TJ in 2012, below the record level of 2010 (910'100 TJ). Main drivers for this increase were colder weather conditions (more heating degree days, Fig. 32), positive economic development and further increase in population. Subsequently, the demand for heating extra-light oil increased by 7.4% and natural gas by 9.7%. Transport fuel demand increased as well, except the demand for petrol which decreased by 3.5% (increasing trend to substitute petrol with diesel). For the same period, the demand for electricity increased by 0.6%. Energy flows for Switzerland in 2012, expressed in terajoules, are shown schematically in Fig. 33. Fig. 34 and Fig. 35 illustrate the relation of energy supply and final energy consumption. Fig. 35 shows final energy consumption by energy source and by type of consumer.

Fig. 32 > Index of heating degree days between 1990 and 2012

Heating degree days (HDD) are a measure of weather conditions in winter[2].



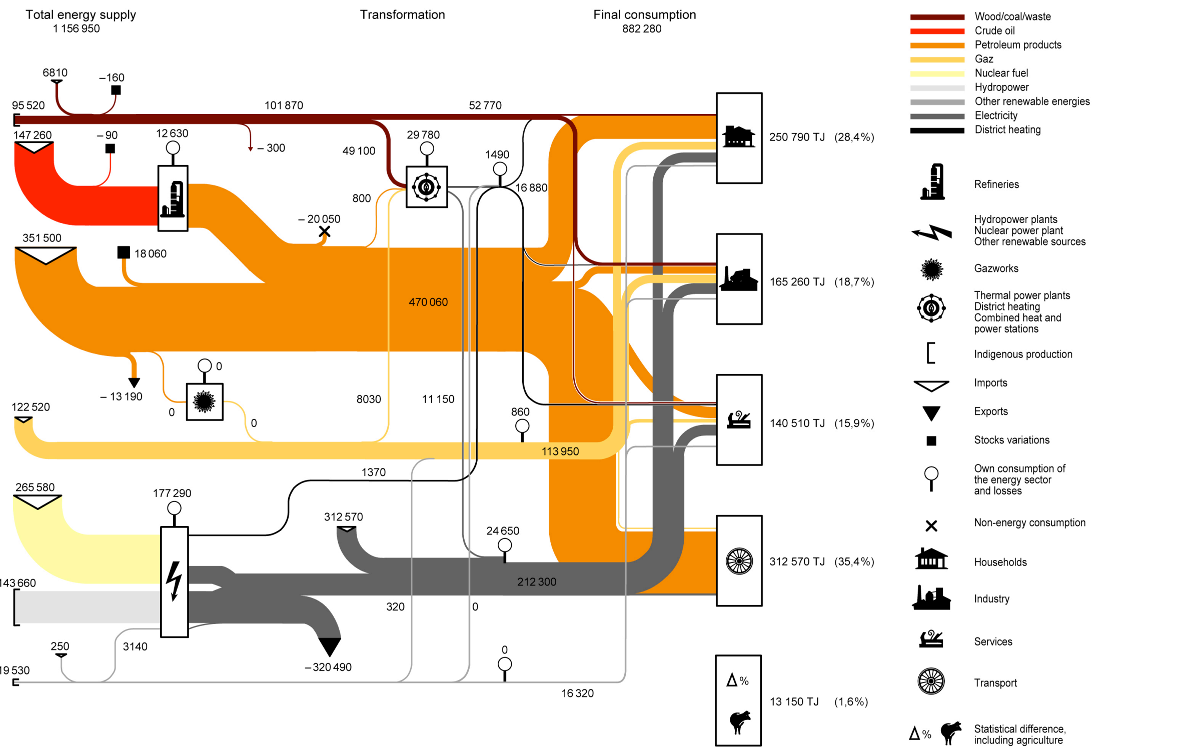
SFOE (2013a)

In 2012, 58.7% of electricity generation was from hydropower plants, 35.8% from the five domestic nuclear power plants and the remaining 4.2% from thermal power plants or other renewable sources, i.e. solar, wind and biogas. The contribution to electricity generation from solar and wind is still small (0.6%). However, supported by the Energy 2000 programme and since 2001 by SwissEnergy it increased markedly. Between 1990 and 2012 solar energy generation increased from 1.0 to 320 GWh and wind power from 0 to 88 GWh.

[2] HDD are calculated as the sum of the daily differences between the mean outdoor temperature (20°C) for outdoor temperatures below 12°C.

Fig. 33 > Energy flow diagram for Switzerland in TJ for 2012

Total energy supply in 2012 accounted for 1'149'030TJ. Because of transmission processes and losses the final energy consumption accounted for only 882'280 TJ.



SFOE (2013a)

Fig. 34 > Gross energy consumption in 2012

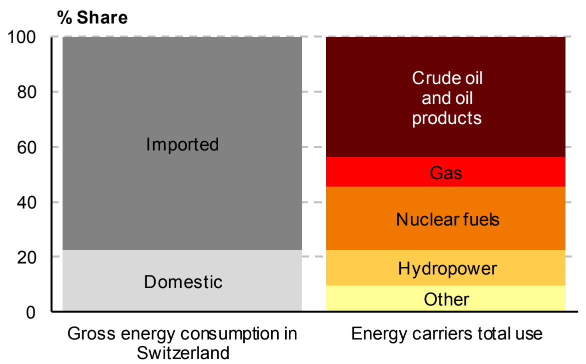
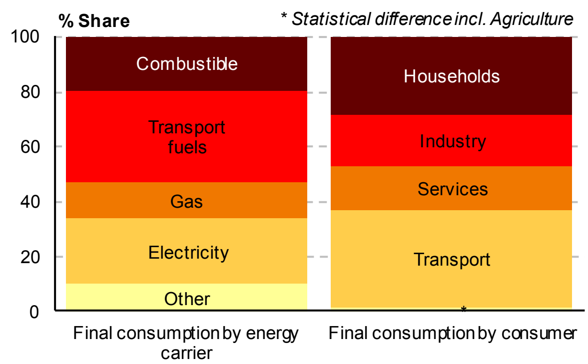


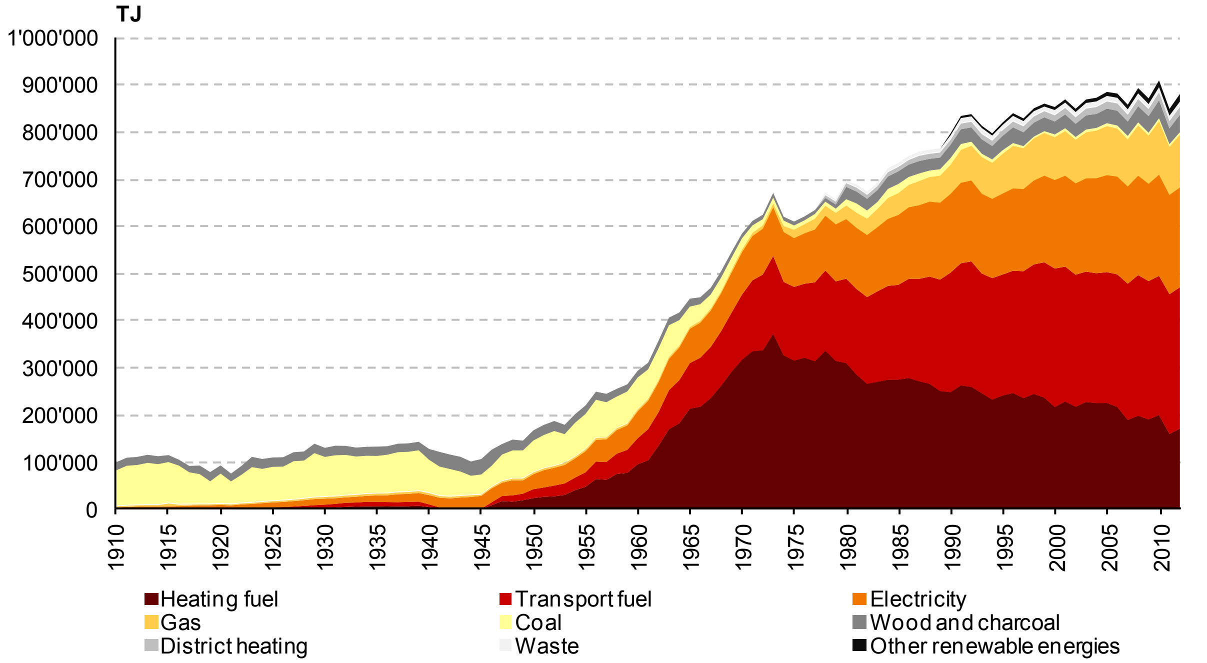
Fig. 35 > Final energy consumption in 2012



SFOE (2013a)

Energy consumption since the first half of the last century increased significantly, the largest increases seen in heating fuel, transport fuel and electricity (Fig. 36). Between 1990 and 2012, total final energy consumption increased by 11%. Gas had the highest increase percentage of nearly 80%. Energy end use by the transport, industry and services, and household sectors relative to 1990 is shown in Fig. 37. The transport sector shows an increase of 19% over the period 1990-2012, but with fluctuations that correlate with the economic development, e.g. periods of stagnation from 1993-1996 and from 2001-2003, and periods of growth (gross value-added) 1997-2000 and 2004-2008.

Fig. 36 > Final energy consumption between 1910 and 2012 according to energy source



SFOE (2013a)

The trend for energy consumption of households reflects the impact of climatic variations on demand for heating. There is a strong correlation between the energy demand of households and the number of heating degree days (Fig. 32). The extraordinary decrease from 2006 to 2007 and 2011 reflects the higher average temperature in 2007 and 2011, but also, as for 2007, the high prices for heating oil (gas oil). In the period 1990-2012, the number of buildings and apartments increased, as well as the average floor space per person. Both phenomena resulted in an increase in the total area heated. Over the same period, however, higher standards were specified for insulation and for combustion equipment efficiency for both new and renovated buildings, compensating for the energy consumption from the additional area heated. The increase of energy end use of households in 2010 is mainly due to colder weather conditions. Although the energy consumption of the industry and services sector is also influenced by the meteorological conditions (especially the services sector), the trend 1990-2012 primary reflects the development of economic activity in this period. The future of the Swiss energy supply is outlined in the Swiss energy outlook (also known as energy perspectives) discussed in section 5.1.1. Energy productivity has remained constant in recent decades; in other words, the index of energy consumption has increased broadly in line with GDP. However, since 2005, real GDP and final energy consumption started to diverge (Fig. 38). The reasons for this development are, on the one hand, an increase in energy efficiency leading to a lower energy input per unit of GDP. On the other hand, since the early 90ies, the production of many energy intensive goods was sourced out to other countries. Although these goods are further consumed in the country, the energy required for their production is no more accounted for in the national total. The ratio of CO_2 emissions to real GDP is discussed in section 2.13.

Fig. 37 > Energy end use by sectors

Indices of energy end use by the transport, industry and services, and household sectors between 1990 and 2012. (1990=100)

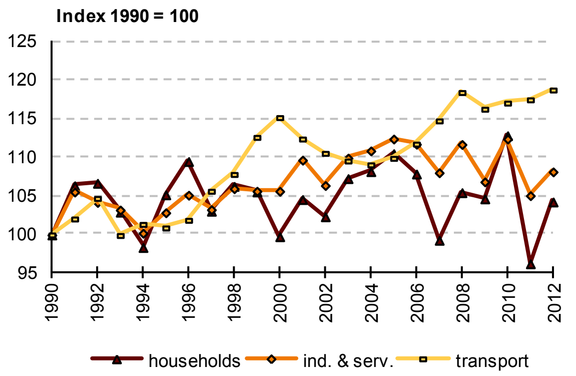
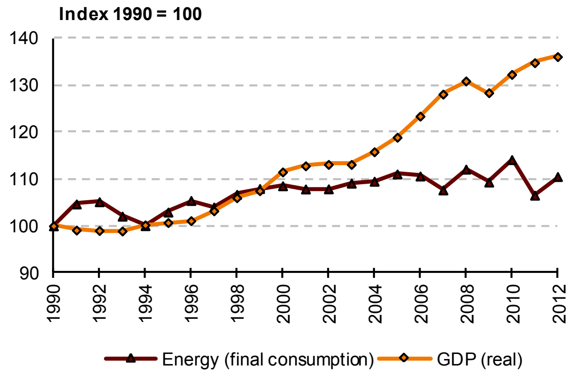


Fig. 38 > Energy end use and GDP

Energy end use and real GDP were increasing nearly synchronously until 2005, when they started to diverge. (1990=100)

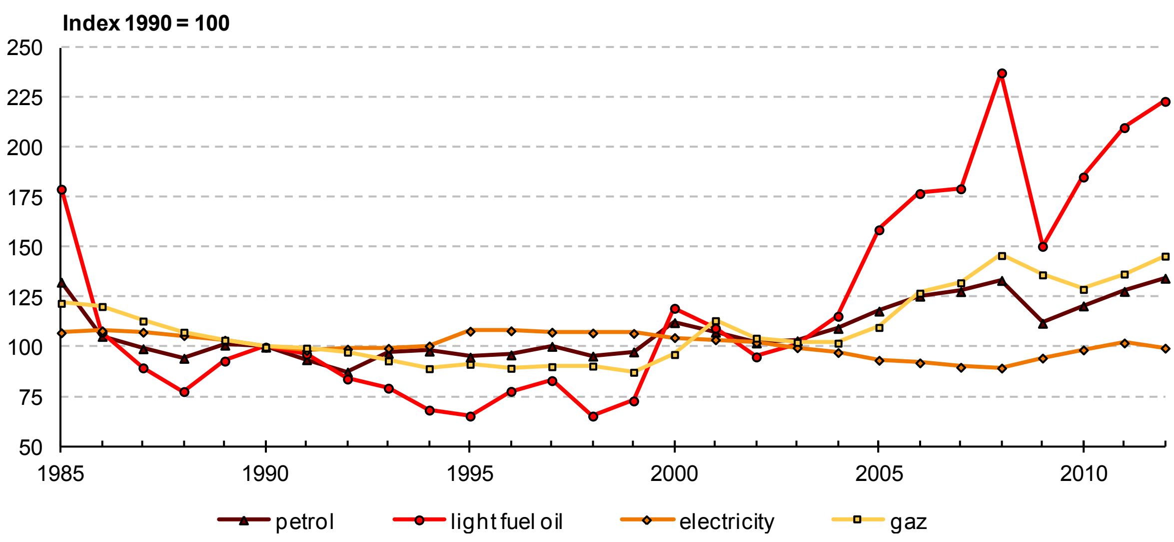


SFOE (2013a)

Energy prices

After rather low energy prices in the early 70s, real prices of energy sources increased between 1978 and 1985. Prices for heating fuel then reached a historic low in 1998. However, from the end of the 1990s, real energy prices have risen again, with a stronger increase since 2004 and another very strong increase between 2007 and 2008 for heating fuel prices. Electricity is an exception, its real prices tended to decrease since the mid-1990s (Fig. 39).

Fig. 39 > Relative development of real energy prices (retail and household level)



SFOE (2013a)

Energy prices are composed of a basic price, energy taxes and value-added tax (VAT). According to a study of the International Energy Agency in 2012 (IEA 2012)[3], Switzerland has lower real energy prices[4]

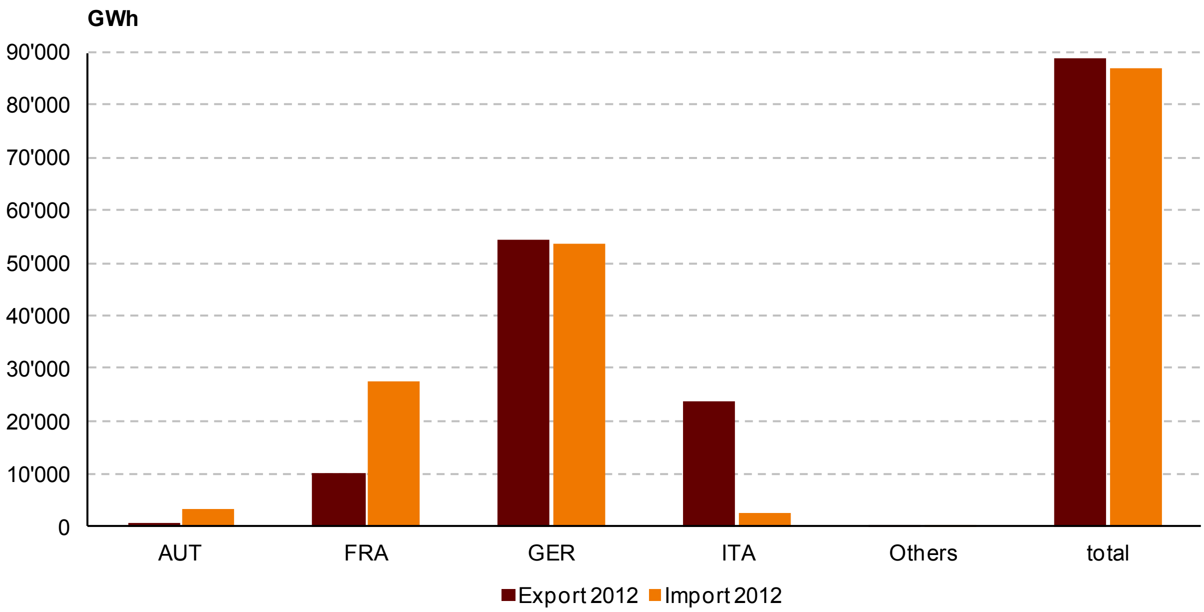
[3] Numbers refer to the 4th quarter of 2012.
[4] Including oil products, coal, natural gas and electricity.

for households and industry than the European OECD average. With or without energy taxes, petrol prices in Switzerland are relatively low, unlike diesel prices, which are higher. The price for unleaded gasoline comprises 47.8% taxes, whereas automotive diesel comprises 47.7%. Furthermore, among most European OECD countries, Switzerland has one of the lowest prices for light fuel oil comprising a tax rate of only 17%. Total taxes on electricity for households account for around 9.8% of the total price. Regarding prices for natural gas, taxes account for around 14.2% for households of the total price and 10.1% for industries.

Electricity trade

Electricity is traded across Switzerland's borders on a fairly large scale. Amongst the factors affecting the volume traded are hydrological and climatic conditions. Exchanges take place with several western and central European countries. Fig. 40 shows Switzerland's total physical electricity exchanges and its individual exchanges with neighbouring countries for 2012. In 2012, total Swiss electricity exports exceeded imports by only 2'200 GWh which corresponds to a slight increase since 2004.

Fig. 40 > Electricity trade



SFOE (2013b)

2.8 Transport

2.8.1 Passenger transport

Modal split

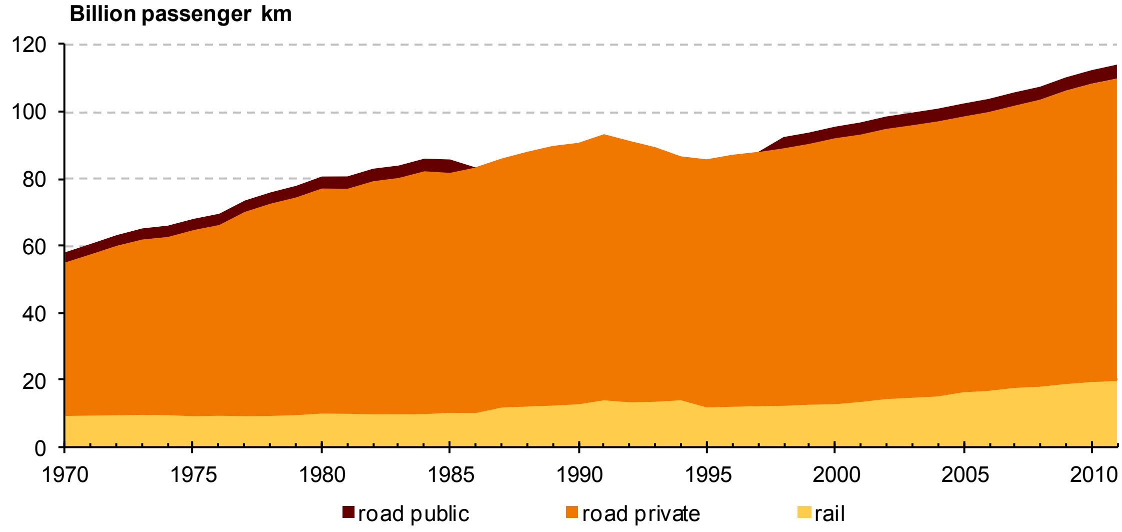
The average daily distance travelled by individuals accounted for 36.7 km per person in 2010, which corresponds to increases of around 17% and 4% compared to 1994 and of 2005, respectively. While daily distances travelled by car remained stable between 2000 and 2005, the trend goes since then towards an increase. The distances travelled by train increased by almost 27% between 2005 and 2010. Leisure traffic gained importance during the last decades and distances travelled for leisure purposes increased since 1984. The share of daily kilometres travelled for leisure purposes accounted for 40% in 2010 (flight travel not included). The share of daily distances related to work and formation accounted for 24% in 1984 and reached almost 30% in 2010 (SFSO and ARE 2012).

This development is also in line with the total annual passenger kilometres. Between 1980 and 2011, total passenger kilometres increased by nearly 35% in private transport (road traffic) and by more than 70% in public transport (road and rail traffic). In 2011, 21% of total passenger kilometres were travelled by public transport means. Fig. 41 shows the demand for passenger transport by road and rail between 1960 and 2011. Compared with other European countries, modal split of public passenger transport is rather high. The share of public transport in percentage of total passenger kilometres accounted for around 16% in EU 27 in 2010 (Eurostat 2012).

Swiss railways play an important role in the transport market, especially in passenger and transalpine freight transport. In 2010, rail network accounted for 6'163 km (SFSO 2013i). To cover increasing mobility demand by rail, the railway project RAIL 2000 was implemented to enhance existent rail infrastructure. Although the rail length did no increase significantly during the last years, the rail capacity and reduction of travel time was improved due the implementation of the first stage of the project RAIL 2000 (SECO 2009). The implementation of the Future Development of Railway Infrastructure project decided in 2009 aims in priority at increasing further capacity and performance, and no longer at reducing journey times (FOT 2012).
Car ownership increased from 509'000 vehicles in 1960 to 4.2 million vehicles in 2012. Today, one inhabitant out of two owns one car in Switzerland. Specific fuel consumption of passenger cars sold in 2012 accounted for 6.21 litres per 100 km which corresponds to a decrease of 2.8% from 2012 Corresponding CO_2 emissions are on average 151 g/km in 2012. The weight of new cars continuously increases since 1990, with a two-year peak of this trend in 2008 and 2009 (AutoSuisse 2012).

Fig. 41 > Passenger transport

Passenger transport by road and rail between 1960 and 2011 in passenger kilometres. Road public data from 1986 to 1997 are missing.



SFSO (2013i)

Aviation

The reduction of negative climate impacts from aviation requires an internationally coordinated multi-step approach. Aircraft transport energy efficiency for scheduled and charter traffic originating from Switzerland (Fig. 42) has improved considerably since 1990. The strong efficiency increase between 1995 and 1997 can be explained by the introduction of new aircraft technology. The efficiency improvement after 2002 is a consequence of increased load factors, by using less but larger aircraft, weight saving measures and through operational optimisations. However, the efficiency improvements have been overcompensated by an even larger increase in passenger kilometres by more than a factor of two compared to 1990, so that total aircraft CO_2 emissions are 45% higher than 1990 (Fig. 43). This has happened despite a sharp globally induced increase in the kerosene fuel price, starting in 2003. Aircraft movements have been nearly constant during the same time period. The aviation sector illustrates the paradox effect of increased absolute CO_2 emissions, despite increased transport efficiency per passenger and distance. The underlying cause for the increase is the tendency towards longer travel distances and/or more frequent travel.

In Switzerland, aviation fuels for domestic flights are taxed. Fuel consumption from domestic flights has fallen by around 50% since 1990 (Fig. 43). The largest contribution to the reduction can be attributed to the improved railway system.

Fig. 42 > Passenger kilometres per unit of fuel

Total of all km travelled by passengers for all flights departing from Switzerland to a destination abroad, divided by the total fuel used.

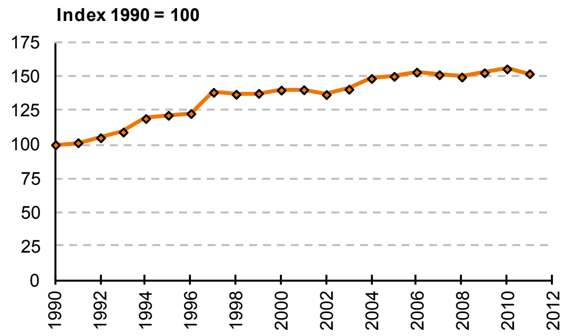
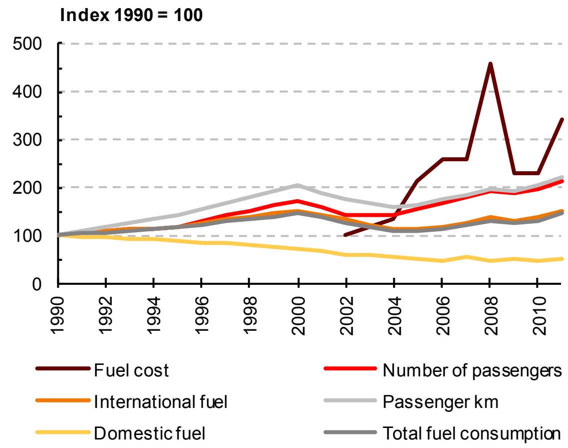


Fig. 43 > Aviation parameters since 1990

Evolution of parameters. Data before 2000 are given at a five-year time step.



Data compiled by FOCA based on FOEN (2013), SFOE (2012) and IATA (2013)

2.8.2 Freight transport

As in most European countries, freight transport has been increasing (Fig. 44) and rail has been losing market shares to road. However, the dwindling trend in rail transport percentage has been stalled at 40% since the early 1990s, mostly due to the restrictions imposed on road freight transport in Switzerland by federal legislation (Alpeninitiative) and bilateral agreements with the EU (Fig. 45). Swiss rail transport has traditionally had (and still has) a particularly strong position compared to that in neighbouring alpine countries. Comparing transalpine freight transport in Switzerland (CH) with France (FRA) and Austria (AUT), it appears that freight transport by road is relatively low in Switzerland but much higher (Fig. 46, Fig. 47) by rail. In 2011, rail and road freight transport through the Alps reached a record of 40.1 million tonnes, twice more than in 1981, one year after the Gotthard tunnel was opened; 64% of the net tonnes transported was carried by rail. As for domestic passenger transport, freight transport by air is negligible in comparison with road and rail transport.

Fig. 44 > Freight transport since 1980

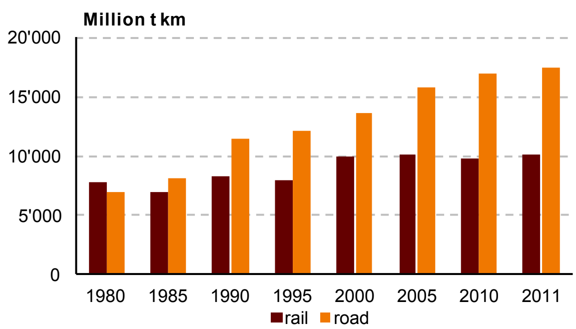
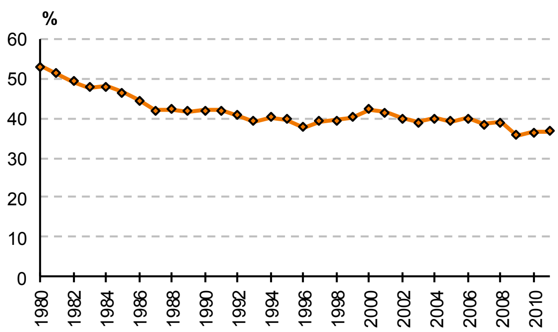


Fig. 45 > Modal split in freight transport



SFSO (2013j, 2013k)

Fig. 46 > Transalpine freight road traffic

Transalpine freight transport by road (including inland, import, export and transit traffic) for CH, AUT and FRA between 1983 and 2011.

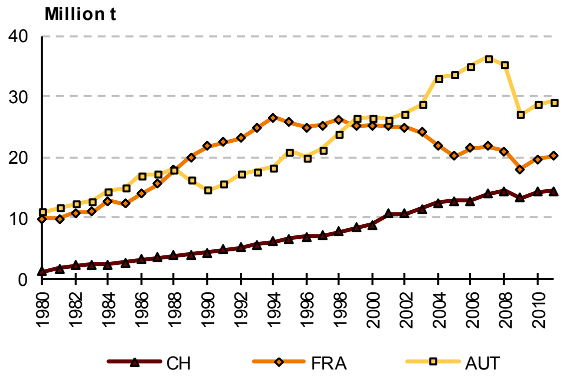
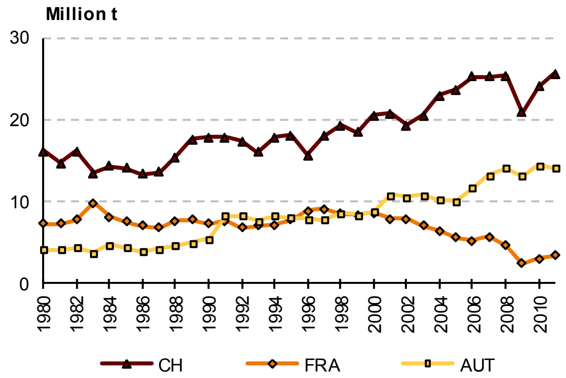


Fig. 47 > Transalpine freight rail traffic

Transalpine freight transport by rail (including inland, import, export and transit traffic) for CH, AUT and FRA between 1983 and 2011.



SFSO (2013k)

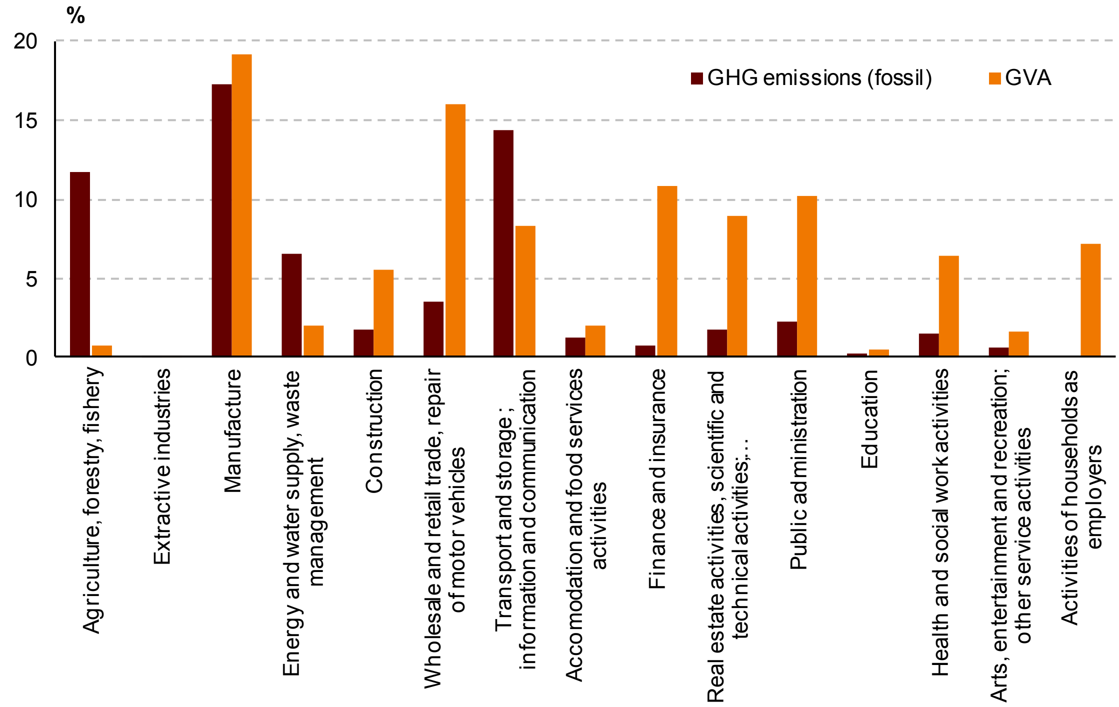
2.9 Industry

Switzerland's economy is largely dependent on the tertiary sector (73%), followed by the secondary sector (26%) and the primary sector (1%). The lion's share of value is created by the financial and insurance sector, trade sector and the manufacture industries (Fig. 48). However, 68% of GHG emissions from the economy were derived from the manufacturing industry, transport and agriculture in 2011 as shown inFig. 48. While emissions from stationary sources decreased in all three sectors between 1990 and 2008, emissions from biomass combustion increased by 58% (Fig. 49). The emissions from transport remained more or less constant in the agriculture/forestry and industry sectors, but increased in the services sector and substantially in private households.

Structural change in Switzerland is continuing. Mainly branches from the secondary sector such as paper and printing industry and textile, apparel and leather industries, have seen a decrease in employees due to relocation abroad. However, the secondary sector in Switzerland (excl. construction sector) has increased its production by 50% between 1990 and 2011 (SFSO 2013l), despite a short drop during the recessionary years 2002 and 2003, as well as at the end of 2008 due to the financial crisis. Simultaneously, the greenhouse gas emissions have slightly decreased as a result of an increase in energy efficiency (see Fig. 49). The emissions of the service sector increased by 11% in the period 1990-2008, whereas its gross values increased by 30%. This shows a relative decoupling of economic growth from emissions.

Fig. 48 > GHG emissions and gross value added in 2011 for various economic activities

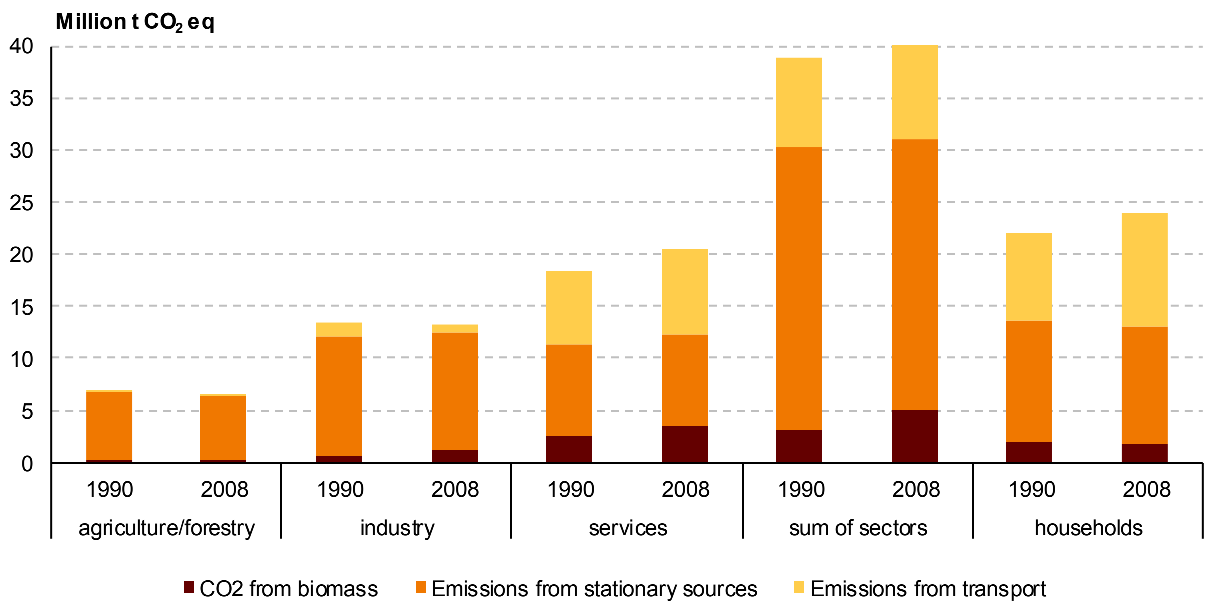
100% correspond to the Swiss national totals of gross value added and greenhouse gas emissions (without LULUCF). 64% of GHG emissions come from the economic activities. The classification of economic activities are based on NOGA 2008 (SFSO 2008).



SFSO (2013d)

Fig. 49 > GHG emissions of economic sectors and private households in 1990 and 2008

Emissions in million tonnes CO_2 equivalent.



SFSO (2013m)

2.10 Agriculture

According to the Swiss Federal Statistical Office (SFSO 2013d), the utilised agricultural area amounted to 1'051'900 ha, or 27% of Switzerland's surface. Another 12% are alpine pastures (used for cultivation and animal husbandry). Settlement and infrastructure areas spread at the expense of alpine farmland and agriculture areas (Fig. 16). Since 1990 the loss of utilised agricultural area is rather small (-1.4%). In 1900, 31% of the Swiss labour worked in the primary sector. In 2011, the share is of 3.5% (SFSO 2013f).

Agriculture in Switzerland is responsible for roughly 10% of total GHG emissions, the most important source being methane from digestion and rumination of animals (mostly dairy cows). The application of nitrogenous fertilizer is a further source of GHG emissions (N_2O). However, GHG emissions from agriculture decreased slightly since 1990 mainly due to the decrease in cattle stock, and despite the fact that CH_4 emissions from enteric fermentation per dairy cow increases.

Since the 1950s, Swiss agriculture has undergone profound structural changes, with the number of farms falling by 1–2% annually on average (SFSO 2013d). Between 1990 and 2011 more than 1'800 farms closed down per year, which corresponds to more than 5 farms per day. On the other hand, the number of farms with areas larger than 20 ha has increased of 46% over the same period. Since the early 1990s, and increasingly since a new agricultural article was stipulated in the federal constitution 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 now met by almost all farms and the share of organic farms reaches about 10%. However, in 2011 the number of organic farms has been increasing for the first time since 2005.

Tab. 4 > Livestock population

	1990	2000	2011	2012 (provisional)
Cattle	1'855'200	1'588'005	1'577'407	1'570'344
Whereof cows	795'100	714'292	699'947	707'683
Horses	51'223	66'173	65'800	56'676
Pigs	1'787'000	1'498'223	1'578'687	1'547'476
Sheep	395'200	420'740	424'018	414'079
Goat	68'300	62'499	83'045	87'304
Poultry	5'938'229	6'982'983	9'477'676	9'883'436

SFSO (2013d)

2.11 Forestry

According to the fourth National Forest Inventory (NFI; Abegg et al. 2012) 32% of Switzerland's area is covered by forests. This is matched or even exceeded by some of our neighbouring countries: Austria (47%), Italy (34%), and Germany (32%, Trading economics 2013). Forest cover is not evenly distributed across Switzerland. More than 50% of forests are located above 1000m. The Alps have therefore the highest forest cover, with forest areas still expanding. Forest exploitation is concentrated in the central lowlands (40% of total wood harvest), which are more easily accessible than in alpine regions and therefore less cost intensive in terms of harvest.

29% of Swiss woodland is privately owned, whereas 71% is public property. The majority of the state owned woodland belongs to bourgeois communities (42%) and political communities (49%). Only 6% are owned by the Swiss Confederation.

Since the third National Forest Inventory surveyed between 2004 and 2006, the forested area has grown by 0.5% per year. The differences between the regions are striking: the greatest increase (around 2.3% per year) was recorded in the Alps as a consequence of natural regeneration of abandoned land previously used by agriculture, whereas the forested area in the central lowlands and the Jura remained unchanged.

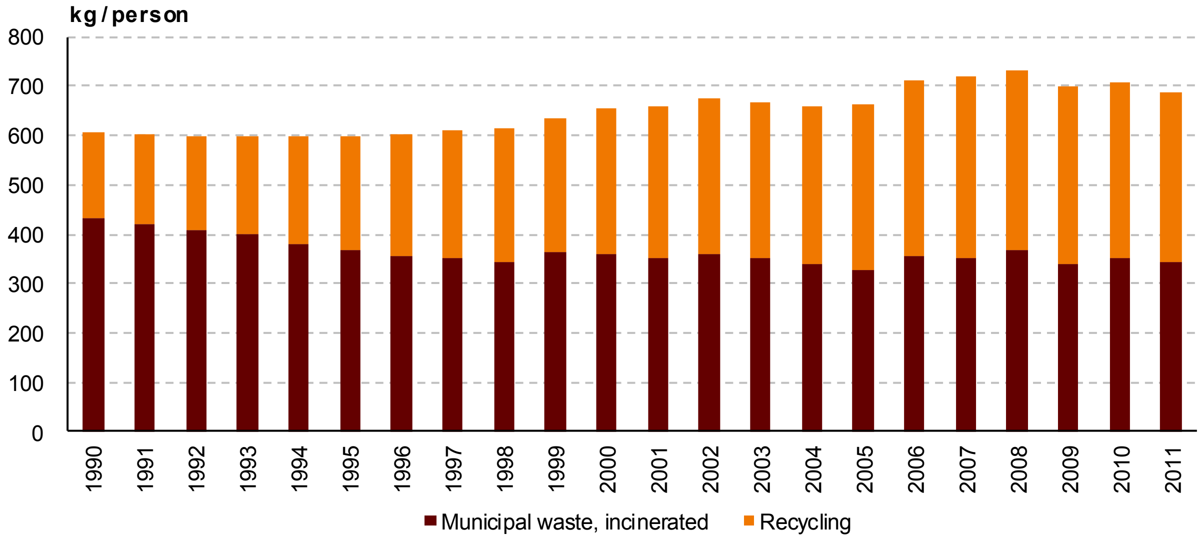
According to the fourth National Forest Inventory (2009-2011), Switzerland's forests account for 416 million m^3 of wood. Of this, 30% are deciduous trees such as beech (18%) and 70% are coniferous trees such as spruce (47%) and fir (15%). Standing volume of living trees is increasing since 30 years. In the last 5 years, standing volume in Swiss forests increased by 2% on average to 357 m^3/ha. The highest increase is observed in alpine forests which are difficult to access and exploit. This increase is mainly due to a slight decrease in harvest and also a lower share of mortality. Annual harvest and mortality decreased from 7.7 (NFI2-3, Brassel and Brändli 1999, Brändli 2010) to 7.2 m^3/ha (NFI3-4, Brändli 2010, Abegg et al. 2012). In the previous NFI period, the storm Lothar was responsible for amounts of salvage logging and high mortality rates within Swiss forests. The average annual growth rate amounts to 8.6 m^3/ha.

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 2000, group certifications enabled larger areas joining the scheme, so that the area of certified forest increased by 100'000 ha per year. In 2005, this trend began to slab. At the moment, 56% of the Swiss forest area and 67% of the harvested roundwood are certified under either or both of the two certifying systems.

2.12 Waste

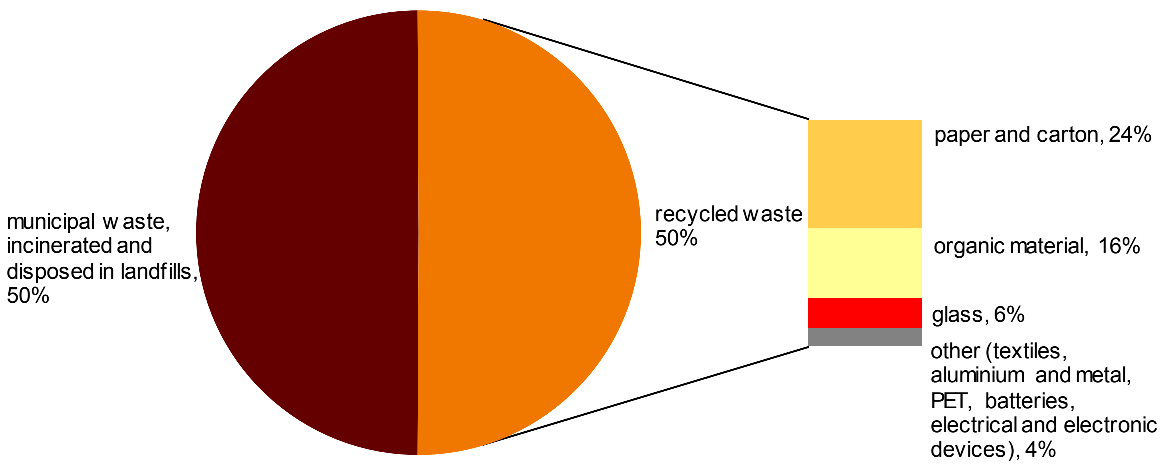
Total municipal waste generated in Switzerland amounted to 5.48 million tonnes in 2011. Thereof, 2.73 million tonnes (or 343 kg per person) were incinerated (0% deposited) and 2.74 million tonnes (or 345 kg per person) were recycled (Fig. 50). Switzerland imports waste to operate waste incineration plants at full capacity for power and heat generation. Recycling systems are highly developed in Switzerland. Solid municipal waste collected for recycling more than doubled since 1990 (including compost, paper and cardboard, glass, tins, tinfoil, aluminium, PET, textiles, electrical and electronical devices), and makes up 50% of the municipal solid waste (Fig. 51). Separate collection of PET (relevant to CO_2 as comprising petrochemical material) has increased significantly in recent years, with 81% of the total PET being recycled in 2011. Recycling rates of glass, aluminium cans, paper and cardboard reach over 90% of the total consumed amounts. In addition to municipal waste, around 12 million tonnes of construction waste are generated each year in Switzerland (80% recycled) and 1.9 million tonnes of waste are classified as hazardous waste.

Fig. 50 > Municipal waste incinerated or disposed and recycled between 1990 and 2011 (without importations)



SFSO (2013m)

Fig. 51 > Share of recycled municipal waste in 2011



FOEN (2012b)

2.13 Emission trends since 1900

In most sectors, the quality of data on GHG emissions is only satisfactory from about 1950 onwards, when emissions started to soar, except for energy sector where energy balance is available by 1910 onwards. Consequently, emission data from the period 1900 to 1950 might be rough estimates, based on a number of assumptions. Fig. 52 shows historical GHG emissions from 1900 to 2011. The total emissions of greenhouse gases more than doubled between 1900 and 1960, and quadrupled between 1900 and 2010. However, total GHG emissions appear to have stabilised since 1980.

The strong increase in CO_2 emissions between 1950 and 1980 arose through the dual effect of the explosion in road traffic and strong economic growth. Over this 30 year period, the CO_2 emissions quadrupled.

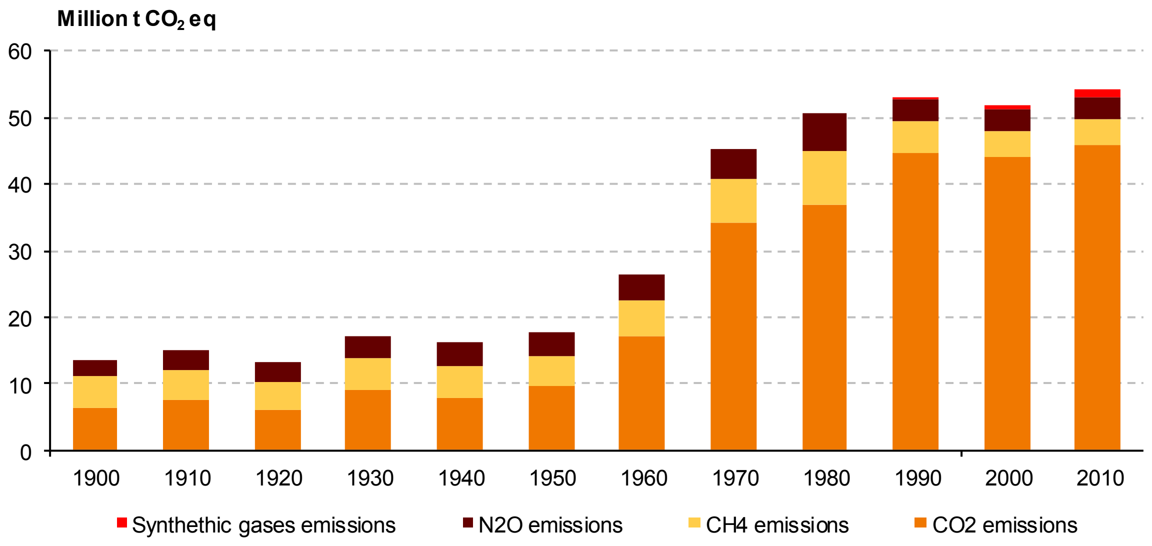
While transport now accounts for almost one third of Switzerland's CO_2 emissions, in 1900 it was merely responsible for 9 percent. As well, demographic growth and the requirements with regard to comfort have led to an increase in the number of households and therefore, to an important increase in heating fuel consumption. In Switzerland, there is also a strong correlation between CO_2 emissions and winter climatic conditions (more energy required for heating buildings during colder winter).

Total methane emissions increased steadily from 1900, peaked around 1980 and have since decreased. In 1990, the largest source of methane emissions was the agricultural sector (71%, mainly cattle), followed by the waste sector (16%, mainly landfills). Methane emissions have decreased by 20% between 1990 and 2010 due to decreasing number of livestock and improved feed quality, technical improvements to limit fugitive emissions, and a ban on land filling. Emissions of nitrous oxide were already substantial in 1900 (over 2.6 million t CO2 eq) and increased steadily until the 1980s. Since then, N_2O emissions have strongly decreased. The main source is agriculture, and more specifically the use of nitrate fertilizer for agricultural intensification. (81% in 1990, 80% in 2010). The synthetic gases HFC, PFC and SF_6, which did not exist in 1950, are used to replace CFCs and HCFCs – synthetic gases depleting the ozone layer. Their emissions are thus continuously increasing.

Gross CO_2 emissions per capita and per unit of real GDP are shown in Fig. 53 and Fig. 54. CO_2 emissions per capita increased significantly after World War II due to increased economic growth. Both indicators have decreased over the last decades. The reasons are an increase in energy efficiency and the outsourcing of the production of many energy intensive goods.

Fig. 52 > Evolution of CO_2, CH_4 and N_2O emissions

Emissions excl. LULUCF



FOEN (2012a)

Fig. 53 > CO_2 emissions per capita

Population values from SFSO (2013a) are included from 1970 onwards. Before, historical data from SFSO (1981) are used.

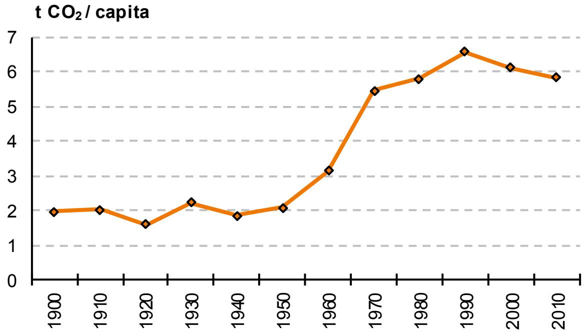
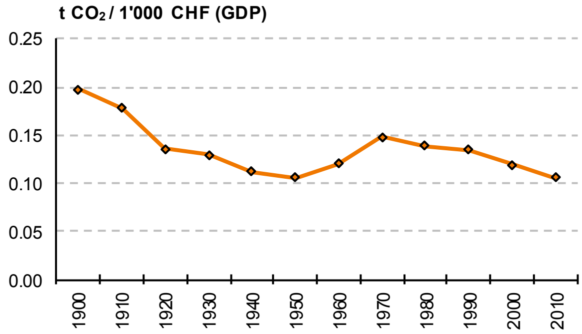


Fig. 54 > CO_2 emissions per GDP

GDP values from SFOE (2012) are included from 1970 onwards. Before, historical data from SFSO (2009) are used.



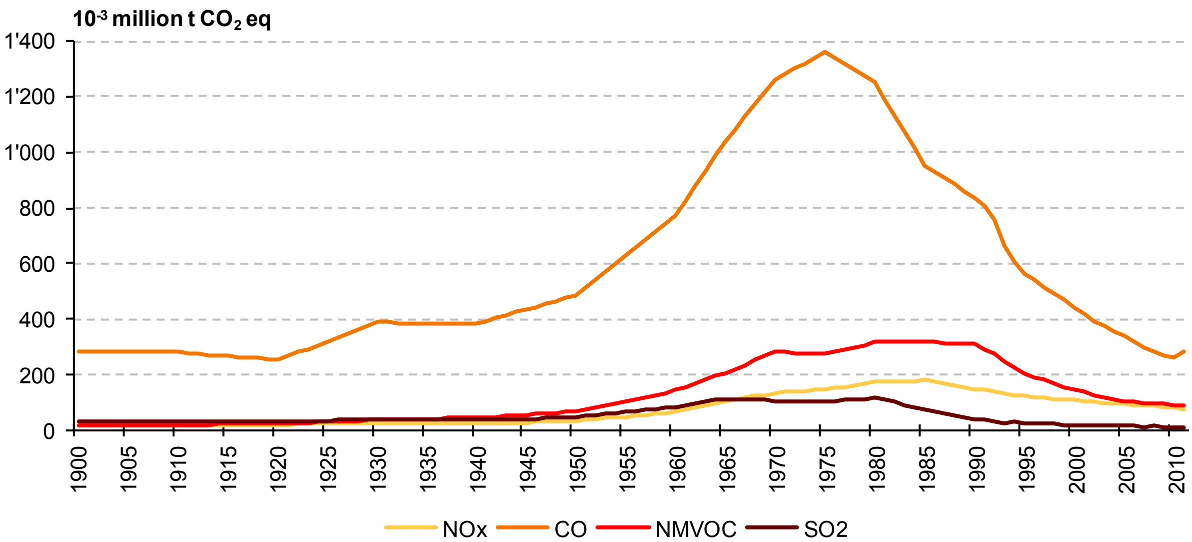
FOEN (2012a), SFSO (1981,2009, 2013a), SFOE (2012)

Indirect Greenhouse Gases and SO_2

Fig. 55 shows the development of the precursor gases NO_x, NMVOCs, CO, SO_2 between 1900 and 2011. Emissions of these four gases increased sharply up to the 1980s (respectively 1975 for CO) and significantly declined over the latest two decades. The reduction in CO emissions starting in 1975 is mainly due to new emission regulations in the traffic sector decreed in 1975. A strict air pollution control policy and the implementation of a large number of emission reduction measures led to a decrease of 48% to 75% in emissions of air pollutants over the period 1990-2011. Firstly, exhaust emissions from road vehicles were abated due to mandatory equipment of new passenger cars with catalyst converters and the introduction of new emission standards for road vehicles. Secondly, higher standards were specified for building insulation and for combustion equipment efficiency. Thirdly, solvents and sulphured fuels have been taxed, and voluntary agreements with industry sectors were concluded. The trend of SO_2 emissions is influenced by the legal restriction of the sulphur content in liquid fuels and the amount of coal consumption.

Fig. 55 > Emissions of the precursor gases CO, NMVOCs, NO_x and SO_2 between 1900 and 2011

Emissions excl. LULUCF. Data prior to 1990 have different system boundaries, data after 1990 from CRF.



FOEN (2013)

The reporting under the UNFCCC (e.g. national GHG inventory) does not include "grey emissions" (emissions derived from the production of goods and energy as well as from the disposal of products abroad). Switzerland mainly depends on imported energy (section 2.7) and on the tertiary sector (section 2.6). Traditionally, heavy industry is virtually absent in Switzerland due to a lack of local mineral resources, which implies that substantial grey emissions are associated with Swiss imports. Estimates of grey emissions suggest that CO_2 equivalents per capita would be around two-thirds to two times higher, if grey emissions would be included (FOEN 2011). Estimates for historic "grey emissions" are not provided.

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3 GHG inventory information

3.1 Summary tables

The summary tables from the latest greenhouse gas inventory submission (September 2013) are available in Annex 2 "Biennial Report", Tables 1 s1-3. Note that the information and tables related to the greenhouse gas inventory presented in chapter 3 of NC6 are consistent with the submission of the National Inventory Report of April 2013 (FOEN 2013).

3.2 Trends in greenhouse gas emissions and removals (1990-2011)

3.2.1 Aggregated greenhouse gas emissions 2011

According to the submission of April 2013, Switzerland emitted 50.010 million t CO_2 eq (excluding LULUCF and international bunkers), or 6.32 t CO_2 eq per capita in 2011. With a share of 84% (Fig. 56), the largest contributor gas was CO_2, 41.856 million t (5.29 tonnes per capita), and the most important source was the energy sector with 39.864 million t CO_2 eq. Tab. 5 shows emissions by gas and sector in Switzerland for the year 2011. A breakdown of Switzerland's total emissions by gas (excluding LULUCF) is given in Fig. 56.

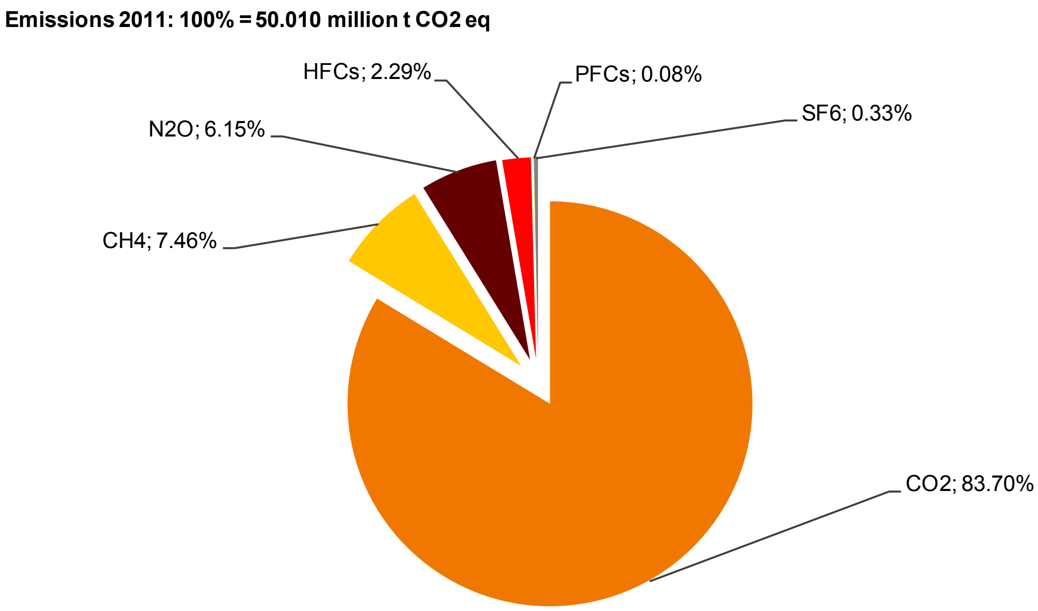
Fuel combustion within the energy sector was by far the largest source of emissions of CO_2 in 2011, accounting for 94% of total CO_2 emissions. Emissions of CH_4 and N_2O originated mainly from agriculture, and the F-gas emissions stemmed by definition from industrial processes.

Tab. 5 > Switzerland's GHG emissions in CO_2 equivalent (million tonnes) by gas and sector in 2011

Emissions 2011		CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total	Share
		CO_2 equivalent (million tonnes)							
1	All Energy	39.344	0.255	0.265				39.864	79.7%
2	Industrial Processes	2.332	0.009	0.054	1.144	0.039	0.164	3.742	7.5%
3	Solvent Use	0.155	0	0.044				0.199	0.4%
4	Agriculture	0	3.159	2.445				5.604	11.2%
6	Waste	0.012	0.309	0.265				0.587	1.2%
7	Other	0.013	0.001	0.001				0.014	0.0%
Total (excluding LULUCF)		41.856	3.732	3.074	1.144	0.039	0.164	50.010	100.0%
5	LULUCF	-3.417	0.001	0.004				-3.411	-6.8%
Total (including LULUCF)		38.439	3.734	3.078	1.144	0.039	0.164	46.599	93.2%
International Aviation Bunkers		4.689	0.001	0.0462				*4.737*	
International Marine Bunkers		0.031	$5.3*10^{-6}$	$303*10^{-6}$				*0.031*	

FOEN (2013)

Fig. 56 > Contribution of individual gases to Switzerland's GHG emissions (excluding LULUCF) in 2011



FOEN (2013)

3.2.2 Emission trends by gas

An overview of the emissions by gas and their contribution towards total greenhouse gas emissions is summarized in Tab. 6 for selected years. Emission trends by gas for the period 1990–2011 are given in Tab. 7.

Tab. 6 > GHG emissions (excluding LULUCF) by gas for selected years

Greenhouse gas emissions	1990		1995		2000		2005	
(excluding LULUCF)	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%
CO_2	44.597	84.2%	43.584	84.7%	43.921	84.9%	46.259	85.3%
CH_4	4.674	8.8%	4.267	8.3%	3.914	7.6%	3.770	7.0%
N_2O	3.458	6.5%	3.323	6.5%	3.183	6.2%	3.070	5.7%
HFCs	0	0.0%	0.179	0.3%	0.491	0.9%	0.882	1.6%
PFCs	0.100	0.2%	0.015	0.0%	0.069	0.1%	0.033	0.1%
SF_6	0.144	0.3%	0.098	0.2%	0.158	0.3%	0.213	0.4%
Total (excluding LULUCF)	**52.973**	**100%**	**51.466**	**100%**	**51.737**	**100%**	**54.227**	**100%**

Greenhouse gas emissions	2008		2009		2010		2011	
(excluding LULUCF)	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%
CO_2	45.448	84.7%	44.239	84.5%	45.903	84.9%	41.856	83.7%
CH_4	3.843	7.2%	3.786	7.2%	3.766	7.0%	3.732	7.5%
N_2O	3.110	5.8%	3.064	5.9%	3.133	5.8%	3.074	6.1%
HFCs	0.999	1.9%	1.039	2.0%	1.094	2.0%	1.144	2.3%
PFCs	0.039	0.1%	0.035	0.1%	0.037	0.1%	0.039	0.1%
SF_6	0.245	0.5%	0.187	0.4%	0.155	0.3%	0.164	0.3%
Total (excluding LULUCF)	**53.683**	**100%**	**52.350**	**100%**	**54.088**	**100%**	**50.010**	**100%**

FOEN (2013)

Tab. 7 > GHG emissions in CO_2 equivalent (million tonnes) by gas between 1990-2011

The column on the far right below (digits in italics) indicates the change in emissions in 2011 relative to 1990. HFCs increased by 5'076'959% when compared to 1990 levels

Greenhouse Gas Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (million tonnes)									
CO_2 emissions including net CO_2 from LULUCF	41.42	43.03	43.19	39.43	39.81	39.68	39.40	37.95	39.53	41.29
CO_2 emissions excluding net CO_2 from LULUCF	44.60	46.32	46.21	43.67	42.94	43.58	44.24	43.42	44.72	44.84
CH_4 emissions including CH_4 from LULUCF	4.68	4.65	4.51	4.38	4.28	4.27	4.20	4.10	4.04	3.98
CH_4 emissions excluding CH_4 from LULUCF	4.67	4.65	4.51	4.38	4.28	4.27	4.19	4.09	4.04	3.98
N_2O emissions including N_2O from LULUCF	3.47	3.47	3.44	3.36	3.32	3.33	3.33	3.23	3.22	3.19
N_2O emissions excluding N_2O from LULUCF	3.46	3.46	3.44	3.36	3.32	3.32	3.33	3.22	3.21	3.18
HFCs	0.00	0.00	0.01	0.01	0.03	0.18	0.22	0.30	0.35	0.41
PFCs	0.10	0.09	0.07	0.03	0.02	0.02	0.02	0.02	0.02	0.04
SF_6	0.14	0.15	0.15	0.13	0.11	0.10	0.09	0.13	0.16	0.15
Total (including LULUCF)	49.82	51.37	51.36	47.34	47.58	47.57	47.27	45.72	47.32	49.05
Total (excluding LULUCF)	52.97	54.66	54.39	51.58	50.70	51.47	52.09	51.17	52.51	52.60

Greenhouse Gas Emissions	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (million tonnes)									
CO_2 emissions including net CO_2 from LULUCF	42.69	45.11	43.51	42.01	41.06	42.06	43.00	41.14	43.83	42.14
CO_2 emissions excluding net CO_2 from LULUCF	43.92	44.87	43.83	45.01	45.63	46.26	45.89	43.93	45.45	44.24
CH_4 emissions including CH_4 from LULUCF	3.92	3.93	3.88	3.79	3.76	3.77	3.78	3.78	3.84	3.79
CH_4 emissions excluding CH_4 from LULUCF	3.91	3.93	3.88	3.78	3.76	3.77	3.78	3.78	3.84	3.79
N_2O emissions including N_2O from LULUCF	3.19	3.22	3.20	3.14	3.09	3.08	3.07	3.10	3.11	3.07
N_2O emissions excluding N_2O from LULUCF	3.18	3.21	3.19	3.14	3.09	3.07	3.07	3.09	3.11	3.06
HFCs	0.49	0.58	0.62	0.70	0.80	0.88	0.91	0.94	1.00	1.04
PFCs	0.07	0.05	0.04	0.06	0.05	0.03	0.03	0.03	0.04	0.04
SF_6	0.16	0.16	0.17	0.17	0.19	0.21	0.20	0.19	0.25	0.19
Total (including LULUCF)	50.51	53.04	51.42	49.87	48.96	50.03	50.99	49.16	52.07	50.26
Total (excluding LULUCF)	51.74	52.80	51.73	52.85	53.53	54.23	53.88	51.95	53.68	52.35

Greenhouse Gas Emissions	2010	2011	Change base year to 2011 (%)
	CO_2 equivalent (million tonnes)		
CO_2 emissions including net CO_2 from LULUCF	43.49	38.44	*-7.2%*
CO_2 emissions excluding net CO_2 from LULUCF	45.90	41.86	*-6.1%*
CH_4 emissions including CH_4 from LULUCF	3.77	3.73	*-20.3%*
CH_4 emissions excluding CH_4 from LULUCF	3.77	3.73	*-20.2%*
N_2O emissions including N_2O from LULUCF	3.14	3.08	*-11.2%*
N_2O emissions excluding N_2O from LULUCF	3.13	3.07	*-11.1%*
HFCs	1.09	1.14	*see caption*
PFCs	0.04	0.04	*-60.7%*
SF_6	0.16	0.16	*14.4%*
Total (including LULUCF)	51.68	46.60	*-6.5%*
Total (excluding LULUCF)	54.09	50.01	*-5.6%*

FOEN (2013)

The emission trends for individual gases are as follows (Tab. 6, Tab. 7, Fig. 57 and Fig. 58).

- Total emissions (excluding LULUCF) show a minimum of 94.4% in 2011 and a maximum of 103.2% in 1991 (with 100% = value of base year 1990). The 2011 total emissions were 5.6% lower than emissions in the base year 1990. CO_2 contributed the largest share of emissions, accounting for 83.7% of the total in 2011.
- Total emissions (including LULUCF) in 2011 show a decrease of 6.5% compared to the emissions recorded in the base year 1990. The net CO_2 emissions/removals from LULUCF show considerable variability from year to year, because heavy storms in 1990 and 1999 ("Lothar") and other factors influence the wood harvesting and tree mortality rates in forests. In the period 1990-2011, wood harvesting gener-

ally increased but is still exceeded by the growth of living biomass. This led to reductions in net removals within the LULUCF sector between 1990 and 2011(Fig. 62).

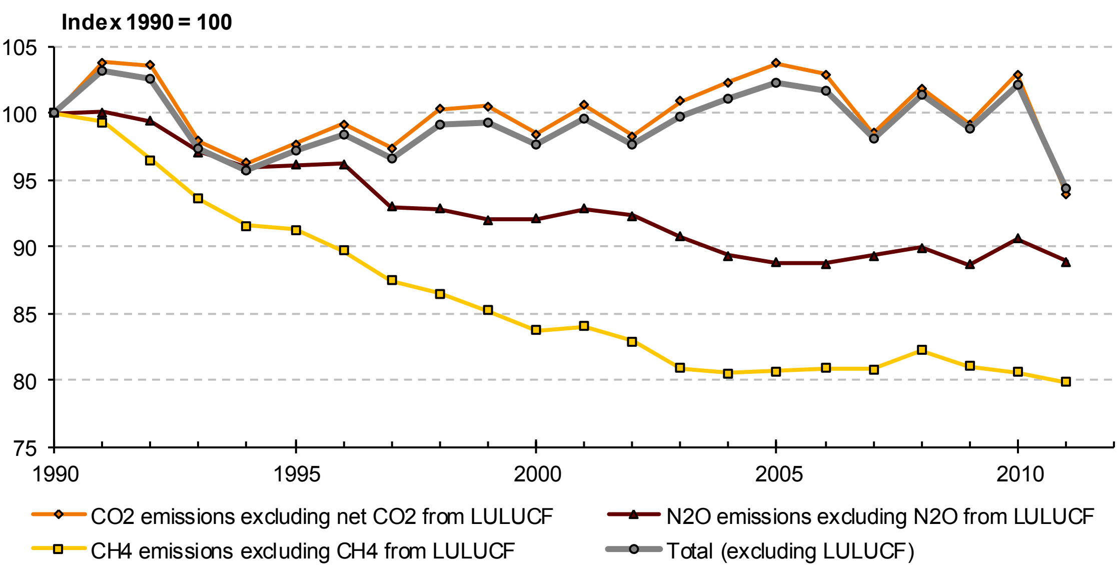
- As CO_2 persistently forms the major part of total GHG emissions (1990: 84.2% and 2011: 83.7%, respectively) its relative trend between 1990 and 2011 runs largely parallel to total GHG emissions excluding LULUCF (Tab. 6 and Fig. 57).

- Between 1990 and 2011, CH_4 decreased by 20.2%, which was mainly attributable to a reduction of livestock that led to a reduction of emissions from enteric fermentation. Moreover, from 2000, a change in waste legislation, banning the disposal of municipal solid waste in landfills, contributed to this trend. The CH_4 share of total GHG emissions decreased from 8.8% in 1990 to 7.5% in 2011.

- In parallel to the reduction of CH_4 due to decreases in livestock populations, N_2O emissions from manure management and agricultural soils declined. Total N_2O emissions dropped by 11.1% between 1990 and 2011 and accounts now for a share of 6.1%.

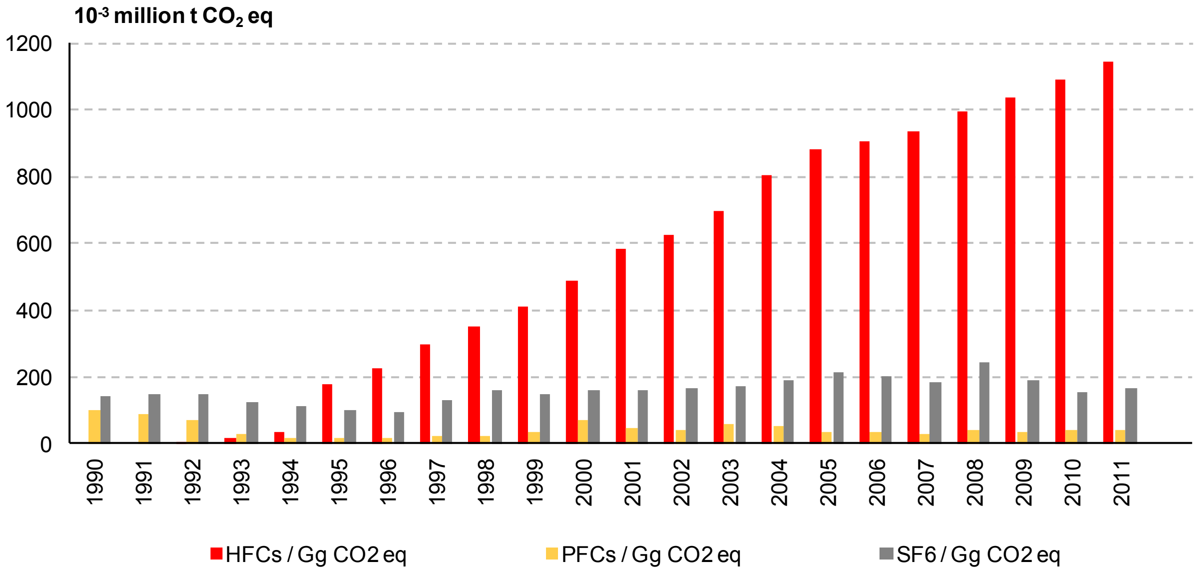
- HFC emissions increased significantly due to their application as substitutes for CFCs, while PFC emissions declined by 60.8%. SF_6 emissions have shown relatively large fluctuations between 0.094 and 0.245 million t CO_2 eq since 1990. In 2011, SF_6 emissions increased by 14.6% compared to 1990. The share of all F-gases combined rose from 0.5% in 1990 to 2.7% in 2011.

Fig. 57 > Relative trend of GHG emissions by gas (excluding LULUCF), 1990–2011. The increase of F-gases, which amounts to 553% in 2011 relative to 1990, is shown in Fig. 58.



FOEN (2013)

Fig. 58 > HFCs, PFCs and SF_6 emissions in Switzerland between 1990-2011



FOEN (2013)

3.2.3 Emission trends by sources and sinks

Tab. 8 shows the emission trends for all major source and sink categories. As the largest share of emissions originated from the energy sector, the table also includes the contributions of the energy subsectors. The percentage shares of source categories are shown for selected years in Tab. 9. Fig. 59 to Fig. 62 are graphical representation of the data in Tab. 8.

Tab. 8 > GHG emissions in CO_2 equivalent (million tonnes) by sources and sinks, 1990–2011.

The column on the far right below (digits in italics) indicates the change in emissions in 2011 relative to 1990.

Source and Sink Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (million tonnes)									
1. Energy	42.01	44.10	44.13	41.81	40.92	41.77	42.61	41.96	43.27	43.37
1A1 Energy Industries	2.55	2.82	2.91	2.56	2.60	2.64	2.85	2.82	3.14	3.18
1A2 Manufacturing Industries and Construction	6.12	6.30	5.96	5.87	5.87	6.06	5.84	5.74	5.92	5.90
1A3 Transport	14.60	15.09	15.42	14.35	14.54	14.23	14.29	14.85	15.06	15.67
1A4 Other Sectors	18.06	19.23	19.23	18.46	17.37	18.35	19.16	18.10	18.70	18.18
1A5 Other (Offroad)	0.21	0.19	0.18	0.17	0.17	0.15	0.14	0.15	0.15	0.13
1B Fugitive emissions from oil and natural gas	0.47	0.47	0.43	0.40	0.38	0.35	0.33	0.32	0.31	0.30
2. Industrial Processes	3.38	3.02	2.87	2.56	2.72	2.65	2.53	2.46	2.56	2.66
3. Solvent and Other Product Use	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.27
4. Agriculture	6.09	6.07	5.98	5.88	5.81	5.82	5.78	5.61	5.58	5.51
6. Waste	1.01	1.01	0.98	0.92	0.86	0.85	0.83	0.82	0.80	0.77
7. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total (excluding LULUCF)	52.97	54.66	54.39	51.58	50.70	51.47	52.09	51.17	52.51	52.60
5. Land Use, Land-Use Change and Forestry	-3.16	-3.29	-3.02	-4.24	-3.12	-3.89	-4.83	-5.45	-5.19	-3.55
Total (including LULUCF)	49.82	51.37	51.36	47.34	47.58	47.57	47.27	45.72	47.32	49.05

Source and Sink Categories	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	CO_2 equivalent (million tonnes)									
1. Energy	42.29	43.22	42.20	43.40	43.83	44.35	44.01	42.01	43.55	42.43
1A1 Energy Industries	3.09	3.22	3.31	3.35	3.67	3.85	4.13	3.88	4.06	3.98
1A2 Manufacturing Industries and Construction	5.79	6.07	5.81	5.95	6.07	6.12	6.26	6.09	6.10	5.72
1A3 Transport	15.90	15.60	15.53	15.69	15.77	15.83	15.95	16.28	16.66	16.47
1A4 Other Sectors	17.09	17.90	17.14	18.04	17.97	18.19	17.31	15.41	16.39	15.91
1A5 Other (Offroad)	0.14	0.13	0.14	0.13	0.11	0.12	0.13	0.12	0.12	0.12
1B Fugitive emissions from oil and natural gas	0.28	0.29	0.26	0.24	0.24	0.24	0.24	0.23	0.24	0.23
2. Industrial Processes	2.93	3.03	3.03	3.08	3.35	3.52	3.50	3.52	3.64	3.51
3. Solvent and Other Product Use	0.26	0.25	0.23	0.22	0.21	0.21	0.21	0.20	0.20	0.20
4. Agriculture	5.50	5.56	5.54	5.46	5.45	5.47	5.49	5.56	5.65	5.59
6. Waste	0.75	0.72	0.72	0.68	0.68	0.66	0.66	0.65	0.63	0.61
7. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total (excluding LULUCF)	51.74	52.80	51.73	52.85	53.53	54.23	53.88	51.95	53.68	52.35
5. Land Use, Land-Use Change and Forestry	-1.23	0.24	-0.31	-2.99	-4.57	-4.20	-2.89	-2.78	-1.62	-2.09
Total (including LULUCF)	50.51	53.04	51.42	49.87	48.96	50.03	50.99	49.16	52.07	50.26

Source and Sink Categories	2010	2011	Change base year (%) to 2001
	CO_2 equivalent (million tonnes)		
1. Energy	43.91	39.86	*-5.1%*
1A1 Energy Industries	4.20	3.99	*56.5%*
1A2 Manufacturing Industries and Construction	5.87	5.37	*-12.2%*
1A3 Transport	16.38	16.21	*11.0%*
1A4 Other Sectors	17.11	13.96	*-22.7%*
1A5 Other (Offroad)	0.12	0.11	*-47.5%*
1B Fugitive emissions from oil and natural gas	0.23	0.23	*-52.1%*
2. Industrial Processes	3.72	3.74	*10.7%*
3. Solvent and Other Product Use	0.20	0.20	*-57.6%*
4. Agriculture	5.65	5.60	*-8.0%*
6. Waste	0.60	0.59	*-41.9%*
7. Other	0.01	0.01	*17.2%*
Total (excluding LULUCF)	54.09	50.01	*-5.6%*
5. Land Use, Land-Use Change and Forestry	-2.41	-3.41	*8.1%*
Total (including LULUCF)	51.68	46.60	***-6.5%***

FOEN (2013b)

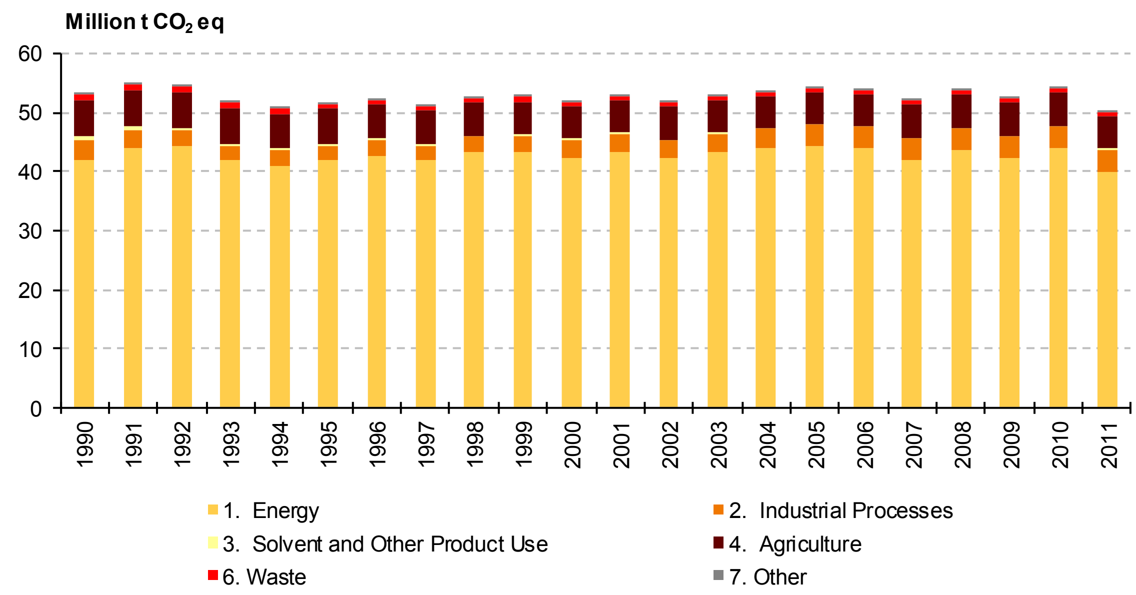
Tab. 9 > GHG emissions (excluding LULUCF) and the percentage of individual source categories

Source and Sink Categories	1990		1995		2000		2005	
	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%
1. Energy	42.007	79.3%	41.774	81.2%	42.290	81.7%	44.345	81.8%
1A1 Energy Industries	*2.551*	*4.8%*	2.637	*5.1%*	3.093	*6.0%*	3.852	*7.1%*
1A2 Manufacturing Industries and Construction	*6.119*	*11.6%*	6.063	*11.8%*	5.788	*11.2%*	6.118	*11.3%*
1A3 Transport	*14.598*	*27.6%*	14.228	*27.6%*	15.901	*30.7%*	15.829	*29.2%*
1A4 Other Sectors	*18.061*	*34.1%*	18.349	*35.7%*	17.089	*33.0%*	18.187	*33.5%*
1A5 Other (Offroad)	*0.206*	*0.4%*	0.148	*0.3%*	0.136	*0.3%*	0.124	*0.2%*
1B Fugitive emissions from oil and natural gas	*0.472*	*0.9%*	0.349	*0.7%*	0.284	*0.5%*	0.236	*0.4%*
2. Industrial Processes	3.381	6.4%	2.653	5.2%	2.930	5.7%	3.520	6.5%
3. Solvent and Other Product Use	0.470	0.9%	0.354	0.7%	0.259	0.5%	0.211	0.4%
4. Agriculture	6.092	11.5%	5.819	11.3%	5.496	10.6%	5.474	10.1%
6. Waste	1.011	1.9%	0.852	1.7%	0.748	1.4%	0.663	1.2%
7. Other	0.012	0.0%	0.013	0.0%	0.014	0.0%	0.014	0.0%
Total (excluding LULUCF)	52.973	100.0%	51.466	100.0%	51.737	100.0%	54.227	100.0%

Source and Sink Categories	2008		2009		2010		2011	
	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%	Million tonnes CO_2 eq	%
1. Energy	43.552	81.1%	42.430	81.0%	43.908	81.2%	39.864	79.7%
1A1 Energy Industries	4.061	*7.6%*	3.976	*7.6%*	4.197	*7.8%*	3.994	8.0%
1A2 Manufacturing Industries and Construction	6.096	*11.4%*	5.719	*10.9%*	5.873	*10.9%*	5.371	10.7%
1A3 Transport	16.662	*31.0%*	16.473	*31.5%*	16.380	*30.3%*	16.206	32.4%
1A4 Other Sectors	16.385	*30.5%*	15.914	*30.4%*	17.110	*31.6%*	13.958	27.9%
1A5 Other (Offroad)	0.115	*0.2%*	0.116	*0.2%*	0.121	*0.2%*	0.108	0.2%
1B Fugitive emissions from oil and natural gas	0.235	*0.4%*	0.231	*0.4%*	0.227	*0.4%*	0.226	0.5%
2. Industrial Processes	3.640	6.8%	3.505	6.7%	3.723	6.9%	3.742	7.5%
3. Solvent and Other Product Use	0.201	0.4%	0.200	0.4%	0.198	0.4%	0.199	0.4%
4. Agriculture	5.648	10.5%	5.593	10.7%	5.647	10.4%	5.604	11.2%
6. Waste	0.626	1.2%	0.608	1.2%	0.597	1.1%	0.587	1.2%
7. Other	0.014	0.0%	0.014	0.0%	0.014	0.0%	0.014	0.0%
Total (excluding LULUCF)	53.683	100.0%	52 350	100.0%	54.088	100.0%	50.010	100.0%

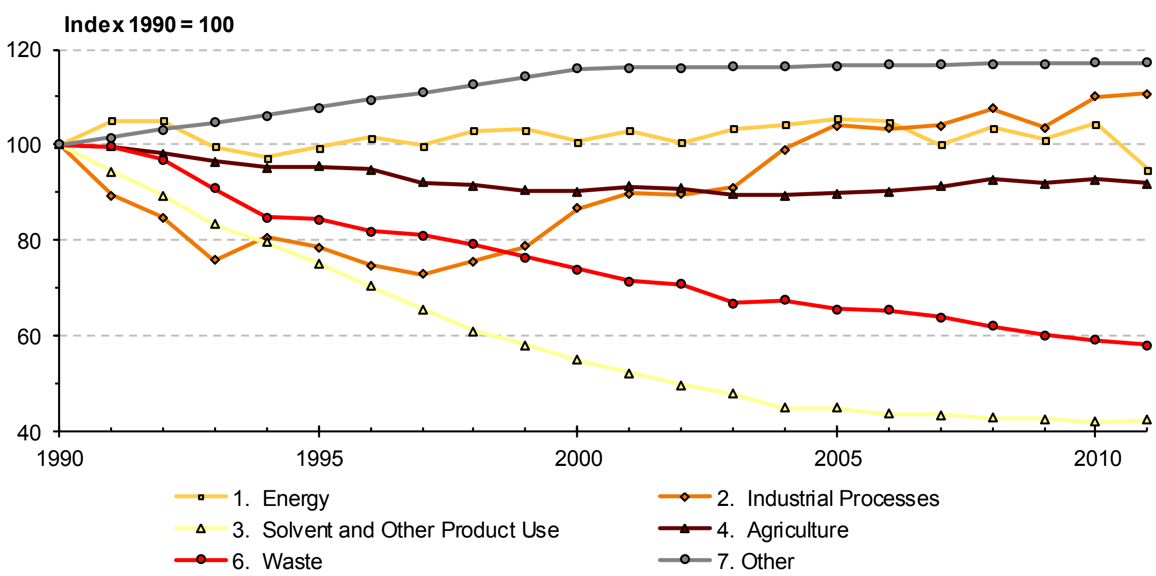
FOEN (2013)

Fig. 59 > GHG emissions (excluding LULUCF) by sectors between 1990–2011



FOEN (2013)

Fig. 60 > Relative emission trends by main source categories (base year 1990 = 100%)



FOEN (2013)

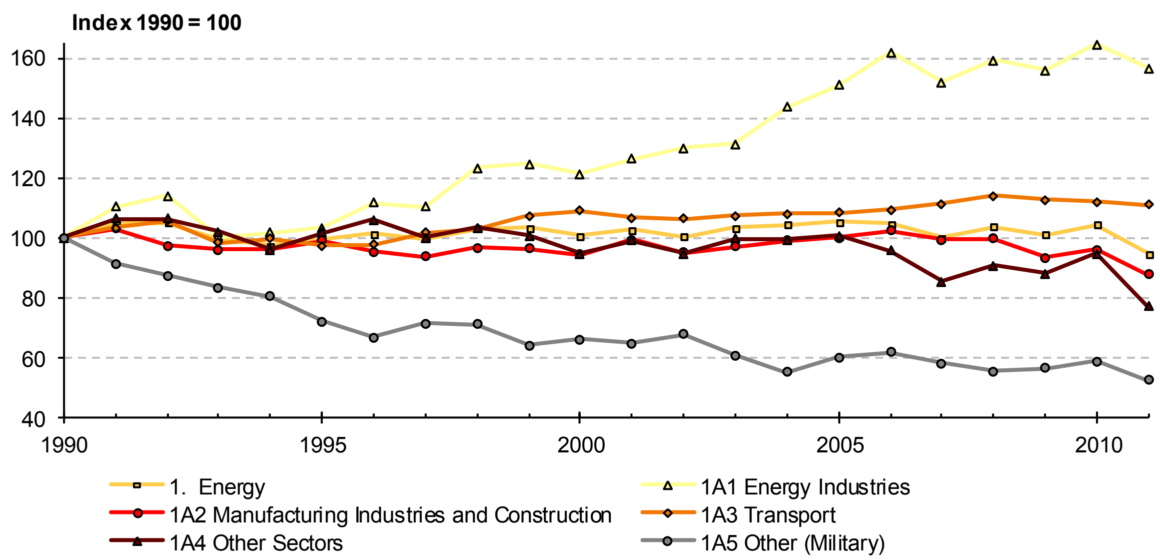
1 Energy

In order to understand the variations in this sector the trends within the sub-categories – representing the major sources of Switzerland's GHG emissions – have to be considered separately (Fig. 61). It is noteworthy that, due to Switzerland's electricity production structure (about 95% generated by hydroelectric and nuclear power plants in 2011; see SFOE 2012: Table 24), the sector 1A1 Energy Industries plays only a minor role – representing waste incineration plants rather than classical thermal power stations.

- Despite differing trends for the sub-sectors, the overall emissions from the energy sector remain at relatively constant level (orange line in Fig. 61) until 2010 but noticeably decreased in 2011 due to mild temperatures.
- Overall emissions from source category 1A1 Energy Industry 2011 have increased by 56.5% since 1990 but decreased by 4.8% compared to the last year. Fluctuations are caused by varying combustion activities in the petroleum refinery industry, waste incineration and new installations of district heating. From 2010 to 2011, emissions from Gaseous Fuel consumption within source category 1A also decreased by 11.3% due to the fact that 2011 was the warmest year measured since measurements started: spring season 2011 was the warmest ever, autumn was the second warmest in 150 years and in November further record warm temperatures were measured. Note that only approximately 10% of sector 1 Energy emissions stem from 1A1. The trend for sub-sector 1A3 Transport (40% of sector 1 Energy in 2011) shows a slight increase over the period 1990–2011 by 11%, but with fluctuations indicating a fairly strong correlation between this sector and economic development.
- The trend for sub-sector 1A4 Other sectors reflects the impact of climatic variations on heating demand. A strong correlation with the number of "heating degree days" – an index of cold weather conditions – is apparent. In 2011 heating degree days decreased by 18.1% compared to 2010 and CO_2 emissions from fuel combustions in source category 1A4 Stationary Sources decreased simultaneously by 19.0%. From 1990 to 2011, the number of buildings and apartments increased as well as the average floor space per person and workplace, resulting in an increase in the total area heated of 30%. Over the same period, however, higher standards were specified for insulation and for combustion equipment efficiency for both new and renovated buildings, compensating for the emissions from the additional area heated.
- For sub-sector 1A5 Other (representing offroad military vehicles including military aviation) GHG emissions decreased steadily during the 1990s, due to decreased use of military vehicles and aviation acitivities. Levels are stable since 2003 at ~60% compared to 1990.

Fig. 61 > Relative emission trends for the sub-categories in the energy sector compared to the sector as a whole.

Fugitive emissions (category 1B, not shown) have continuously decreased from 100% in 1990 to 51% in 2003 and since then remain stable



FOEN (2013)

2 Industrial processes

In line with economic development, overall emissions in the industry sector showed a decreasing trend in the 90s and a rebound between 1998 and 2011 (Fig. 60). Their share of the total greenhouse gas emissions in 2011 was of the order of 7.5% (Tab. 9). Since 2005 the Ordinance on Chemical Risk Reduction (Swiss Confederation 2005) is in place and regulates the use of F-Gases, which led to an emission stabilization in this source category.

3 Solvent and other product use

There is a decreasing trend in overall emissions throughout all the years, which is however by far less pronounced since 2004. Whereas overall NMVOC emissions have decreased by 71.8% since 1990, direct CO_2 emissions from the post combustion of NMVOCs have increased. NMVOC emissions, the main source of indirect CO_2 emissions of the sector, have diminished between 1990 and 2004 due to their limitation brought by the Ordinance on Air Pollution Control (Swiss Confederation 1985) and the introduction of the VOC tax in 2000 (Swiss Confederation 1997) (Fig. 60) Emissions from this sector make up less than 0.4% of total Swiss greenhouse gas emissions in 2011 (Tab. 9).

4 Agriculture

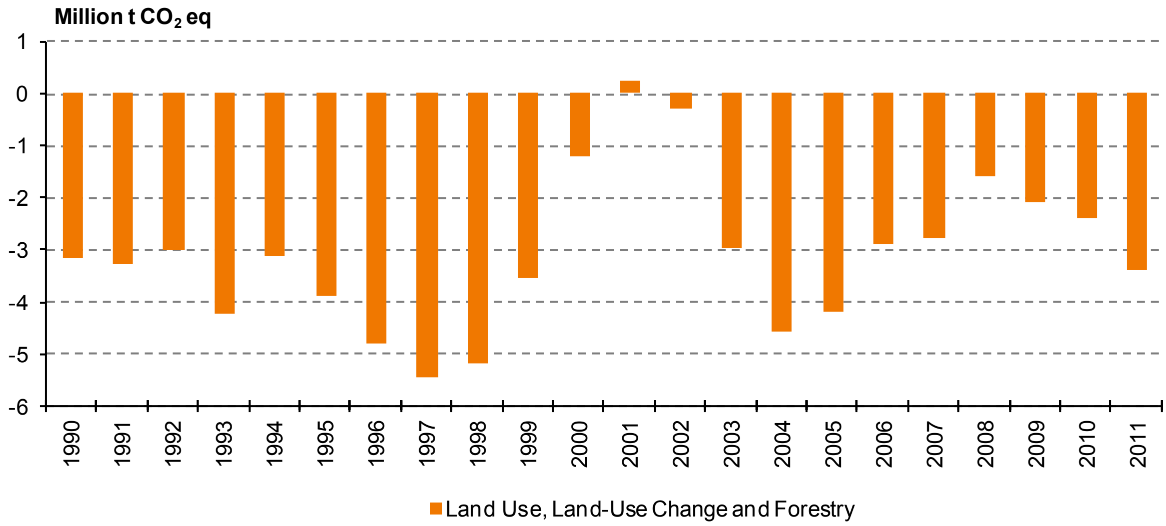
Declining populations of cattle and swine and reduced fertilizer use have led to a decrease in CO_2 eq emissions until 2004. Since then, CH_4 emissions remained relatively stable (Fig. 60). The agriculture sector contributed 11.2% to the total greenhouse gas emissions in 2011 (Tab. 9).

5 Land Use, Land-Use Change and Forestry

Fig. 62 shows net emissions and removals from the LULUCF sector in Switzerland, which is dominated by biomass dynamics in forests. Except for 2001 the removals in the LULUCF sector were higher than the emissions throughout the period 1990-2011. However, a strong year to year variation is evident over the whole period. The reason for the positive value in 2001 is the winter storm "Lothar" end of 1999 which caused great damages in the forest stands and increased harvesting. The reduction of the removals from 2004 to 2008 is due to the reduction of dead wood as CO_2 sink (2005) towards a source in 2008. In 2011, the LULUCF sector was a net CO_2 sink of the order of 6.8% of total greenhouse gas emissions.

Fig. 62 > Net CO_2 equivalent balance of sector Land Use, Land-Use Change and Forestry (LULUCF).

Positive values refer to emissions, negative values to removals. The contributions of CH_4 and N_2O emissions are very small compared to the net CO_2 emissions and removals.



FOEN (2013)

6 Waste

Total emissions from the source category Waste decreased steadily throughout the period 1990-2003 (Fig. 60). Since 2000, emissions have been reduced further by a change in legislation: disposal of combustible municipal solid wastes on landfills has been banned, leading to a decrease in methane emissions from landfill sites and an increasing amount of municipal solid waste being incinerated in waste incineration plants, with emissions reported under source 1A1 Energy Industries rather than sector 6 Waste. Altogether, "waste-related" emissions including emissions from waste management activities reported in source categories 1A, 4D and 6 have increased since 1990 by 31.6% (this data is not shown in Fig. 60).

7 Other

The total emissions from sector 7 Other increased troughout the period 1990-2000. Since 2000 the emission are stable. Please consider that emissions from sector 7 Other are not accounted for in the Kyoto Protocol and are only of minor importance (0.03% of total CO_2 eq emissions).

3.2.4 Emission trends for indirect greenhouse gases and SO_2

Emission trends for indirect greenhouse gases show a very pronounced decline (Tab. 10 and Fig. 63). From 1990 to 2011, a strict air pollution control policy and the implementation of a large number of emission reduction measures led to a decrease of 48% to 75% in emissions of air pollutants. The main reduction measures were abatement of exhaust emissions from road vehicles and stationary combustion equipment, taxation of solvents and sulphured fuels, and voluntary agreements with industry sectors (FOEN 2010; Swiss Confederation 1985, 1997).

The energy sector was by far the largest source of indirect greenhouse gas emissions (Tab. 11) with the only exception being NMVOC, where in 2011 sector 3 Solvent and Other Product Use accounted for 23.2% of the total. The total shown in Tab. 11 includes NMVOC emissions from LULUCF, which are estimated at constant 0.095 million tonnes per year (SAEFL 1996). Fig. 64 shows the relative contributions of the various sectors for each individual gas in 2011 (data from Tab. 11, but excluding NMVOC from LULUCF). The energy sector can clearly be identified as the main source of NO_x, CO and SO_2, whereas sector Solvent and Other Product Use dominates NMVOC emissions.

Tab. 10 > Indirect GHG and SO_2 emissions (10^{-3} million tonnes), 1990–2011 (excl. NMVOC from LULUCF)

Indirect Greenhouse	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gases and SO2	10^{-3} million tonnes									
NOx	149	148	141	129	127	123	118	114	113	113
CO	836	807	756	663	606	564	545	512	489	473
NMVOC	311	294	273	244	222	205	193	180	166	156
SO2	40	37	33	27	28	26	26	24	23	17

Indirect Greenhouse	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Gases and SO2	10^{-3} million tonnes									
NOx	110	106	100	98	96	95	92	89	88	83
CO	443	419	390	377	357	340	316	297	287	271
NMVOC	147	139	128	119	109	105	101	97	95	93
SO2	16	18	16	15	16	16	15	13	14	12

Indirect Greenhouse	2010	2011
Gases and SO2	10^{-3} million tonnes	
NOx	82	77
CO	262	286
NMVOC	91	88
SO2	12	10

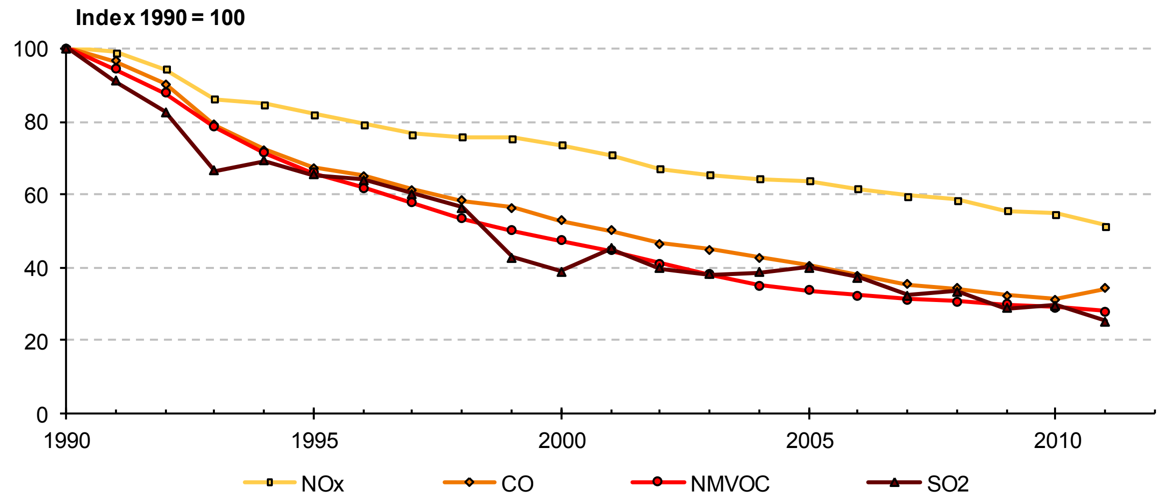
FOEN (2013)

Tab. 11 > Indirect GHG and SO_2 emissions (10^{-3} million tonnes) by source, 2011. The total NMVOC emissions include NMVOC from LULUCF.

Sources	NOx	CO	NMVOC	SO2
	Emissions 2011 (10-3 million tonnes)			
1 Energy	71.7	270.5	31.1	9.3
2 Industrial Processes	0.43	6.22	7.35	0.79
3 Solvent and Other Product Use	0.0004	0.0125	42.4428	0.0069
4 Agriculture	4.2	NO	4.0	NO
5 LULUCF	IE, NE	IE, NE	95.5	NE
6 Waste	0.6	8.7	2.6	0.1
7 Other	0.07	0.80	0.13	0.01
Total	77.00	286.19	183.07	10.18

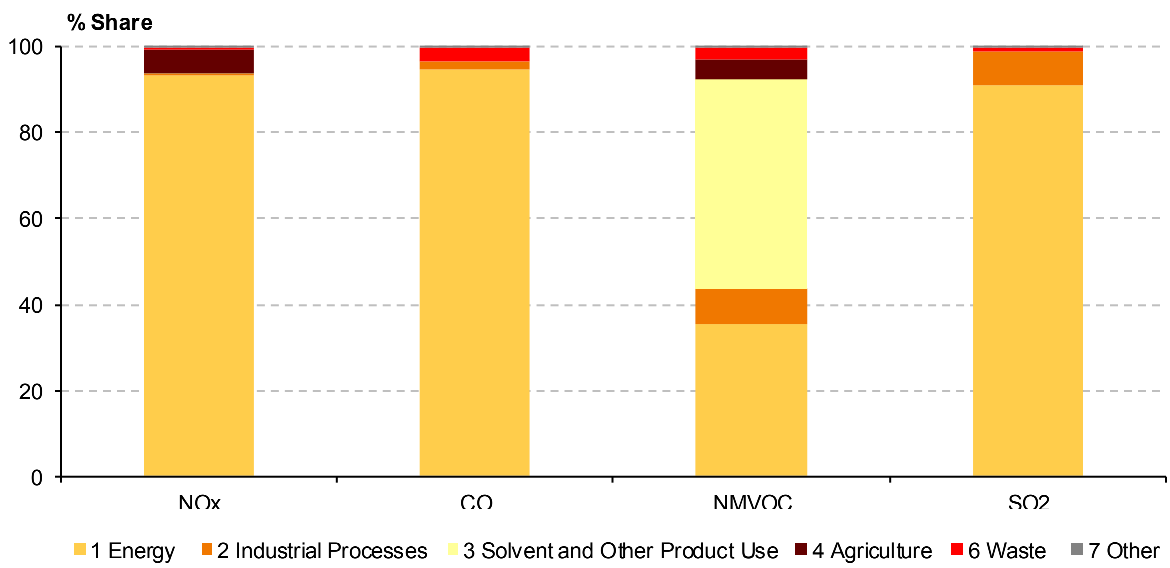
FOEN (2013)
IE = Included elsewhere; NE = Not Estimated; NO = Not Occurring

Fig. 63 > Relative emission trends for indirect GHG and SO_2 emissions (excluding NMVOC from LULUCF) between 1990–2011 (base year 1990 = 100%)



FOEN (2013)

Fig. 64 > Relative contributions of individual sectors to indirect GHG and SO_2 emissions in 2011 (excluding NMVOC from LULUCF)



FOEN (2013)

3.3 Data for activities under Art. 3, para. 3 and 4 of the Kyoto Protocol (KP-LULUCF)

Switzerland elected to account for forest management under the elective voluntary activities of Art. 3, para. 4 of the Kyoto Protocol (FOEN 2006b, section F). In accordance with decision 16/CMP.1 (FCCC/KP/CMP/2005/8/Add.3), credits from forest management are capped in the first commitment period. For Switzerland, the cap amounts to 1.83 million t CO_2 (0.5 million t C) per year, or 9.15 million t CO_2 for the whole commitment period. An overview of GHG sources and sink activities for the time series 1999 to 2011 is given in Tab. 12 and Fig. 65.

Tab. 12 > Overview of net CO_2 equivalent emissions and removals (10^{-3}million tonnes CO_2 eq) for activities under article 3, paragraphs 3 and 4 of the Kyoto Protocol, 1999-2011

Positive values refer to emissions, negative values refer to removals

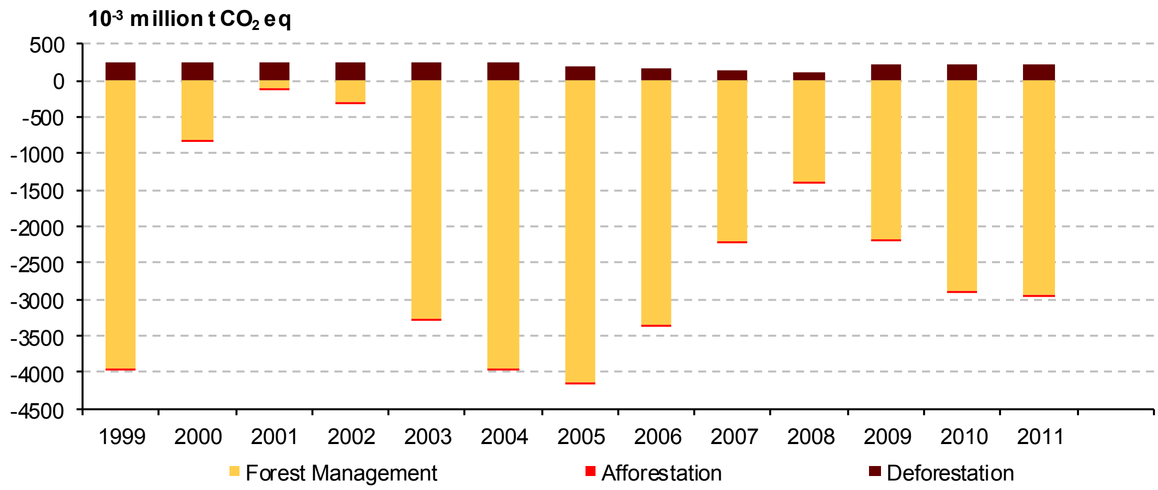
Greenhouse gas source and sink activities	1999	2000	2001	2002	2003	2004	2005
A. Article 3.3 activities	**228.20**	**228.19**	**227.28**	**225.85**	**224.10**	**222.61**	**177.08**
A.1. Afforestation and Reforestation	-6.40	-7.19	-8.23	-9.67	-11.41	-13.26	-15.60
A.2. Deforestation	234.60	235.38	235.51	235.52	235.51	235.87	192.67
B. Article 3.4 activities	**-3941.42**	**-801.22**	**-96.70**	**-297.06**	**-3256.69**	**-3938.76**	**-4142.46**
B.1. Forest Management incl. biomass burning	-3941.42	-801.22	-96.70	-297.06	-3256.69	-3938.76	-4142.46
gains living biomass	-12538.67	-12548.99	-12558.14	-12567.19	-12576.31	-12586.43	-12602.52
losses living biomass	9955.69	12833.46	13232.16	13075.27	10612.85	10272.12	10719.66
litter	-183.95	55.92	310.98	236.12	-202.74	-442.97	-941.39
dead wood pool	-1114.46	-1079.98	-1025.80	-1009.55	-1062.07	-1115.30	-1226.30
soil C min. soils	-69.07	-71.80	-66.09	-57.11	-60.11	-75.71	-102.55
soil C org. soils	8.68	8.69	8.70	8.70	8.71	8.71	8.73

Greenhouse gas source and sink activities	2006	2007	2008	2009	2010	2011	
A. Article 3.3 activities	145.24	119.76	77.43	207.07	202.07	200.66	
A.1. Afforestation and Reforestation	-17.99	-20.99	-23.02	-25.15	-30.35	-32.55	
A.2. Deforestation	163.22	140.75	100.45	232.23	232.43	233.22	
B. Article 3.4 activities	-3339.56	-2200.43	-1374.82	-2178.56	-2884.02	-2936.20	
B.1. Forest Management incl. biomass burning	-3339.56	-2200.43	-1374.82	-2178.56	-2884.02	-2936.20	
gains living biomass	-12707.70	-12805.29	-12904.16	-12915.75	-12920.06	-12924.49	
losses living biomass	10298.16	10749.27	10856.07	10447.87	10211.58	10188.90	
litter	-194.38	224.17	650.77	275.94	-125.54	-146.81	
dead wood pool	-628.87	-278.80	93.99	58.94	-11.42	-21.71	
soil C min. soils	-119.62	-108.06	-82.08	-55.77	-48.23	-46.67	
soil C org. soils	8.74	8.75	8.76	8.76	8.77	8.77	

FOEN (2013)

Fig. 65 > Net CO_2 equivalent emissions and removals(10^{-3} million tonnes) for activities under article 3, paragraph 3 (afforestation, deforestation) and paragraph 4 (forest management) of the Kyoto Protocol, 1999-2011.

Positive values refer to emissions, negative values refer to removals.



FOEN (2013)

3.4 Status of the national inventory system

3.4.1 National entity with overall responsibility

Federal Office for the Environment (FOEN)
National GHG Inventory System, Dr. Paul Filliger (project leader)
Climate Division, Section Climate Reporting and Adaptation
CH-3003 Bern, Switzerland
Phone +41 (0)31 322 68 58 Fax +41 (0)31 323 03 67
climate@bafu.admin.ch *www.climatereporting.ch*

3.4.2 Institutional, legal and procedural arrangements

The Swiss National Inventory System (NIS) is developed and managed under the auspices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC). It is hosted by an office of DETEC, the Federal Office for the Environment (FOEN). As stipulated in the CO_2 Act of 23. December 2011 (Art. 39), the FOEN has the lead within the federal administration regarding climate policy and its implementation.

As part of a comprehensive project (Swiss Climate Reporting Project), the FOEN directorate mandated its Climate, Economics, and Environmental Monitoring Division in early 2004 to design and establish the NIS in order to ensure full compliance with the reporting requirements of the UNFCCC and the Kyoto Protocol by 2006. Today, the NIS is fully operational. The responsibility lies within the Climate Division of the FOEN which was established on 1st January 2010. Having regard to the provisions of Art. 5, paragraph 1 of the Kyoto Protocol, the NIS covers the following elements:

- arrangements with partner institutions, relating to roles and responsibilities;
- participation in the inventory development process;
- data use, communication and publication;
- inventory development plan;

- setting-up of a QA/QC system;
- official consideration and approval of data;
- upgrading and updating of the national air pollution database (EMIS);
- data documentation and storage.

With the formal approval of Switzerland's initial report under article 7, paragraph 4 of the Kyoto Protocol (FOEN 2006b) by the Federal Council on 8 November 2006 the Swiss NIS became operative. By providing for structures and in defining tasks and responsibilities of institutions, organisations and consultants involved, the NIS itself is a key tool in ensuring and improving the quality as well as the process management of inventory preparation.

3.4.3 Roles and responsibilities

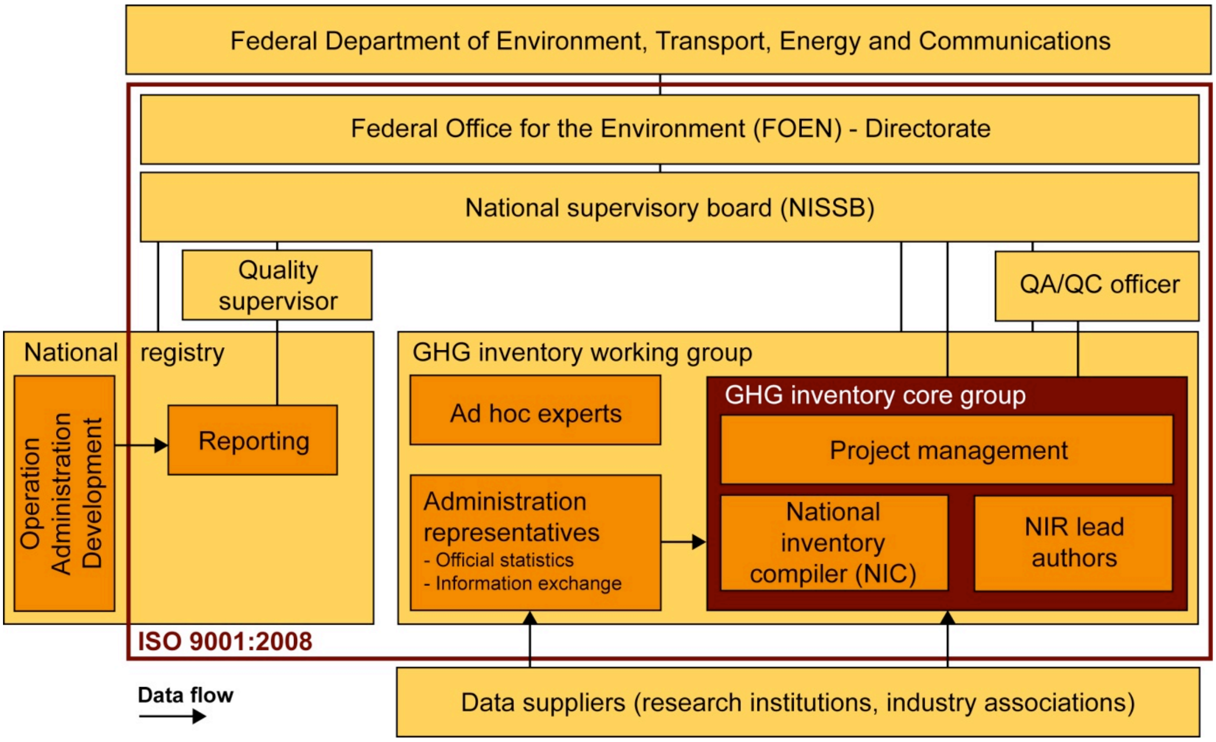
The **NIS supervisory board** was established by decision of the FOEN directorate in summer 2006. The board oversees activities related to the GHG inventory and to the national registry. It is independent of the inventory preparation process and, by its composition, combines technical expertise and political authority. In order to put more emphasis on operational and security issues of the national registry, the national supervisory board has updated its formal mandate in 2011 to explicitly cover registry specific issues and assign the corresponding responsibilities. The main tasks of the national supervisory board are:

- official consideration of the annual inventory submission and recommendation of the inventory for official approval by the FOEN directorate;
- assessment and approval of the recalculation of inventory data;
- handling of any issues arising from the UNFCCC review process that cannot be resolved at the level of the inventory project management or the registry administration;
- facilitation of any non-technical negotiation, consideration or approval processes involving other institutions within the federal administration;
- support of the registry administration in maintaining a secure and reliable registry environment.

The national registry is largely run independently of the national greenhouse gas inventory. Its operation is coordinated by the registry administrator, whose work is overseen by the registry quality supervisor (Fig. 66).

The QA/QC officer is responsible for enforcement of the defined quality standards of the national inventory. The officer also advises the national supervisory board on matters relating to the conformity of the inventory with reporting requirements. Tasks and competencies are described in detail in the Description of the Quality Management System (FOEN 2013a).

Fig. 66 > Institutional setting of the National Inventory System



FOEN (2006b, 2013)

The **GHG inventory working group** encompasses all scientific and technical personnel involved in the inventory preparation process or representing institutions that play a significant role as suppliers of data. The group as a whole meets at least once per year to take stock of the state of the inventory, discuss priorities in the inventory development process, and to address specific issues of general interest that arise, e.g. from domestic or international reviews.

The **GHG inventory core group** which meets four times per year, comprises the inventory experts employed by the FOEN or mandated on a regular basis, who are entrusted with major responsibilities for inventory planning, preparation and/or management. All inventory data are assembled and prepared for input into the CRF reporter by the GHG inventory core group, which is responsible for ensuring the conformity of the inventory with the updated UNFCCC Reporting Guidelines on Annual Inventories (UNFCCC 2006b) and the 2008 Kyoto Protocol Reference Manual (UNFCCC 2008). The core group consists of:

- the inventory project management (with overall responsibility for the integrity of the inventory, communication of data, and information exchange with the UNFCCC secretariat);
- the national inventory compiler (responsible for the EMIS inventory data base, key category analyses, and for the CRF tables);
- the NIR lead authors (responsible for the inventory report and carrying out centralized data assessments such as uncertainty analysis);
- selected sectoral experts.

The QA/QC officer, albeit no formal member, attends the meetings of the core group.

The GHG inventory core group coordinates and integrates the activities of data suppliers within and outside the FOEN as well as those of mandated experts. Further data suppliers contributing to the inventory are research institutions and industry associations (see Table 1-1 in FOEN 2013 for a detailed list of data suppliers). The latter are obliged by Art. 46 of the Federal Act on the Protection of the Environment (Swiss Confederation 1983) to provide the authorities with the information needed to enforce the law and, if necessary, to carry out inquiries.

The formal arrangements (agreements, contracts, and documentations of roles and responsibilities) that have been established to consolidate and formalize cooperation between the relevant partners contributing to, or involved in, the GHG inventory preparation process are described in section H.1.1 of Switzerland's initial report under article 7, paragraph 4 of the Kyoto Protocol (FOEN 2006b) and the updates made in the annual National Inventory Report (FOEN 2013, section 13).

Information regarding the Swiss GHG inventory is available online at *www.climatereporting.ch*.

3.4.4 Process of inventory preparation

GHG Inventory and KP-LULUCF Inventory

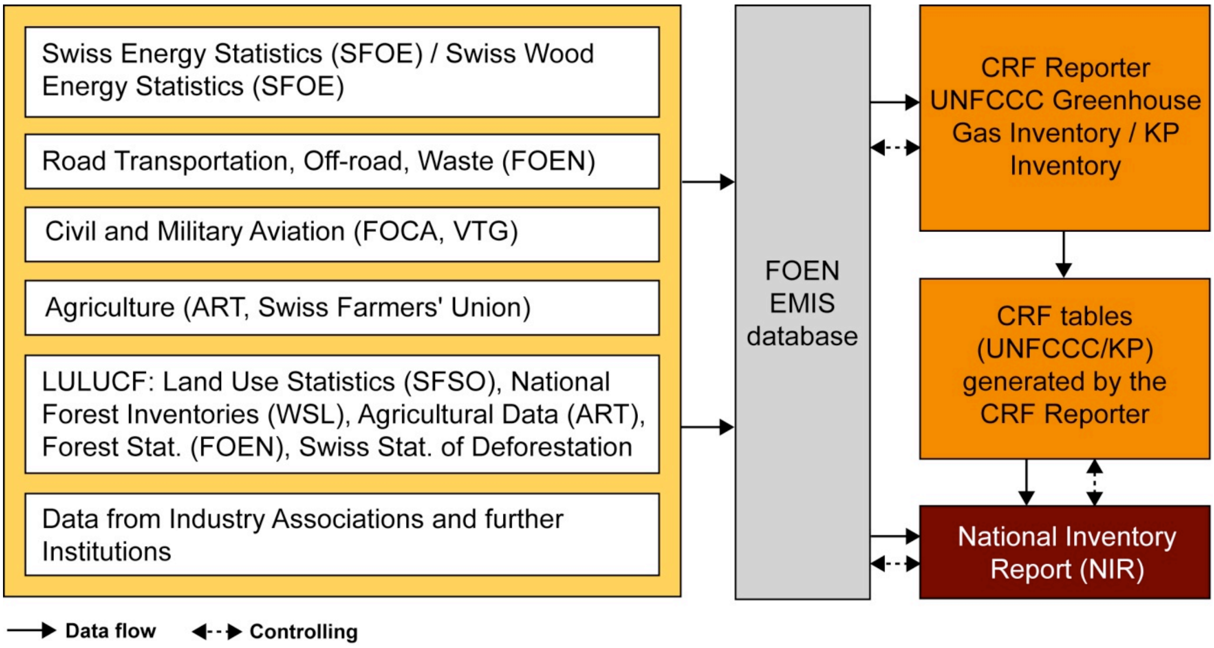
All inventory data, including activity data and emission factors for both inventories are compiled centrally by the FOEN. While emissions and removals from sector 5 LULUCF and KP-LULUCF are calculated by the Forest Division and sector 4 Agriculture by the Agroscope Reckenholz-Tänikon, all other sectors are calculated or compiled by the Air Pollution Control and Chemicals Division. Activity data are provided by the data suppliers, while emission factors are partly updated by the data suppliers and partly by the Air Pollution Control Division (formerly Air Pollution Control and Non-Ionizing Radiation Division).

Data Collection, Processing and Storage, Including for KP-LULUCF Inventory

The data needed to prepare the UNFCCC greenhouse gas inventory in the CRF is collected by various data suppliers. Since the individual data suppliers bear the main responsibility for the quality of data provided, they are also responsible for the collection of activity data, emission factors, and for the selection of methods compliant with the relevant guidelines (see below "Methodologies"). Several QA/QC activities (see section 3.4.7 or, for detailed information, FOEN 20013a) ensure and continuously improve the quality of inventory data.The Air Pollution Control and and Chemical Division (formerly Air Pollution Control and Non-Ionizing Radiation Division) at the FOEN maintains the EMIS database, which contains all the basic data needed to prepare the GHG inventory in the CRF. At the same time, background information on data sources, activity data, emission factors and methods used for emission estimation is documented in the data base and/or the NIR.

Fig. 67 illustrates the data collection and processing steps leading to the CRF tables required for reporting under the UNFCCC and under the Kyoto Protocol. From EMIS, an interface transfers the data to the CRF reporter (Version 3.5.2) that generates the CRF tables that are submitted using the UNFCCC submission portal released in February 2009. The CRF tables are documented in the NIR. The NIR authors and the reviewers control the correctness of the data transferred from EMIS into the NIR. Figures and tables shown in the NIR are exported directly from EMIS. The NIR authors check the correspondence between the exports and the CRF tables. A detailed illustration of the sectoral steps of inventory processing is given in the monitoring protocols of NIS core processes and sub-processes, as shown in a couple of examples in FOEN (2013a).

Fig. 67 > Data collection for EMIS database, CRF reporter and National Inventory Report (NIR)



FOEN (2013)

QA /QC procedures and extensive review of GHG Inventory and KP-LULUCF Inventory

The national inventory system has an established quality management system (QMS) that complies with the requirements of ISO 9001:2008. Certification has been obtained in 2007 and upheld since through annual audits. An overview over QA/QC procedures and review activities is given in FOEN (2013, in its section 1.6.1), a full description of the QMS is provided as a supplement (FOEN 2013a) to the national inventory report.

Methodologies: General description

Emissions are calculated on the basis of the standard methods and procedures published in the revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997a, 1997b, 1997c), in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000), and in IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003), Under the UNFCCC, these guidelines and good practice guidance have been adopted for mandatory use in reporting on GHG inventories. The 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006), adopted in April 2006 by the IPCC, have been consulted in a few cases.

National and reference approach for sector 1 Energy

The national approach for sector 1 Energy is based on import and fuel consumption statistics (fuel sales in the transport sector) in Switzerland. The other sectors rely on national statistics and data surveys. For the various sectors, tier 1, tier 2 and tier 3 methodologies according to IPCC Guidelines (IPCC 1997b) and good practice guidance (IPCC 2000) are used. GHG emissions by sources and removals by sinks due to land use, land-use change and forestry (LULUCF sector) are calculated according to IPCC 2003. Tab. 1-2 in FOEN (2013) indicates the approaches adopted in compiling the Swiss GHG inventory.

The reference approach is used as a check for (i) overall energy consumption and (ii) the resulting CO_2 emissions reported in source category 1 Energy. In Switzerland, it is applied on the basis of data published in the Swiss overall energy statistics (SFOE 2012). The results of the reference approach are compared with the results of the sectoral approach for sector 1 Energy in order to test the quality and completeness of the inventory.

National Air Pollution Database EMIS

One part of the emissions has been calculated by multiplying emission factors and activity rates in the "FOEN EMIS database". Another part of the emissions has been calculated by the data suppliers (transport, synthetic gases, agriculture). In the latter cases, the resulting emission data have been directly inserted into FOEN EMIS database.

A large body of emission data is adopted from Switzerland's national air pollution database EMIS, which is operated by FOEN (FOEN 2006a). EMIS was established at SAEFL (former name of FOEN) in the late 1980s. Its initial purpose was to record and monitor emissions of air pollutants. It has since been extended to cover greenhouse gases, too. Its structure corresponds to the EMEP/CORINAIR system for classifying emission-generating activities. EMEP/CORINAIR uses the nomenclature for reporting ("NFR code", UNECE 2003). The revised 1996 IPCC Guidelines provide a correspondence key between IPCC and EMEP/CORINAIR source categories (IPCC 1997a: Annex 2). EMIS thus contains cross-references to IPCC/UNFCCC coding formats.

EMIS calculates emissions for various pollutants using emission factors and activity data according to the EMEP/CORINAIR methodology. The original EMIS database underwent a full redesign in 2005/2006. It was extended to incorporate more data sources, updated, and migrated to a new software platform. At the same time, activity data and emission factors were being checked and updated. Emission data from EMIS that are relevant for the GHG inventory are exported to the CRF Reporter.

Input data for the EMIS database comprise the SFOE Swiss overall energy statistics, the SFOE Swiss wood energy statistics, FOEN statistics and models for emissions from road transportation, statistics and models of off-road activities, modelled emissions based on the import statistics for F-gases, waste and agricultural statistics, extracts from the National Forest Inventory and the national forest statistics (see Fig. 67).

KP- LULUCF Inventory

Emission factors for parts of sector 5 LULUCF (forest land) and the KP-LULUCF tables are calculated by the Forest Division of the FOEN. A detailed description of the calculation of these emission factors can be found in Chapter 7.3 and Chapter 11.3 of FOEN (2013). Both data sets are imported in the EMIS database (FOEN 2006a).

3.4.5 Key source identification

The key category analyses are performed according to the good practice guidance (IPCC 2000: section 7) for 1990 and the latest reported year. A tier 1 level and trend assessment is applied with the proposed threshold of 95%. A tier 2 key category analyses has also been carried out with the proposed threshold of 90% of the sum of all level assessments weighted with their uncertainty. The tier 2 key category analysis uses the tier 2 uncertainty analyses which is updated biennially.

Tab. 13 presents an overview on key catagories according to the combined key category analyses without and with LULUCF categories for both tier 1 and tier 2, and for both 1990 and 2010

Tab. 13 > Overview on key categories according to the combined KCA without and with LULUCF categories for both Tier 1 and Tier 2, and for both 1990 and 2011

Overview on key categories without and with LULUCF categories for both Tier 1 and 2, and for both the submission and the base year								
IPCC Source Categories and fuels if applicable (with LULUCF categories)		Direct GHG	2011		1990	2011		1990
			Tier 1	Tier 1	Tier 1	Tier 2	Tier 2	Tier 2
1A1	1. Energy A. Fuel Combustion 1. Energy IndustriesGaseous Fuels	CO2	KC level	KC trend	KC level	-	-	-
1A1	1. Energy A. Fuel Combustion 1. Energy IndustriesLiquid Fuels	CO2	KC level	KC trend	KC level	-	-	-
1A1	1. Energy A. Fuel Combustion 1. Energy IndustriesOther Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
1A2	1. Energy A. Fuel Combustion 2. Manufacturing Industries and ConstructionGaseous Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	-
1A2	1. Energy A. Fuel Combustion 2. Manufacturing Industries and ConstructionLiquid Fuels	CO2	KC level	KC trend	KC level	-	-	-
1A2	1. Energy A. Fuel Combustion 2. Manufacturing Industries and ConstructionOther Fuels	CO2	KC level	KC trend	-	KC level	KC trend	-
1A2	1. Energy A. Fuel Combustion 2. Manufacturing Industries and ConstructionSolid Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
1A3a	1. EnergyA. Fuel Combustion 3. Transport; Civil Aviation	CO2	-	KC trend	KC level	-	-	-
1A3b	1. EnergyA. Fuel Combustion 3. Transport; Road TransportationDiesel	CO2	KC level	KC trend	KC level	KC level	KC trend	-
1A3b	1. EnergyA. Fuel Combustion 3. Transport; Road TransportationGasoline	CH4	-	-	-	-	KC trend	-
1A3b	1. EnergyA. Fuel Combustion 3. Transport; Road TransportationGasoline	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
1A3b	1. EnergyA. Fuel Combustion 3. Transport; Road TransportationGasoline	N2O	-	KC trend	-	-	KC trend	KC level
1A4a	1. Energy A. Fuel Combustion 4. Other Sectors; Commercial/InstitutionalGaseous Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	-
1A4a	1. Energy A. Fuel Combustion 4. Other Sectors; Commercial/InstitutionalLiquid Fuels	CO2	KC level	KC trend	KC level	-	KC trend	KC level
1A4b	1. Energy A. Fuel Combustion 4. Other Sectors; ResidentialBiomass	CH4	-	-	-	-	KC trend	KC level
1A4b	1. Energy A. Fuel Combustion 4. Other Sectors; ResidentialGaseous Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
1A4b	1. Energy A. Fuel Combustion 4. Other Sectors; ResidentialLiquid Fuels	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
1A4c	1. Energy A. Fuel Combustion 4. Other Sectors; Agriculture/ForestryLiquid Fuels	CO2	KC level	-	KC level	-	-	-
1A5	1. Energy A. Fuel Combustion 5. OtherLiquid Fuels	CO2	-	KC trend	KC level	-	-	-
1B2	1. Energy B. Fugitive Emissions from Fuels2. Oil and Natural Gas	CH4	-	KC trend	KC level	KC level	KC trend	KC level
2A1	2. Industrial Proc.A. Mineral Products; Cement Production-CO2	CO2	KC level	KC trend	KC level	KC level	KC trend	KC level
2C1	2. Industrial Proc.C. Metal Production; Steel Production	CO2	KC level	KC trend	-	KC level	KC trend	-
2F1	2. Industrial Proc.F. Consumption of Halocarbons and SF6; Refrig. & AC Eq.	HFC	KC level	KC trend	-	KC level	KC trend	-
2F9	2. Industrial Proc.F. Consumption of Halocarbons and SF6; Other	HFC	-	-	-	-	KC trend	-
2F9	2. Industrial Proc.F. Consumption of Halocarbons and SF6; Other	SF6	-	-	-	-	-	KC level
3	3. Solvent and Other Product Use	CO2	-	KC trend	KC level	KC level	KC trend	KC level
3	3. Solvent and Other Product Use	N2O	-	-	-	-	KC trend	KC level
4A	4. AgricultureA. Enteric Fermentation	CH4	KC level	-	KC level	KC level	-	KC level
4B	4. AgricultureB. Manure Management	CH4	KC level	-	KC level	KC level	-	KC level
4B	4. AgricultureB. Manure Management	N2O	KC level	KC trend	KC level	KC level	KC trend	KC level
4D1	4. AgricultureD. Agricultural Soils; Direct Soil Emissions	N2O	KC level	KC trend	KC level	KC level	KC trend	KC level
4D2	4. AgricultureD. Agricultural Soils; Pasture, Range and Paddock Manure	N2O	KC level	KC trend	-	KC level	KC trend	KC level
4D3	4. AgricultureD. Agricultural Soils; Indirect Emissions	N2O	KC level	KC trend	KC level	KC level	KC trend	KC level
5A1	5. LULUCFA. Forest Land1. Forest Land remaining Forest Land	*CO2*	*KC level*	*KC trend*	*KC level*	*KC level*	*KC trend*	*KC level*
5A2	5. LULUCFA. Forest Land2. Land converted to Forest Land	*CO2*	*KC level*	*KC trend*	*KC level*	*KC level*	*KC trend*	*KC level*
5B1	5. LULUCFB. Cropland1. Cropland remaining Cropland	*CO2*	*KC level*	*KC trend*	*KC level*	*KC level*	*KC trend*	*KC level*
5C1	5. LULUCFC. Grassland1. Grassland remaining Grassland	*CO2*	-	-	-	*KC level*	*KC trend*	-
5C2	5. LULUCFC. Grassland2. Land converted to Grassland	*CO2*	*KC level*	*KC trend*	-	*KC level*	*KC trend*	-
5E2	5. LULUCFE. Settlements2. Land converted to Settlements	*CO2*	*KC level*	*KC trend*	*KC level*	*KC level*	*KC trend*	*KC level*
6A	6. Waste A. Solid Waste Disposal on Land	CH4	-	KC trend	KC level	KC level	KC trend	KC level
6B	6. Waste B. Wastewater Handling	N2O	KC level	-	-	KC level	-	KC level
6D	6. Waste D. Other	CH4	-	KC trend	-	KC level	KC trend	-

FOEN (2013)

3.4.6 Recalculation of data

The inventory has been improved continuously and reached a consolidated state. Recalculations that further improve the inventory or that implement recommendations and encouragements from the various review procedures are considered (and approved) by the inventory core group. Substantial recalculations that impact the national total are presented to the National Inventory System Supervisory Board for approval.

3.4.7 Quality Assurance and Quality control (QA/QC)

QA /QC Procedure

The GHG inventory is managed according to an inventory-specific quality management system (QMS) that was established in 2004. This QMS is designed to comply with the quality objectives of Good Practice Guidance of IPCC (2000), to ensure and continuously improve transparency, consistency, comparability, completeness, accuracy, and confidence in national GHG emission and removal estimates. Furthermore, Switzerland adopted timeliness as a quality criterion. Switzerland's inventory system is designed to produce a high quality inventory that ensures full compliance with the reporting requirements of the UNFCCC and the Kyoto Protocol.

The quality management system is designed according to a plan-do-check-act cycle (PDCA cycle), which is a generally accepted model according to international standards. Key findings from QA/QC procedures are included in the inventory development plan (IDP), which represents the main instrument for continuous improvement in subsequent inventory cycles. This approach is in accordance with procedures described in decision 19/CMP.1 (UNFCCC 2006a) and in the IPCC Good Practice Guidance (IPCC 2000, chapter 8). The QMS complies with the ISO 9001:2008 standard and has been certified by the Swiss association for quality and management systems (SQS) in December 2007 (SQS, 2008) and re-certified in 2010 (SQS, 2010). Certification is upheld since through annual audits by SQS. The major QMS elements are summarized below. The detailed state of its implementation is documented in the Description of the Quality Management System (FOEN 2013a).

Responsibilities for QA/QC activities

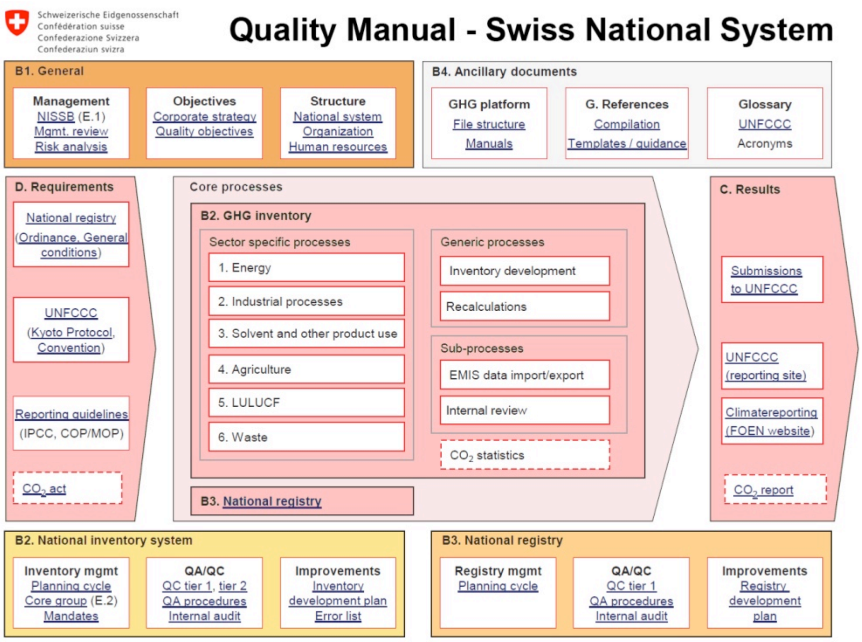
The national inventory system has a dedicated QA/QC officer who is responsible for coordinating and ensuring compliance with procedures related to quality control and quality assurance. QA/QC activities are carried out by everyone involved in inventory preparation, and various cross-checks are set up to minimise inconsistencies and errors in the inventory. Individual responsibilities are described in detail in sections 2.1 and 5.1 of FOEN (2013a). Results from QA/QC activities are documented and reviewed by the QA/QC officer. Based on these feedbacks, suggestions for further improvements of the inventory are developed by the QA/QC officer, which are then discussed in the GHG inventory core group, added to the inventory development plan and assigned to the relevant expert.

QA/QC plan

The QA/QC plan is represented by a quality manual as required by the ISO 9001:2008 standard. This quality manual constitutes the core of the quality management system. It consists of a systematic compilation of all documents relevant to quality issues on the FOEN internal document management system. The quality manual contains information regarding requirements, core processes, and results of the inventory process and the national registry, as well as QA/QC activities, management and supporting documents (Fig. 68, FOEN 2013a). The core processes are represented by detailed flowcharts that specify tasks and responsibilities, data sources and collection processes, reference material and guidelines, and archived documents.

The quality manual is reviewed annually by the QA/QC officer and modified after consultation with the project management if necessary.

Fig. 68 > Overview of the quality manual of the national inventory system



FOEN (2013a)

QC procedures

All contributors to the inventory complete checklists that have been designed according to table 8.1 of the good practice guidance (IPCC 2000). During the period of data collection, the data suppliers fill in the checklists. Once completed, the checklists are returned to FOEN. Simultaneously to GHG inventory preparation, the suppliers of emission data, the national inventory compiler, the NIR lead authors and the project management complete the respective checklists. The QA/QC officer reviews the checklists and contacts the suppliers if concerns about data integrity and/or the quality control procedures arise and arranges for necessary measures to be taken.

In addition to general QC, the inventory project management promotes specific tier 2 QC procedures both by providing for a FOEN (co-)funding of selected research projects and by initiating internal studies, where appropriate. Significant outcomes are fed into the inventory development plan (IDP; FOEN 2013a, chapter 3, Annex E) in order to be considered in future inventory submissions.

QA review procedures

Apart from the UNFCCC reviews of the Swiss inventory, various other efforts are made to assure the high quality standards set out in the quality objectives:

Expert peer reviews are commissioned periodically to provide in-depth analysis of specific sectors. In 2006, energy and industrial processes have been scrutinized, as well as methane emissions from agriculture. In 2009, the waste sector was subject to a domestic expert review. At the end of 2010, a thorough review of the LULUCF sector has taken place. The review of the industrial processes sector has been done in 2012/13.

Internal reviews of the NIR, GHG inventory CRF tables, Kyoto Protocol LULUCF CRF tables, and the QA/QC supplement are made prior to each submission. They are performed by members of the GHG inventory core group as well as by the staff of the consultancies involved in inventory compilation.

The outcomes of all those reviewing activities are evaluated by the project management and the QA/QC officer, resulting in suggestions for amendments and improvements. The core group decides which items are to be followed up and who will take on the responsibility for implementation of the changes in future submissions (IDP).

FOEN operates a homepage (*www.climatereporting.ch*) where the Swiss GHG inventories (NIR, CRF tables, QA/QC supplement, UNFCCC review reports); the Swiss national communications and other reports submitted to the UNFCCC and the Kyoto Protocol may be downloaded. On this web site, most papers, internal reports, domestic reviews, Excel calculation sheets, and other difficult-to-access materials ('grey literature') quoted in the Swiss GHG inventory are provided online. The climate reporting homepage thus provides the option for public review.

Inventory improvements based on recommendations of the ERT

The recommendations made by the Expert Review Team during the annual reviews are taken into the inventory development plan and are the guideline for the ongoing improvement process of the inventory.

Documentation and archiving procedures

Inventory data as well as background information on activity data and emission factors are archived by the national inventory compiler in the EMIS data base. EMIS allows to file background information (e.g. interim worksheets; references; rationale for choice of methods) for any subset of inventory-related data (EMIS 2013/ (NFR-Code); FOEN 2006a).

Information on the QMS, all QA/QC activities performed, decisions reached by the experts (minutes), results of key category analyses and uncertainty analyses as well as inventory development plan (IDP) is docu-mented and archived in the FOEN IDM system and accessible to authorised collaborators via the GHG inventory web platform All inventory information, as far as needed to reconstruct and interpret inventory data and to describe the inventory system and its functions, is archived after each submission. It is accessi-ble at a single location at the FOEN in Ittigen near Bern. Data backup is managed by the Federal Office of Information Technology, Systems and Telecommunication (FOITT) using a storage area network. FOITT runs backup facilities at two distinct locations on a daily as well as on a weekly basis.

Verification activities

The time series have been compared between the current and the previous submission. All activity data, implied emission factors and emissions undergo the triple check:

- the results of the last reporting year are compared with the results of the second last reporting year within the current CRF;
- the CRF tables of the second last reporting year are compared between the current CRF tables and the CRF tables of the previous submission;
- the CRF tables for the base year 1990 are compared between the current CRF tables and the CRF tables of the previous submission.

The findings are discussed among the core group members and the modelling specialists. All differences identified by the verification process are investigated and the reasons for the differences sought. As a further quality assurance step, every submission is reviewed by personnel not directly involved in the preparation of a particular section of the inventory and revised accordingly.

The FOEN supports a monitoring campaign at the high altitude research station Jungfraujoch, where various greenhouse gases are measured continuously. The location of the research station normally provides for analysis of tropospheric background concentrations. However, under special meteorological conditions, an estimate of Swiss emissions can be derived from the measurements. For a couple of F-gases, a comparison of the inventory data with the inferred emissions is presented in Annex A6.1 (FOEN 2013). Further research is needed to refine the approach and apply it to other greenhouse gases.

As an additional activity, the emission factor of all subcategories used in the Swiss Inventory have been compared to the corresponding emission factors of other countries (UNFCCC *http://unfccc.int/di/FlexibleQueries.do*) and to the IPCC default value if available (INFRAS 2012). If respective Swiss values deviate more than ±10% from other countries' average or from the IPCC default value, explanations for the divergence are provided.

Treatment of Confidentiality Issues

Nearly all of the data necessary to compile the Swiss GHG inventory are publicly available. There are, however, a few exceptions:

- Emission data that refer to a single enterprise are in general confidential;
- The reporting of disaggregated emissions of F- gases is confidential (not confidential as aggregated data);
- In the civil aviation sub-sector one data source (FOCA 1991) has been marked confidential by the Federal Office of Civil Aviation (FOCA);
- Unpublished AREA land use statistics raw data have been temporarily classified confidential by the Swiss Federal Statistical Office (SFSO).

Confidential data will be made available by the FOEN in line with the procedures agreed under the UNFCCC for the technical review of GHG inventories (UNFCCC 2003).

3.4.8 Procedures for official consideration and approval of the inventory

The process for the official consideration of the GHG inventory is defined in the mandate of the NIS supervisory board (see section 3.4.3 and Fig. 67). It is furthermore illustrated in the monitoring protocols of NIS core processes and sub-processes assembled in the QA/QC manual (FOEN 2013a). At the NIS supervisory board meeting that takes place after the completion of the inventory (generally in mid-March) the inventory project management submits the National Inventory Report and the CRF tables to the members of the board for consideration. Following that procedure the chair of the NIS supervisory board presents the inventory for official approval to the FOEN directorate.

3.5 National registry

3.5.1 Name and contact information of the registry administrator

Federal Office for the Environment (FOEN)
Swiss Emissions Trading Registry
Climate Division
CH-3003 Berne, Switzerland
Phone: +41 (0)31 322 05 66
Email: *national-registry@bafu.admin.ch*
Registry: *https://www.national-registry.ch*
Web: *http://www.bafu.admin.ch/emissions-trading*

Main Contact
Mrs. Christine Kieffer

Phone: +41 (0)31 322 05 66
E-mail: *national-registry@bafu.admin.ch*

3.5.2 Cooperation with other Parties

Switzerland uses the Seringas™ registry software, which was developed by the French Caisse des Dépôts et Consignations, CDC. Further developments, updates and releases of the software are undertaken in cooperation with all Seringas™ licensees. As of today the same software is used by Belarus, Kazakhstan, Monaco and Russia.

In addition, Switzerland cooperates with Monaco and hosts the registry of Monaco on Swiss servers. Both national registries are however maintained as independent systems with independent registry administrators.

3.5.3 Conformity to the technical standards for data exchange

The Swiss national registry conforms to the technical standards for data exchange as specified in the UNFCCC data exchange standards (DES) for registry systems under the Kyoto Protocol, technical specifications, version 1.1.9 (UNFCCC 2012), of 25.01.2013.

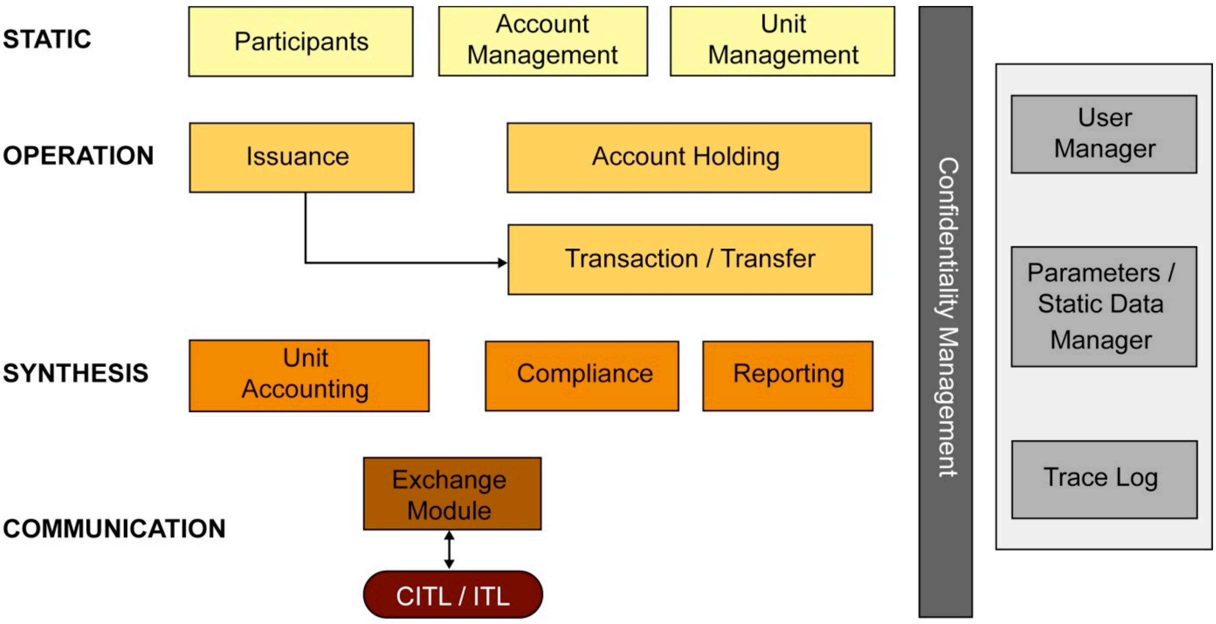
As stated in the independent assessment report IAR, the Swiss national registry has fulfilled the obligations regarding conformity with the DES and is therefore fully compliant with the registry requirements defined in decisions 13/CMP.1 and 5/CMP.1. The Swiss national registry is connected to the ITL and fully operational since 04.12.2007. The daily reconciliations confirm the integrity of the database.

3.5.4 Description of the data base structure and capacity of the national registry

Switzerland has implemented the Seringas™ system using a Microsoft SQL server relational data base management system with a dedicated data model. The total capacity of the registry is only limited by the maximum size of the Microsoft SQL server.

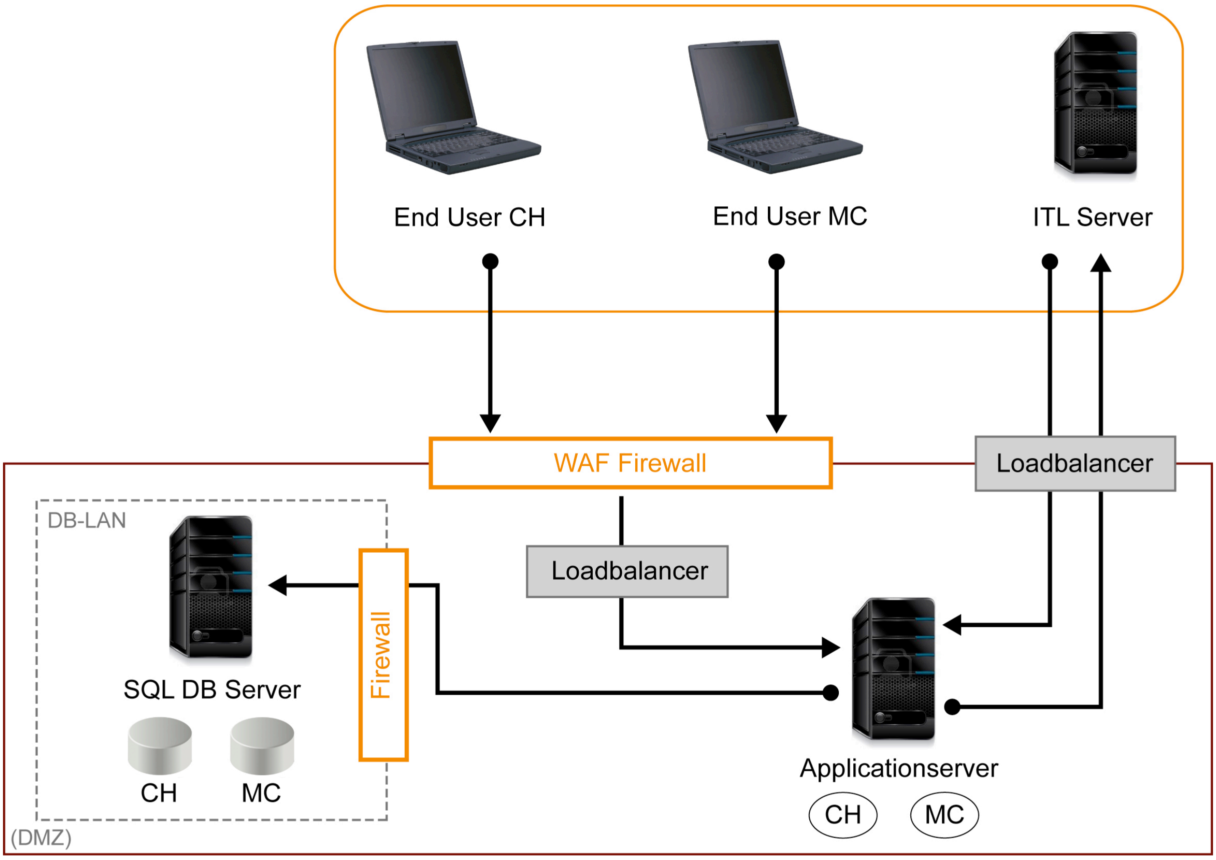
The data model for the national registry was developed by CDC Fig. 69 s a specific characteristic of the data base structure, the registry of Monaco is run in parallel on Swiss servers. The information and communication technology (ICT) architecture is illustrated in Fig. 70.

Fig. 69 > Data model for the Swiss national registry



Caisse des Dépôts et Consignations, CDC

Fig. 70 > Information and Communication Technology (ICT) architecture



FOITT (2013)

3.5.5 Procedures employed to minimize and manage discrepancies and to correct problems

In case of discrepancies, the conformity of the Swiss national registry to DES ensures the correct treatment and reception of information by the ITL. Thus, the common operational procedures of the UNFCCC are followed.

Internal incident and change management procedures were defined in cooperation with Monaco, our support team, and the Federal Office of Information Technology, Systems and Telecommunication (FOITT).

3.5.6 Security measures

The solution is based on a two-tier architecture. The front-end and the database tier are separated from each other by means of a firewall. The front-end tier is protected from the Internet by means of a web application firewall (WAF) and a loadbalancer (reverse proxy). Access to the front-end is restricted to port 443 (https). The users of the system are authenticated by means of a two-factor mechanism requiring username and password as well as a code sent via text messages (smsTAN). In order to keep the system software up to date, the servers are subject to a continuous patch process. All servers are physically installed in a data centre and therefore the appropriate physical controls are in place.

System operations are in compliance with the IT security instructions of the federal administration (FITSU 2007).

3.5.7 Information publicly accessible by means of the user interface

Publicly accessible information is provided on the Swiss national registry website at *https://www.national-registry.ch*. The national allocation plan is accessible under "National Allocation Plan". All other information can be downloaded by selecting the menu item "Public reports". Information made available to the public is conforming to the criteria defined in annex E to decision 13/CMP.1:

- § 45 13/CMP.1:Reports "List of legal entities holding an account in the national registry" and "List of accounts opened in the national registry";
- § 46 13/CMP.1:No report available as no ERUs were issued by Switzerland;
- § 47 13/CMP.1:Report "Annual summary of quantity of units per type of operation made in the national registry";
- § 48 13/CMP.1: Report "List of legal entities holding an account in the national registry".

The following information is considered as confidential, thus not publicly available (Decision 13/CMP.1 paragraphs are indicated in parentheses):

- The total quantity of ERUs, CERs, AAUs and RMUs in each account at the beginning of the year (the total quantity is only available by account type) (Decision 13/CMP.1, paragraph 47(a));
- The identity of the transferring accounts from which ERUs, CERs, AAUs and RMUs were acquired by the national registry of Switzerland (Decision 13/CMP.1, paragraph 47(d));
- The identity of the acquiring accounts to which ERUs, CERs, AAUs and RMUs were transferred from national registry of Switzerland (Decision 13/CMP.1, paragraph 47(f));
- Current holdings of ERUs, CERs, AAUs and RMUs in each account (Decision 13/CMP.1, paragraph 47(l)).

3.5.8 Internet address of the interface to the national registry

The user interface is located on the Swiss national registry website (*https://www.national-registry.ch*).

3.5.9 Measures taken to safeguard, maintain and recover data in the event of a disaster

The backup strategy is illustrated in Tab. 14. The system itself is not redundant. In case of loss of a system, it has to be rebuilt from the backup files.

Tab. 14 > Backup strategy

	Description	Frequency	Retention period	Storage
System data	Full backup	Weekly	3 months	Tape, offsite
	Incremental backup	Daily	1 week	Tape, offsite
Application DB	Online backup of the data base	Daily	3 months	Tape, offsite
	Creating transaction log files	Hourly	1 week	Local system disk on the data base server. This device is separate from the device holding the DB.
Transaction log files	Transaction log files will be subject to the system data backup			

FOITT (2009)

3.5.10 Test procedures

Basic tests are performed by the application support provider SFW, on the international transaction log (ITL) DEVELOPER environment. The Annex H test during the registry initialization process successfully tested the software of the Swiss national registry against the ITL. New versions, updates or bug fixes of the Swiss national registry software are tested in the integration environment before implementation in the production environment. Major changes are tested during the testing cycle on the REGISTRY environment of the ITL. If test end criteria are reached, the new version or update is installed in the production environment.

3.5.11 Status of national registry at the beginning of 2012

The Swiss national registry got fully operational with the international transaction log (ITL) on 04.12.2007. Tab. 15 shows the total quantities of Kyoto Protocol units in the Swiss Registry by account type at the beginning of 2012.

Tab. 15 > Total quantities of Kyoto Protocol units by account type at the beginning of 2012

Standard Electronic Format (SEF) Table 1

	Unit type					
Account type	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**
Party holding accounts	229124568	NO	889349	28740	NO	NO
Entity holding accounts	61584711	7637735	NO	21331575	NO	NO
Sum of Party and entity holding accounts	**290709279**	**7637735**	**889349**	**21360315**	**NO**	**NO**
Article 3.3/3.4 net source cancellation accounts	172587	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	20	NO	NO	578809	NO	NO
Retirement account	NO	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal in storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	**290881886**	**7637735**	**889349**	**21939124**	NO	NO

FOEN (2013)

A summary of the information on starting values and annual transactions in the Swiss registry is given in Tab. 16. Tab. 17 shows the total quantities of Kyoto Protocol units in the Swiss registry by account type at end of 2012. All three tables (Tab. 15, Tab. 16, and Tab. 17) are part of the standard electronic format (SEF) for reporting Kyoto Protocol units, as per decision 14/CMP.1 and decision 15/CMP.1 section I.E.

Tab. 16 > Summary information on additions and subtractions

Standard Electronic Format (SEF) Table 5(a)

	Additions					
	Unit type					
Starting values	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**
Issuance pursuant to Article 3.7 and 3.8	242838402					
Non-compliance cancellation						
Carry-over	NO	NO		NO		
Sub-total	242838402	NO		NO		
Annual transactions						
Year 2007	NO	NO	NO	302480	NO	NO
Year 2008	42859242	NO	NO	114864819	NO	NO
Year 2009	20744628	2937304	NO	124002707	NO	NO
Year 2010	62533288	13831338	NO	89445539	NO	NO
Year 2011	28605616	48645038	889349	87585470	NO	NO
Year 2012	34105658	345090673	979764	177617154	74930	NO
Sub-total	188848432	410504353	1869113	593818169	74930	NO
Total	**431686834**	**410504353**	**1869113**	**593818169**	**74930**	**NO**

	Subtractions					
	Unit type					
Starting values	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**
Issuance pursuant to Article 3.7 and 3.8						
Non-compliance cancellation	NO	NO	NO	NO		
Carry-over						
Sub-total	NO	NO	NO	NO		
Annual transactions						
Year 2007	NO	NO	NO	NO	NO	NO
Year 2008	22000000	NO	NO	91733307	NO	NO
Year 2009	1469850	1385986	NO	128620906	NO	NO
Year 2010	32540664	10109101	NO	91028907	NO	NO
Year 2011	50861383	46280858	NO	78057580	NO	NO
Year 2012	53465884	295761046	345431	155415116	NO	NO
Sub-total	160337781	353536991	345431	550255816	NO	NO
Total	**160337781**	**353536991**	**345431**	**550255816**	**NO**	**NO**

FOEN (2013)

Tab. 17 > Total quantities of Kyoto Protocol units by account type at the end of 2012

Standard Electronic Format (SEF) Table 4

	Unit type					
Account type	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**
Party holding accounts	237265784	NO	1523682	49100	NO	NO
Entity holding accounts	34083269	56967362	NO	43513253	74930	NO
Sum of Party and entity holding accounts	**271349053**	**56967362**	**1523682**	**43562353**	**74930**	**NO**
Article 3.3/3.4 net source cancellation accounts	172587	NO	345431	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	84	NO	NO	750158	NO	NO
Retirement account	NO	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal in storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	**271521724**	**56967362**	**1869113**	**44312511**	**74930**	**NO**

FOEN (2013)

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4 Policies and measures

4.1 General policy context

The overarching context for environment and climate policy is the federal Constitution where, prominently in the opening paragraphs (Swiss Confederation 1999a, Art. 2), sustainable development is listed as one of the main objectives. In pursuit of this commitment, Switzerland has established an Interdepartmental Sustainable Development Committee (ISDC), which defined the priorities for action and oversees implementation and monitoring of progress. The intention is to make sustainability assessments an integral part of decision-making and policy evaluation.

The Federal Council has set out its main policy focus areas for sustainable development in its "Sustainable Development Strategy 2012-2015", adopted as part of the Swiss government's regular legislative planning cycle. It represents an important contribution on the part of Switzerland to the United Nations Conference on Sustainable Development ("Rio+20"), which was held in Brazil in June 2012.

The current strategy - the fourth of its kind since 1997 - centres around a renewed Action Plan. This features a range of measures that are grouped according to the ten key challenges facing sustainable development in Switzerland. The strategy reviews the implementation of sustainable development policy over the past 20 years and, in the interests of continuity, picks up on the guidelines defined in the previous version.

With a view to achieving the goals defined in the strategy, this latest version also 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 strategy sets out the institutional framework for strategy implementation.

One of the Federal Council's overarching objectives for the incorporation of the sustainable development principle into the activities of the federal government is to combat global warming, in particular by reducing energy consumption and the increasing use of renewable energies, and to manage natural hazards. Switzerland's climate and energy policies are in line with the sustainable development strategy.

By ratifying the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, Switzerland committed to contribute to the stabilization of GHG emissions at a level that would prevent dangerous anthropogenic interference with the climate system. In addition, Switzerland has ratified the Kyoto Protocol, which sets Switzerland's national GHG emission target to 8% below 1990 emissions over the period from 2008-2012.Switzerland has also committed to continue its emission reduction efforts under the Kyoto Protocol for the years 2013-2020 to achieve a reduction of 20% below 1990 levels by 2020 (see section 4.1.1.).

The implementation of measures to reach the national emission targets is divided between different authorities. In Switzerland, the principle of subsidiarity is deeply ingrained (Swiss Confederation 1999a, Art. 3, 5a) and therefore the allocation of tasks to the federal authorities is limited in favour of cantonal or municipal authorities. While the strategic decisions and the overall framework lie within the remit of the federal authorities, the concrete legislation and its implementation very often remains within the competences of the cantons (Swiss Confederation 1999a, Art. 74). This is reflected in the complex and diverse cantonal and federal legislative frameworks that are relevant to the overall Swiss climate policy. Consequently, the funding of measures is also divided between federal, cantonal and private entities, depending on the individual measures. For some measures, for example, federal funds are allocated to cantonal implementing agencies, provided cantonal funds matching the amount of the federal contribution are also allocated.

The Swiss political system, with its strong public participation process (see section 2.1), thus leads to a wealth of implementing agencies and a complex funding structure. Policies and measures funded (at least partly) by federal funds are subject to evaluation by the Swiss Federal Audit Office. Specific incentive programmes are normally evaluated independently during and at the end of their implementation.

4.1.1 Quantified economy-wide emission reduction target

International and national contexts of Switzerland's commitments to economy-wide emission reduction targets

By ratifying the UNFCCC in 1993, Switzerland committed to contribute to the stabilization of GHG emissions at a level that would prevent dangerous anthropogenic interference with the climate system. To deepen its commitment, Switzerland ratified the Kyoto Protocol in 2003, which entered into force in 2005. In this context, Switzerland committed to quantified emission reductions for the first commitment period (2008-2012). Switzerland is continuing its emission reduction efforts under the Kyoto Protocol and has committed for the second commitment period (2013-2020), pending ratification by the Parliament, to further emission reductions. In parallel to an emission reduction commitment under the Kyoto Protocol for the second commitment period, Switzerland has committed to the corresponding emission target under the Convention under its system of "pledge and review" where the majority of Parties to the Convention have announced emission reduction targets.

The corresponding national legislation has been set in place. The CO_2 Act that entered into force on 1st May 2000 set emission reduction objectives and instruments, in view of achieving the Kyoto commitment of the first period. In the meantime, this Act has been revised to allow a continuation of the climate policy after 2012. It was approved by the Parliament at the end of 2011 and entered into force on 1st January 2013.

Quantified economy-wide emission reduction target for the period 2008-2012

Under the first commitment period of the Kyoto Protocol, the national GHG emission target of Switzerland for the period 2008-2012 was set at 8% below the emissions of 1990 (Annex 2, Table 2(a)). Switzerland translated this reduction commitment into national targets for energy related CO_2 emissions. Within the CO_2 Act approved by the Parliament on 8th October 1999 (entry into force on 1st May 2000) (Swiss Confederation, 1999b), CO_2 emissions from fossil fuels are required to decrease by 10% over the period 2008-2012 compared to 1990. This overall objective is split between fossil thermal fuels (for heating and process) with a reduction target of 15%, and fossil motor fuels (transport) with a reduction target of 8%. The CO_2 Act allows the use of the flexible mechanisms to comply with these reduction targets, as under the Kyoto Protocol (see section 4.4.2).

The CO_2 Act complies with the Swiss commitment under the Kyoto Protocol. While the CO_2 Act only covers approximately 80% of the total GHG emissions as regulated under the Kyoto Protocol, the reduction target of 10% in the CO_2 Act has been set to reach the Kyoto target, provided that the other five GHG emissions under the Kyoto Protocol remain unchanged compared to 1990.

Quantified economy-wide emission reduction target for the period 2013-2020

The revised CO_2 Act covering the period 2013-2020 was approved by the Parliament on 23rd December 2011 (entry into force on 1st January 2013) (Swiss Confederation 2011). Based on this legislation, Switzerland will reduce its GHG emissions at least by 20% by 2020 in comparison to the 1990 levels (Annex 2, Table 2 (a)). This emission reduction target is unconditional both under the Kyoto Protocol and the Convention.

As planned in the revised CO_2 Act, the Federal Council may increase the reduction target in accordance with international agreements. Switzerland would consider a higher reduction target up to 30% by 2020 compared to 1990 levels, subject to comparable emission reduction commitments from other developed countries and adequate contribution from developing countries according to their responsibilities and capabilities in line with the 2°C target. This target was set at the 16th Conference of the Parties (COP 16) in 2010 as the maximum global average temperature in comparison to pre-industrial levels that should not be surpassed, in reference to the requirements of science and as documented in the Fourth Assessment Report of the IPCC.

Gases and sectors covered

Whereas the CO_2 Act in its former version that was in force until the end of 2012 (Swiss Confederation 1999b) translated Switzerland's objective under the Kyoto Protocol into national targets related to CO_2 emissions only, Switzerland's quantified economy-wide emission reduction target by 2020 under the national legislation covers all gases and sectors covered under the Kyoto Protocol for the same period (2013-2020) (Annex 2, Table 2(b, c)). The CO_2 Ordinance for the period 2013-2020 (Swiss Confederation 2012), which implements the revised CO_2 Act (Swiss Confederation 2011), allows for a harmonization of the gas coverage between the national target and the international commitment under the Kyoto Protocol for the second commitment period.

Global warming potential values

For the first commitment period under the Kyoto Protocol, Switzerland uses the global warming potential (GWP) values provided by the IPCC in its Second Assessment Report ("1995 IPCC GWP values") (IPCC 1995) based on the effects of the GHG over a 100-year time horizon, as per decision 2/CP.3, paragraph 3. For the second commitment period under the Kyoto Protocol, as per decision 15/CP.17, paragraph 2, Switzerland uses the GWP values listed in the column entitled "Global warming potential for given time horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the IPCC (IPCC 2007), based on the effects of greenhouse gases over a 100-year time horizon, as included in annex III to decision 15/CP.17. These GWP values are reflected in annex one of the CO_2 Ordinance for the period 2013-2020 (Annex 2, Table 2(b)).

Use of market-based mechanisms

Switzerland will use carbon credits generated from the flexible mechanisms under the Kyoto Protocol (Certified Emission Reductions (CERs) from the Clean Development Mechanism (CDM) and Emission Reduction Units (ERUs) from Joint Implementation (JI)) and from the new market-based mechanisms under the Convention to reduce its emissions over the period 2013-2020. The exact amount of carbon credits is not yet known (Annex 2, Table 2(e) I) and Table 2(e)II).

The revised CO_2 Act for the 2013-2020 period (Swiss Confederation 2011) defines Switzerland's -20% target as domestic, however carbon credits for emission reductions achieved abroad will play a role in the case of fossil fuel thermal power plants, the emissions trading scheme (ETS), companies exempted from the CO_2 levy that are not participating in the ETS, as well as in the sanction mechanism. Furthermore, Switzerland will use additional carbon credits recognized under the Kyoto Protocol to meet the difference between the approach used under the national legislation (i.e. emission reduction target defined for the year 2020) and the one of the Kyoto Protocol (i.e. "carbon budget" approach used to calculate the quantified emission limitation or reduction commitment (QELRC) for a period).

For a possibly higher target than -20% by 2020 compared to 1990, in addition to the carbon credits that will be used for achieving the -20% target (see above), carbon credits will also be used by Switzerland for maximum three fourth of the additional emission reductions beyond the -20% target by 2020 compared to 1990, as planned in the CO_2 Act for the 2013-2020 period.

As of 2013, Switzerland is applying qualitative restrictions on the use of carbon credits. In this context, Switzerland will use carbon credits generated from the new market mechanisms under the Convention (which may include possible carbon credits from approaches reducing emissions from deforestation and forest degradation in developing countries (REDD) if the quality of the mechanisms is guaranteed.

Under the Kyoto Protocol, Switzerland does not plan to buy Assigned Amount Units (AAUs) from other countries but does not exclude the use of AAUs from other countries through the linking of its emission trading scheme (ETS) with other schemes. Switzerland may use a limited amount of its own carried-over AAUs.

Approach to counting emissions and removals from the LULUCF sector

According to Art. 3.7 of the Kyoto Protocol, the LULUCF sector is only included in the calculation of the assigned amount, when this sector constituted a net source of GHG emissions in 1990. In Switzerland, the LULUCF sector was a net sink in 1990 and is therefore excluded from the base year level and target (Annex 2, Table 2(d)).

The reporting under UNFCCC of the LULUCF sector is land-based. The activity-based approach is valid for accounting under the Kyoto Protocol. Switzerland accounts for the KP Art. 3.3 activities Afforestation and Reforestations, Deforestation and for the KP Art. 3.4 activity Forest management.

4.2 Domestic and regional programmes pursuant to the implementation of the Kyoto Protocol

The principles and instruments of Swiss environmental policy are stipulated in the Federal Act on the Protection of the Environment, adopted in 1985 and revised several times since then. The CO_2 Act supplements this modern legislative framework (section 4.1) and provides the principle basis for the Swiss national policy on climate change.

The Environmental Protection Act and the CO_2 Act have a direct bearing on compliance with commitments under the first and second commitment periods of the Kyoto Protocol. Furthermore, the Environmental Protection Act provides for measures to mitigate emissions from waste disposal (CH_4), synthetic gases (HFC, PFC, SF_6) and GHG precursors. Fiscal incentives are recognized as an essential instrument for promoting the efficient use of resources.

Additionally, the Federal Council and the Parliament decided in 2011, in the aftermath of the nuclear accident in Fukushima, to exit step by step from nuclear power production. The Federal Council is about to adopt its new energy strategy 2050. In a first stage, the strategy will introduce a package of necessary policies and instruments to foster the use of renewable energies, to improve the energy efficiency and thereby to reduce energy and power consumption until 2020. Therefore, the new energy strategy shall contribute to achieve the long term goals of Switzerland's climate policy – to reduce GHG emissions to 1 – 1,5 tonnes per year and person.

The Swiss national legislation also provides the basis for the implementation and use of the flexible mechanisms of the Kyoto Protocol, in particular the CDM and JI, so that Switzerland's participation in these mechanisms is possible.

Institutional arrangements with regards to the flexible mechanisms

The national secretariat for the flexible mechanisms (Designated National Authority (DNA) under the CDM and Designated Focal Point (DFP) under JI) entitled SwissFlex was established in 2004 and announced to the UNFCCC in 2007. Activities relating to the implementation of the flexible mechanisms as well as enquiries concerning the mechanisms and the examination and approval of project proposals are coordinated by an interdepartmental working group called IDA-Klima, HF6. Besides FOEN, the members of this group are drawn from the Swiss Federal Office of Energy (SFOE), the State Secretariat for Economic Affairs (SECO), the Swiss Agency for Development and Co-operation (SDC) and the Federal Department of Foreign Affairs (FDFA). The homepage of the national secretariat for the flexible mechanisms can be found here: *http://www.bafu.admin.ch/emissionshandel/06135/index.html?lang=en*.

By April 2013, the Swiss DNA had issued some 2500 letters for CDM projects. 40% of these letters were letters of approval to Swiss or Swiss-based entities and 60% were letters of authorization for participation in already registered projects, mainly to foreign entities. The issuance of authorizations to foreign entities is mainly due to the early connection of the Swiss registry to the international transaction log (ITL) of the UNFCCC. Indeed, in order to be able to transfer CERs from the CDM registry into a national registry, an authorization from the receiving registry is needed. Therefore, many foreign entities willing to deliver early credits opened an account in the Swiss registry and applied for authorizations.

By April 2013, the Swiss DFP had issued some 150 letters of approval for JI projects to Swiss or Swiss-based entities.

4.3 Sectoral and cross-sectoral policies and measures

This section describes policies and measures in the different policy sectors. Some of the policies are developed across sector boundaries. In section 4.3.1, an overview over most recent developments is given, followed by a brief description of the general framework of environmental legislation (4.3.2). The section on climate policy (4.3.3) focuses on the CO_2 Act and the measures directly related to it. The following section (4.3.4 Energy) deals with policies and measures related to energy efficiency, reduced energy consumption and renewable energy, while the subsequent section (4.3.5 Transport) includes aspects of spatial development, transport infrastructure, sustainable modes of transport and emission standards. The remaining sections are concerned with the respective sectors: Industry (4.3.6), agriculture (4.3.7), forestry (4.3.8) and waste (4.3.9).

4.3.1 Most important developments since 2009

The most important developments in the Swiss Climate Policy are:

- Revised CO_2 Act coming into force in January 2013 covering the period until 2020. One target is to reduce GHG emissions by 20% by 2020 compared to 1990. Reductions are to be achieved domestically only;
- Start of the Building programme 2010-20, financed via a share of one-third of CO_2 tax revenues (at most CHF 200 million per year) and funds from the cantons; managed by the federal government and cantons. Cap will be raised to CHF 300 million per year, if CO_2 tax is increased;
- Replacement of the Climate Cent on fuels for transport (0.015 CHF/litre), a private sector initiative running from 2005 to 2012, by the obligation to offset 5-40% of the transport-related CO_2 emissions under the restriction that compensation cost do not exceed 0.05 CHF/litre by importers of fossil motor fuels, starting 2013;
- Second term of SwissEnergy programme 2011-2020 (follow-up to Energy 2000 and first term SwissEnergy programme 2006-2010); under the new energy strategy 2050 (4.3.4) the SwissEnergy programm is being reinforced for the period 2013-2020.
- Decision of the Federal Council to phase out of nuclear energy after the accident at the Fukushima Daiichi nuclear power plant, approved by the parliament in September 2011. The energy strategy 2050 launched by the Federal Council in April 2012 will be submitted to parliament in mid-2013 and is expected to enter into force at the beginning of 2015.

4.3.2 Environmental policy

Swiss environmental policy is addressing a wide spectrum of environmental issues within Switzerland, ranging from pollution of air, water and soil, exposure to noise, to protecting stratospheric ozone or to reducing and managing waste. The fight against climate change is a major aspect in the Swiss environmental policy.Some of these policy areas are linked directly or indirectly to Swiss GHG emissions.

The Environmental Protection Act is based on three main principles:

- Principle of precaution;
- Control of ecological damage at source;
- "Polluter pays" principle.

The main instruments to implement these principles are the definition of legally binding emission limits, introduction of levies on potentially damaging substances or practices, as well as the obligation of environmental compatibility assessments for particular facilities and installations. The Environmental Protection Act also stipulates that the Confederation and the cantons monitor the state of the environment and its evolution. The latest national report on the state of the environment has been published in July 2013 (FOEN 2013b), documenting the current state of the environment and the effectiveness of the measures taken to date.

The principles of the environmental policy have been realigned in recent years. One of the main objectives was to increase the efficiency of action on environmental policy. In many areas of the policy the focus is now on economic incentives to encourage environmental behaviour and joint problem solving by all the parties involved.

Apart from the Environmental Protection Act, there are various other legislative arrangements that are related to environmental issues. The two most relevant laws in the context of climate change mitigation are the CO_2 Act and the Energy Act. The Forests Act, the Spatial Planning Act, the Agriculture Act, the Road Traffic Act, and Heavy Vehicle Charge Act and the Technical Ordinance on Waste have components that contribute to sectoral policies. A detailed description of policies and measures is given in the following sections.

In view of the international dimension of environmental problems, Switzerland seeks to further international efforts to tackle problems on a global level. Environmental issues are an integral part of Swiss foreign policy, and Switzerland is contributing at a political as well as at a technological level to resolving environmental problems in multilateral consortia.

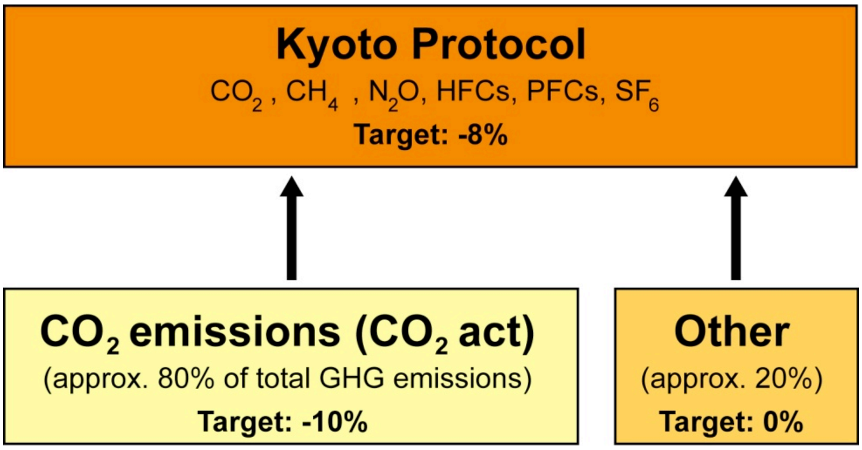
4.3.3 Climate policy

The centrepiece of Swiss climate policy is the CO_2 Act. The first CO_2 Act (Swiss Confederation 1999b) entered into force in 2000 and covers the period from 2008-2012 and the fully revised CO_2 Act (Swiss Confederation 2011) the period from 2013-2020. Apart from the objectives, they contain policies and measures to reach the set targets.

The first CO_2 Act took effect in 2000 and formed the legal framework for implementing Switzerland's international commitment. It limits CO_2 emissions from fossil fuel use for heating and transport to 10% below 1990 levels over the period from 2008-2012. The overall target is further divided into a reduction target of 15% on heating and process fuels and 8% on transport fuels and is by concept sufficient to reach the Kyoto target, provided that the other greenhouse gas emissions remain unchanged compared to 1990 (Fig. 71).

Fig. 71 > Comparison of emission reduction targets set out under the Kyoto Protocol and CO_2 Act

The CO_2 Act exclusively limits the emissions of CO_2 from fossil fuel use for transport and heating. The reduction target (-10% compared to 1990) is therefore higher than the target defined by the Kyoto Protocol (-8% compared to 1990), which covers 6 greenhouse gases. A 8% reduction of the total emissions could be translated into a 10% reduction of 80% of the total greenhouse gas emissions, provided the remaining 20% are unchanged.



The primary instruments to reach the targets for the period 2008-2012 are:

- voluntary actions in various areas;
- subsidiary CO_2 levy for heating and process fuels as well as transport fuels;
- measures in other policy areas that are relevant to climate change mitigation;
- emissions trading scheme (cap and trade) and complementary use of flexible mechanisms.

The CO_2 Act obliged the Federal Council to propose further reduction targets for the time period after 2012. The legislative process was initiated by a popular initiative „for a sound climate", which requested domestic emission reductions of at least 30% below 1990 by 2020, mainly by promoting energy efficiency measures and renewable energy. Following public consultation, the Federal Council put forward a draft CO_2 legislation for parliamentary discussion in August 2009 as a counter-proposal to the popular initiative "for a healthy climate". The fully revised CO_2 Act, which covers the period from 2013-2020, was adopted by parliament in 2011 and came into force on 1st January 2013 (Swiss Confederation 2011).

It contains the national reduction target that demands a reduction of domestic GHG emissions by at least 20% by 2020 compared to their 1990 level. Since the emission reductions have to be realized mainly within Switzerland, the existing potential for greenhouse gas reductions can be exploited. Hereby, the revised CO_2 Act sets incentives to increase the use of renewable energies, to develop new, innovative technologies and creates new working places in promising areas.

The reduction target is shared between the building, transport and industrial sectors. It is expected that, compared with 1990 levels, a 40% reduction in the building sector, a 10% reduction in the transport sector and a reduction of 15% in the industrial sector can be achieved by 2020. In line with the continuous reduction, the CO_2 ordinance sets interim targets for 2015 in these three sectors. If developments suggest that the targets will not be reached, DETEC will propose additional measures to the Federal Council.

The revised CO_2 Act sets out various measures for buildings, transport and industry. Some measures of the first CO_2 Act (Swiss Confederation, 1999b), such as the CO_2 levy on heating and process fuels, the building refurbishment programme as well as the CO_2 emission limits for new cars, will be continued.

On the international level within the framework of the second commitment period of the Kyoto Protocol from 2013-2020, Switzerland declared its intentions to reduce its GHG emissions by 20 % below their 1990 level by 2020.

The following paragraphs describe the main policies and measures of Switzerland's Climate policy:

The CO_2 levy on heating and process fuels (2008 - today)

By increasing the price of heating fuels, the CO_2 levy set 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 schedule for introducing the CO_2 levy and its rates were adopted by parliament in March 2007. Depending on the development of the CO_2 emissions from heating and process fuels in comparison with yearly interim targets, the CO_2 levy was to be increased gradually. It was introduced as of January 2008 at an initial rate of CHF 12 per tonne of CO_2 and left at that level for 2009. In January 2010, it was increased to CHF 36 per tonne CO_2, because CO_2 emissions from heating and process fuels in 2008 were above the threshold triggering the increase.

The CO_2 levy is to be continued under the revised CO_2 Act. It will be increased from the current CHF 36 to CHF 60 per tonne of CO_2 from 1 January 2014, because the intermediary target set for 2012 was not met. Further increases are possible in 2016 and 2018, depending on reduction targets triggering the increase. The revised CO_2 Act sets the maximum levy at CHF 120 per tonne of CO_2.

Certain sectors of the economy which are particularly affected by the CO_2 levy and which operate in competitive international markets may, as under the first CO_2 Act, apply for exemption from the CO_2 levy, provided the company commits to emission reductions (for more details see paragraphs below).

While the proceeds from the CO_2 levy were initially to be fully and equally refunded per capita to the Swiss population and to the business community in proportion of wages paid, a parliamentary decision of June 2009 earmarked a third (up to a maximum of CHF 200 million per year) of the revenues from the CO_2 levy for the building refurbishment programme. The cap was liftet from CHF 200 to 300 million per year with the new legislation. The program is partly co-funded out of cantonal budgets and co-managed by the federal government and the cantons (see paragraph "building refurbishment programme" and section 4.3.4).

Emissions trading scheme (2008 - today)

Switzerland introduced its emissions trading scheme (ETS) in 2008 in order to give companies, especially those industries with substantial CO_2 emissions from the use of heating and process fuels, the possibility to be exempted from the CO_2 levy. The ETS is based on the cap and trade principle. Under the first CO_2 Act, tradeable emission allowances were issued every year to the companies participating in the ETS (ETS companies) up to their defined reduction target. The amount of emission allowances issued to the companies depended on the technological potential and economic viability of various measures within the company. Companies had to surrender each year enough allowances to cover their emissions.

Under the revised CO_2 Act, the ETS continues. For the period 2013-2020 it has been enlarged and aligned with the European Emissions Trading Scheme (EU ETS) with a view to link both systems. Noteable amendements include the mandatory nature of the ETS for large, greenhouse gas-intensive companies and partial auctioning of emission allowances. For those allowances still given away for free, harmonised allocation rules apply which are based on the same benchmarks of emissions performance as in the EU.

Exemption from CO_2 levy without participation in the ETS (2008 - today)

The first CO_2 Act provided the possibility for companies with substantial CO_2 emissions to apply for exemption from the CO_2 levy without participation in the ETS, provided the company commits to emission reductions. The company has to elaborate an emission reduction target, based on the technological potential and economic viability of various measures within the company. The possibilty for companies of certain sectors with substantial CO_2 emissions to apply for exemptions still exists under the revised CO_2 Act. The instrument has been slightly adapted for the period 2013-2020.

Guidelines and ordinances regulate the CO_2 levy and the procedures for exemption.

Building programme (2010 - today)

In order to increase the refubishment rate of buildings and to promote the use of renewable energies in the building sector, a third of the revenues from the CO_2 levy on heating and process fuels, up to a maximum of CHF 200 million per year, were earmarked for this purpose (see also section 4.3.4). The new building programme has superseded the building programme that was run in the framework of SwissEnergy and is financed by a financial input from the revenues of the CO_2 levy. It was adopted by parliament in 2009 and is operational since 1st January 2010. It is limited to ten years. A mid-term evaluation must be sumitted to the parliament in 2015.

However, with the revision of the CO_2 Act, the parliament increased the maximum amount earmarked for the building programme from CHF 200 million to CHF 300 million per year (the effective increase is related to the increase in the CO_2 levy). As the CO_2 levy will be augmented in 2014, more financial means are available to promote measures to reduce emissions in buildings.

The funds for the building refurbishment programme are split between two sub-programmes: Two thirds are dedicated to refurbishing existing buildings (national building programme part A), and up to one third is used to subsidize renewable heating systems, use of waste heat, and services engineering (national building programme part B).

The entire programme is estimated to result in a cumulative reduction of up to 2.9 million tonnes CO_2 by 2020.

The Climate Cent (2005 - 2013) and the obligation to compensate for importer of fossil transport fuels (2013 - today)

The revenue from the private sector initiative “Climate Cent”, the price surcharge levied on all petrol and diesel imports at a rate of 1.5 cents per litre since October 2005, was fed into the Climate Cent Foundation. The purpose of the Climate Cent Foundation, the implementing entity for the levy on transport fuels, was to invest those revenues into projects aimed at reducing CO_2 emissions in Switzerland and abroad. Annually, approximately CHF 100 million was available for such mitigation projects.

With these funds, the Climate Cent Foundation had to meet the reduction target of totally 17 million tonnes CO_2 over the period 2008-2012, as agreed with the Federal Department of the Environment, Transport, Energy and Communications (DETEC). Of the total reductions, at least 2 million tonnes needed to be offset within Switzerland, either in the transport, the building, or the industrial sector. The major part of the annual reduction commitment could be met by use of project-based mechanisms as set out in the Kyoto Protocol. The Climate Cent Foundation could either fund mitigation projects abroad and count the resulting emission reduction certificates towards its commitment or buy certificates from third parties to match its target. All international credits needed to be issued from projects approved as per the rules of the Kyoto Protocol in order to count towards the reduction target. The Swiss Climate Cent Foundation can fulfil all its commitments until the end of 2013.

Under the revised CO_2 Act the climate cent has been replaced by an obligation for fossil fuels importers to compensate part of the transport-generated CO_2-emissions (see section 4.3.5 for details).

Regulations for combined cycle power plants (2008 - today)

According to a federal decree that came into force in January 2008, planned combined cycle power plants that are run by fossil fuels only obtain planning permission if their CO_2 emissions are fully compensated. The compensation should be achieved domestically to at least 70%, with supplementary use of emission certificates. If an electricity shortage is imminent, the share of domestic compensation can be reduced to 50%. Since the federal decree was coming to an end, the parliament decided in 2010 to integrate the obligation to fully compensate the emissions caused by combined cycle power plants that are run by fossil fuels into the CO_2 Act. The partial revision of the Act came into force in 2011.

The obligation to compensate emissions caused by gas fired combined cycle power plants continues under the revised CO_2 Act. Compared to the first CO_2 Act, the possibility to use the flexible mechanisms as foreseen by the Kyoto Protocol has been raised from 30 to 50%.

Regulations for CO_2 emission levels for the new passenger car fleet (2012 - today)

Since the effect of a voluntary agreement between the Swiss automobile importers and DETEC was insufficient, the parliament amended the CO_2 Act in 2011 to include CO_2 emission targets for newly registered vehicles. These prescriptions came into effect in spring 2012 and are based on the EU regulation. The first target has been set at 130g CO_2 /km by 2015 (see section 4.3.5. for details).

The CO_2 emission standards for new cars introduced in 2012 are continued under the revised CO_2 Act. Until 2015 the average of the imported car fleet has to be below the limit of 130g CO_2 per km. New objectives for passenger cars as well as the introduction of CO_2 emission standards for vans and light-duty vehicles, which have to be achieved until 2020, are currently under parliamentarian discussion.

Tax exemptions and reductions

Tax exemptions and reductions can provide some form of support to users of fossil fuels and biofuels. As described above, companies can apply for exemption of the CO_2 levy on fossil fuels if they commit to achieve emission reduction targets.

Exemptions and reductions from other taxes are not widespread. Switzerland has so far only a few companies and farmers which benefit from reductions in the rate of the excise tax on petroleum. Since July 2008, biofuels have attracted full relief from the mineral oil tax, provided they comply with certain minimum environmental and social criteria. Some vehicles such as agricultural vehicles or vehicles used for the concessionary transport of persons are also exempted from the Heavy Vehicle Fee.

Technology fund (2013 - today)

A technology fund is established and financed with CHF 25 million a year from the revenue of the CO_2 levy. This fund provides for loan guarantees for innovative companies to ease access to debt capital dedicated to invest in developing new low-emission technologies.

Adaptation (2013 - today)

In the revised CO_2 Act, adaptation is included as complementary measure to mitigation. On this basis, an adaptation strategy has been developed and will be implemented with an action plan.

Tab. 18 > Summary of climate policies and measures

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in million tonnes CO_2 equivalent)					
						1995	2000	2005	2010	2015	2020
CO_2 Act	-10% CO_2 attributable to the use of fossil fuels as energy sources, over the period 2008-2012; -20% by 2020 in comparison to 1990	Only CO_2 until 2012 and all Kyoto GHG since 2013	legislation	implemented, in force since 1.5.2000 (first CO_2 Act) and 1.1.2013 (fully revised CO_2 Act)	FOEN	[a]	[a]	[a]	[a]	[a]	[a]
Exemption from CO2 levy without participation in the ETS	Emission reduction targets to obtain exemption from CO_2 levy	CO_2, N_2O, PFCs	Economic	implemented, in force since 1.1.2008	FOEN (with SFOE support), targets developed with third parties; companies exempted from the CO_2 levy	n.a.	n.a.	n.a.	0.38-0.50	0.45-0.60	0.45-0.60
Emissions trading scheme (cap and trade)	Using market mechanisms to achieve greenhouse gas reductions	CO_2, N_2O, PFCs	Economic	implemented, in force since 1.1.2008	FOEN; companies exempted from the CO_2 levy	n.a.	n.a.	n.a.	n.e.	0.4.	0.8.
Use of the flexible mechanisms of the Kyoto Protocol	Using market mechanisms to help achieving emission reduction targets at least cost	All Kyoto GHG	Economic	implemented, in force since 2008	Entities according to the Kyoto Protocol; FOEN; companies exempted from the CO_2 levy	n.a.	n.a.	n.a.	3.0	n.a.	n.a.
CO_2 levy	Promotion of energy efficiency and less CO2 intensive energy sources. Reduce use of fossil heating fuels[b,c].	CO_2	Fiscal, economic	implemented, levied since 1.1.2008 (rate has been evolving over time and can further evolve)	FOEN	n.a.	n.a.	n.a.	0.2	0.8	2.0
National building refurbishment programme (Part A)	Refurbishment of existing buildings envelope to reduce CO_2 emissions[d]	CO_2	Economic, incentive and subvention	adopted for 2010-2012, running for 2013-2019	FOEN/SFOE	n.a.	n.a.	n.a.	0.01	0.4	0.9
Climate Cent	0.015CHF/litre diesel or petrol: buying emission reduction certificates from the flexible mechanisms of the Kyoto Protocol	CO_2	Financial	levied 2005-2012, implemented from 2005 to 2012	Climate Cent Foundation	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Climate Cent	0.015CHF/litre diesel or petrol: Additional mitigation projects within Switzerland	CO_2	Negotiated	levied 2005-2012, implemented since 2005	Climate Cent Foundation	n.a.	n.a.	n.a.	0.2	0.1	0.1

Obligation for compensation for transport fossil fuel importers	Offset part of the CO_2 emissions caused by the use of transport fuels	CO_2	Regulatory, economic	implemented since 2013	FOEN;Transport fuels importers	n.a.	n.a.	n.a.	n.a.	0.3	1.5
CO_2 emissions regulations for new passen-ger cars	Reduction of average fuel consumption of new cars	CO_2	Regulatory	implemented since 2012	SFOE, FEDRO; Importers and manufacturers of passenger cars	n.a.	n.a.	n.a.	n.a.	0.7	1.7
Obligation to offset emissions from gas fired combined cycle power plants	Offset CO_2 emissions from gas fired combined cycle power plants	CO_2	Regulatory	implemented since 2008	FOEN; Gas fired combined cycle power plants	n.a.	n.a.	n.a.	n.a.	0.75	0.75

a: The CO_2 Act is the legal framework for various measures. Its overall mitigation target is -10% for the period 2008-2012 compared to 1990. For the period 2013-2020, the mitigation target is -20% by 2020 compared to 1990. Where possible, the mitigation impact of the various policies and measures is listed under the individual measures.
b: 12CHF/t CO_2 on heating and process fossil fuels in 2008 and 2009, 36CHF/t CO_2 for 2010-2013 and 60 CHF/t CO_2 as of 2014.
c: For the calculation the rate of 36 CHF/t CO_2 is fixed for 2010-2015. For 2016-2020 it is assumed that the CO_2 levy will be increased to 72 CHF/tCO_2.
d: For the calculation the rate of 36 CHF/t CO_2 is fixed for 2010-2015. For 2016-2020 it is assumed that the CO_2 levy will be increased to 72 CHF/tCO_2. Started in 2010 the programm has little impact in 2010. As soon as the refurbishments will be realized the impact will increase.
i.e.: included elsewhere
n.a.: not applicable
n.e.: not estimated

Information, training and advisory services (2013 - today)

Additionally, the CO_2 Act requests the Confederation and the cantons to support measures to train people implementing the CO_2 Act and to improve public knowledge about mitigation of greenhouse gas emissions and about adaptation to climate change.

4.3.4 Energy policy

Legal framework

Energy policy was anchored in the Swiss federal constitution in 1990, when an energy article was added. It stipulates that the federal government and the cantons are obliged to use their competences to ensure an adequate, broad-based, secure, economical 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, and simultaneously demonstrates how difficult it is to find suitable solutions that meet the given criteria.

The energy article in the federal constitution is elaborated further in the Energy Act, the Nuclear Energy Act and the Electricity Supply Act, which form the legal basis for a sustainable and modern energy policy. In addition to legal instruments, the energy policies of the federal government and the cantons are also based on energy perspectives as well as on strategies, implementation programmes and the evaluation of energy-related measures at the municipal, cantonal and federal level.

Review of the Swiss energy policy by the International Energy Agency

In 2011, the International Energy Agency IEA (IEA 2012) carried out an in-depth review of the Swiss energy policy and recommended Switzerland to:

- Develop a road map containing different scenarios to deal with the consequences of nuclear phase-out, taking into account the cost to the Swiss economy, energy security and environmental implications, and including all technologically and economically feasible options;
- Consider a package of new gas-fired capacity, renewable energy, improved efficiency, imports of electricity and reduced oil consumption in the heating and transport sector, in working out the new Energy Strategy 2050;
- Address, as a matter of urgency, uncertainty over:
- post-2012 national climate targets and the role of gas-fired power;
- the feasibly exploitable potential of renewable energy, and the level and structure of green electricity supports to achieve this;
- adequacy of transmission and distribution grid investments;
- Examine financial mechanisms to address uncertainty in the energy policy;
- Consider increasing end-user energy prices, in a revenue-neutral way, to better support the goals of new energy policy;
- Enhance public awareness of the benefits and challenges of different energy sources in view of the need for energy security, CO_2 reductions and economic efficiency;
- Work to agree with the EU on closer co-operation and integration in energy and climate policies.

Policies and measures in the energy sector

The policies and measures in the energy sector are addressing the following priority areas: energy efficiency (buildings, industry & services, mobility, electric appliances, energy supply companies), renewable energies, energy fees, fossil power plants, R&D facilities and beacon projects, exemplary function of the federal government and SwissEnergy programme. Policies and measures are allocated to various interlinked programmes and frameworks, both at federal and cantonal level. Key policies are described in more detail below.

Nuclear phase-out: After the accident at the Fukushima Daiichi nuclear power plant (NPP), the Federal Council decided to suspend the authorization procedure for three new NPPs and to decommission the existing NPPs at the end of their life time as well as to redefine the Swiss energy policy. This new energy policy has been approved by the Lower House of Parliament in June and by the Upper House in September 2011. The government has then elaborated an Energy Strategy 2050. A first legislative package with measures in energy, fiscal, research and other related policies has been submitted for broad public consultation later in 2012. In September 2013, the dispatch concerning this first package of political measures of the energy strategy 2050 has been approved by the Swiss Federal Council and dispatched to the parliament for consultation. The planned amendment of the Swiss Energy Act aims at the proposed targets of -16% energy consumption per person and -3% electricity consumption per person until 2020 (based on energy scenario POM) and of -43% energy consumption per person and -13% electricity consumption per person until 2035 (based on energy scenario NEP) compared with 2000 (Swiss Federal Council 2013a,b). The package is expected to enter into force in 2015. Progress in implementation is to be regularly monitored.

In order to ensure the security of supply, the government, as part of its new Energy Strategy 2050, is placing emphasis on increased energy savings (energy efficiency), the expansion of hydropower and new renewable energies, and, if necessary, on fossil fuel-based electricity production (mainly in gas-fired combined-cycle power plants for peak supply, but also combined heat and power production for baseload in winter) and imports. Furthermore, Switzerland's power grid should be expanded without delay and energy research strengthened. (*www.energystrategy2050.ch*)

Energy strategy 2050: In order to cover the shortfall in the electricity supply caused by the decision not to replace the nuclear power plants, Switzerland's energy policy has to be revised. The government has therefore set the following priorities:

- **Reduction in energy consumption**: The new energy perspectives show that demand for electricity could rise to around 90 terawatt-hours (TWh) a year by 2050, if tighter measures are not taken (2010: around 60 TWh). The main reasons for this are population growth, increasing duplication of household appliances (for example a second TV), new appliances and applications, greater living space per person, but also the increasing electrification of transport. In order to stabilise electricity demand at some 64 TWh towards the end of the decade, the government intends to encourage the economical use of energy in general and of electricity in particular. Enhanced efficiency measures include minimum requirements for appliances (best practice, energy label) and other regulations, bonus-malus mechanisms (efficiency bonus), measures to raise public awareness (strengthening of SwissEnergy, described below) and measures regarding the production of heat;
- **Broadening of electricity supply**: Hydropower and new renewable energies should be bolstered in particular. Their share in the current energy mix needs to be expanded significantly. This is the main aim of the cost-reflective feed-in tariff. However, in order to meet demand, fossil fuel-based electricity generation probably needs to be expanded, primarily by constructing gas-fired combined-cycle power plants intended to provide peak load, but also combined heat and power plants for baseload in winter. The government is retaining its climate policy objectives;
- **Energy supply**: Electricity exchange with Europe is essential for a secure electricity supply and the temporary power balancing. The rapid expansion of the electricity transmission grid and the transformation of transmission networks into smart grids are absolutely essential for future domestic production infrastructures and electricity exchange. These “intelligent” grids allow direct interaction between consumers, the network and power producers and offer great potential with regard to optimising the electricity system, delivering energy savings and consequently bringing down costs. Switzerland's power grid should be optimally integrated into the European grid and the future European “supergrid”;
- **Expansion and restructuring of electricity transmission grid and energy storage**: The increas-ing share of irregular power production (wind, solar) requires the expansion and restructuring of transmission grids and of the pool of power plants to ensure the necessary storage and reserve capacities;
- **Strengthening energy research**: The restructuring of the energy system needs to be supported by the strengthening of energy research. To that end, the energy research portfolio in the Federal Institute of Technology (ETH) domain and at the universities of applied sciences have been reviewed and cooperation between universities, business and centres of technological expertise encouraged. A plan of action on “Coordinated Energy Research Switzerland” with relevant roadmaps has been drawn up for efficiency enhancing technologies, power grids and the storage and distribution of electricity. The necessary federal funding for pilot schemes and demonstration facilities is being provided. These efforts are to be coordinated with measures contained in the Cleantech Masterplan (described below);
- **Confederation, cantons, cities and communes will lead by example**: They should meet their own electricity and heating needs through renewable sources of energy and apply the principle of 'best practice' in all fields. The private sector should also play its part in taking measures to reduce commercial energy consumption and strengthen Switzerland's position as a location for business by coming up with innovative, energy saving products. The energy industry should seize the opportunity to play an active part in reshaping the national energy system and make the necessary investments;
- **Beacon projects guide the way**: Pilot and demonstration projects developed by various industries and groups should provide valuable experience for Switzerland's future in terms of energy. The fields of Smart Buildings, Smart Cities, Smart Grids and district heating networks are key in achieving an optimisation of the energy system, and thus in contributing to a reduction in energy consumption, emissions and costs;
- **Encouraging international co-operation**: International co-operation in the field of energy should be further intensified. Efforts should be made to conclude a bilateral agreement on electricity with the European Union, which is being negotiated since 2007. In addition, contacts with neighbouring countries should be intensified.

The SwissEnergy programme: In 1990, the national programme “Energy2000” was launched in the wake of the introduction of the energy article in the federal constitution. Since then, efforts to curb growing energy consumption and to promote renewable energy have been increased. In 2001, the Federal Council launched the successor programme "SwissEnergy", in line with the Energy Act and the CO_2 Act that came into force in 1999 and 2000 respectively. The SwissEnergy programme represents a major policy instrument for increasing energy efficiency and the use of renewable energy. Running initially from 2001 to 2010, the programme has been extended to 2020. It aims to reduce fossil fuel use and CO_2 emissions as required by the CO_2 Act and contains targets for electricity generation and heat production from renewable sources.

SwissEnergy is managed by the Swiss Federal Office of Energy (SFOE) and includes a wide array of projects, most of them voluntary. The projects are normally run in close co-operation between SFOE, cantons, municipalities, industry and environmental and consumer associations. The programme encompasses five thematic priorities: mobility, electrical appliances, industry and services, buildings, renewable energy. These are supplemented and reinforced by additional three intersecting priority areas: Cities, municipalities, residential zones, regions, agglomerations / training and further education / communication. The programme is making significant contributions by 2020 towards the objectives of the Energy Strategy 2050 regarding energy efficiency and renewable energy, by enhancing the effect of regulatory and assistance measures.

Programme results are subject to detailed monitoring and verification. To bolster the implementation of the Energy Strategy 2050, SwissEnergy's funding is due to increase from CHF 26 million in 2012 to CHF 55 million in 2015. Additional funding is to be sourced from third parties (trade and industry, cantons and municipalities). The share of third-party funding is expected to gradually increase. The intention is that projects supported by SwissEnergy should be able to become established on the market over the long term, and this goal is to be achieved with the aid of targeted project management, the limitation of the timeframe for the funding of each project, and where possible the specification of reduction paths.

In the last few years, several tasks formerly vested with SwissEnergy have become a legal obligation: promotion of renewables has shifted from a programme-type activity supplementing a modest and inadequate feed-in tariff to a comprehensive feed-in system, whose enforcement and continuity is guaranteed by law. Many minimum efficiency performance standards, previously introduced in the form of voluntary agreements (cars, some appliances), codes of conduct (some energy-using products) are now legally mandated (and by and large aligned with those of the European Union). Hence, the role of SwissEnergy is shifting towards that of a facilitator for the above mentioned regulations and laws.

The Building programme: The Buildings programme (see 4.3.3) of Federal Government and cantons promotes energy-efficiency renovations of buildings and investments in renewable energies, waste heat recovery and building utilities optimisation (national building programme part B). Starting 2010, the programme runs until 2019. The implementation for this part of the national building programme is in the hands of the cantons.

Building codes of the cantons in the energy sector (MuKEn): In order to harmonize the building codes in buildings throughout Switzerland, the cantons under the guidance of the Conference of Cantonal Energy Directors (EnDK) agreed in 1992 on common energy and insulation standards (model ordinance "Rational use of energy in high-buildings"). With the "model instructions of the cantons in the energy sector" , a second edition was adopted in August 2000. The third edition followed in 2008 (MuKEn 2008), with requirements for energy reduction in buildings getting increasingly stringent. The implementation of the relevant provisions is done by the cantons in the cantonal energy laws.

The "building codes of the cantons in the energy sector (MuKEn, edition 2008)" will be revised until 2014. By 2018, the cantons have to put the new MuKEn into cantonal legislation, in particular with the following measures: New buildings are to be self-supporting from 2020, the refurbishment of existing buildings is to be intensified and the use of renewable energy to be simplified.

Cleantech Masterplan: In September 2011, after thorough stocktaking and broad public consultations, the government adopted the Cleantech Masterplan, a strategy to promote resource efficiency and renewable energies. It aims at strengthening Cleantech businesses through greater coordination of science, business, government and policymaking so as to achieve a strong position in the global growth market for resource-efficient technologies, products and services by 2020. It identifies five areas of action: research, knowledge and technology transfer; regulation and market-based promotion programmes; international markets and export promotion; policy to encourage innovation; skills and training.

Electricity market reform: Electricity market reform has been significantly advanced under the 2008 Electricity Supply Law. The law contains necessary elements for effective market liberalisation: an independent regulator, an independent system operator, regulated third-party grid access, and freedom to choose the supplier. The market has been opened to consumers of more than 100 MWh per year, corresponding to roughly half of total demand in the country. Because of low market prices, more and more big customers are switching to a new supplier. Customers who had switched to market contracts before the enactment of the 2008 Electricity Supply Law, can return to the regulated prices. This is likely to reduce incentives for investing in electricity infrastructure. Full market opening has been set for 2015, but is subject to a possible referendum. Electricity market reform includes a planned revision of the Electricity Supply Law by 2015. Closely related to market reform is a bilateral agreement with the European Union on electricity, which is being negotiated since 2007.

Tab. 19 > Summary of policies and measures in the energy sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in million tonnes CO_2 equivalent)					
						1995	2000	2005	2010	2015	2020
Energy strategy 2050	Reduced energy consumption, increase energy efficiency, expand hydropower and new renewables	CO_2	Regulatory, economic, incentive and subvention	in legislative process	Mainly SFOE, FOEN, Cantons	n.a.	n.a.	n.a.	n.a.		n.a.
Voluntary agreements with trade & industry	Emission reductions to comply with CO_2 and Energy Act. Voluntary agreements without exemption from CO_2 levy.	CO_2	Voluntary	implemented, valid since 2000	SFOE, FOEN	n.a.	n.a.	n.a.	superseded by negotiated agreements with trade and industry, see Tab. 18 > Summary of climate policies and measures		
Programme Swiss Energy	Reduction of fossil fuel use and CO_2 emissions by increasing energy efficiency and the use of renewable energy	CO_2	Various	implemented, valid since 2001	SFOE	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
National building refurbishment programme (Part B)	Promotion of renewable energy, energy recuperation and optimiza-tion of building services	CO_2	Economic, incentive and subvention	adopted for 2010-2012, running 2013-2019	SFOE, FOEN, Cantons				0.07	0.8	2.0
Cantonal building programme	Promotion of renewable energy, energy recuperation and optimiza-tion of building services; supplementary to national programme	CO_2	Economic, incentive and subvention	implemented, in force since 2010	Cantons / SFOE	n.a.	n.a.	n.a.	0.07	0.07.	0.07
Building codes with the Cantons	Reduction of energy consumption of buildings	CO_2	Legislation	ongoing process of implementation by the Cantons, valid since 1992, updated in 2000, 2008	Cantons in coordination with SFOE	0.24-0.32	0.5-0.66	0.74-1.05	0.62-1.11	0.77-1.43	1.33-2.17
Cleantech Masterplan	Increase energy efficiency and renewable energy	CO_2	Voluntary agreement	in process; adopted 2011, running until 2020	SERI, SECO, SFOE, FOEN, cantons, economy, science	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

a: For the calculation, the rate of 36 CHF/t CO_2 is fixed for 2010-2015. For 2016-2020 it is assumed that the CO_2 levy will be increased to 72 CHF/tCO_2.

4.3.5 Transport policy

General policy context

Switzerland has developed an integrated strategy for transport policy, seeking better coordination between transport modes, spatial planning, and taking into account environmental concerns. This strategy has been developed further with a better integration of transport policy into spatial development and the general sustainability context. The main thrust of the adopted policies lies in promoting a shift towards more sustainable modes of transport, planning and providing infrastructure that supports such a shift, and by passing legislation that reduces emissions and promotes low-emission technologies in the various transport sectors. While a variety of measures are designed to reduce specific energy consumption, many are part of the general transport policy approach that involves reducing unnecessary motorized mobility, shifting traffic from road to more environmentally friendly modes, and improving intermodal transport chains and interconnectivity.

Passenger transport

The latest projections (ARE 2012a) for passenger (and freight) transport still show significant 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-motorized 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, with the development of agglomeration programmes (see below).

Switzerland has an excellent rail infrastructure that is permanently maintained, modernized and improved. The first phase of a major expansion of rail transport capacity RAIL 2000 was opened on 12.12.2004. It marked a milestone for Swiss public transport, as rail service levels increased by 12% from one day to the next (more trains, faster connections between Swiss cities). In particular, travel time between Zurich and Bern has been reduced by 20%. This leap in performance has increased the attractiveness of public transport and is expected to consolidate the strong position of rail transport in Switzerland. At the same time, work is progressing on the New Rail Link trough the Alps (NRLA). Although the difficult alpine geology has posed major challenges for the construction work, the first tunnel (Lötschberg) opened in 2007. The commissioning of the tunnel increased the capacity and attractiveness for both transalpine freight and passenger transport from Switzerland and northern Europe to Italy. The new St Gotthard link is expected to open in 2016, the Ceneri tunnel in 2018. By improving connections to the European high-speed rail network, Swiss transport policy encourages the transfer of short-distance international traffic from air to rail. Efforts are being made to shorten overall travel times between Switzerland and the cities of Munich, Stuttgart, Paris and Lyon. Although there are severe budgetary constraints, the financing of the major rail infrastructure projects is secured on the basis of the 'FinÖV', a public transport fund, which draws revenues from the heavy vehicle fee for rail infrastructure projects.

Funding for development and maintenance of road infrastructure is provided through the **infrastructure fund**, which was launched in 2007 and is running until 2027. Over those 20 years, it will provide CHF 20.8 billion in the following four areas:

- Completing the national motorway network: CHF 8.5 billion;
- Eliminating congestion hotspots in the existing motorway network: CHF 5.5 billion;
- Infrastructure for public and private transport in the agglomerations: CHF 6 billion, of which 2.56 billion will be devoted to urgent projects and 3.44 billion to agglomeration programmes;
- Maintenance of main roads in mountain and peripheral regions: CHF 0.8 billion.

Out of this fund, Switzerland runs an agglomeration programme aimed at providing financial resources for infrastructure projects that promote public and non-motorized transport in sub-urban regions and agglomerations. In the first round in 2007, 30 agglomeration programmes with integrated transport schemes have been submitted to the federal office of spatial development (ARE), 27 out of these have been approved and financially supported by the infrastructure fund. In a second round until June 2012, another 41 agglomeration programmes have been submitted for approval. These programmes are covering 90% of all Swiss agglomerations, 23 out of 26 cantons, around 800 cities and communities as well as parts of neighbouring regions from Germany, France, Italy, Austria, and the Principality of Liechtenstein. Resources are allocated to projects leading to an efficient and sustainable transport system in cities and agglomerations. Priority is given to those projects where the largest benefits are expected.

In order to enhance coordination between transport and spatial development, the federal authorities approved a transport plan in 2006, including a strategy for infrastructure policy and the main road and rail infrastructure projects (*http://www.are.admin.ch/sachplan/04894/04896/index.html*):

- Optimal capacity management of existing infrastructure, with the emphasis on sustainable spatial development – consolidating agglomerations and improving connectivity between Swiss cities and the European highspeed rail network. Top priority is assigned to improvements of the rail network;
- Regional priorities, particularly capacity problems in urban areas. There is a strong link to the agglomeration programmes;
- Improvement of the road network in areas of high traffic density where road capacity is critical and the risk of congestion is rising;
- Further extension of the rail network, oriented towards increased capacity and improving critical links and nodes.

Switzerland has developed further **programmes** aimed at specific parts of the transport sector:

- Leisure transport programme: The strategy paper highlights a very dynamic transport segment and proposes several measures to reduce motorized leisure transport, involving various stakeholders, especially sports event managers and tourism agencies (Swiss Federal Council 2009);
- Non-motorized transport: A similar strategy included in other programmes proposes several measures (including financial mechanisms) for increasing the share of non-motorized transport;
- Traffic telematics programme: This federal programme aims to optimize traffic flows and capacity by improving information systems and traffic management in congested areas, thereby enhancing road use efficiency and postponing infrastructure expansion projects;
- Service centre for innovative and sustainable mobility: Operated by the federal offices for spatial development (ARE), environment (FOEN), energy (SFOE), roads (FEDRO), public health (FOPH), and transport (FOT), the centre supports new, innovative mobility projects and represents a common point of contact for all interested parties. The activities of the service centre focus on the interfaces of the different transport modes and aim at improving performance and sustainability of the whole transport system. The service centre started in 2006 as a pilot experiment and is now in its consolidation phase until 2014. During the pilot phase, 21 projects were implemented, in the ongoing implementation phase, 15 projects have been realized so far. For the promotion of innovative projects a total of around 500'000 CHF is available per year.

Emission standards: Switzerland is following the European path of reducing air pollutants by introducing stricter Euro emission standards for new vehicles. For passenger cars, the Euro 4 standard has been in force since 2006; Euro 5 since September 2009 and Euro 6 will be in force as of September 2014. With regard to reducing particulate matter (PM) and diesel soot emissions, particle filter trap systems have been introduced for various types of vehicles (city buses, construction machinery, etc.). The active promotion of filter systems is envisaged, e.g. via fiscal incentives for purchasing new or retrofitting old engines (on import taxes or at the cantonal level on yearly taxes).

CO_2 emission targets: In 2002, the association of Swiss automobile importers signed an agreement with DETEC to reduce the specific fuel consumption of the newly released motor car fleet by 24% between 2000 and 2008. The average fuel consumption of new cars was 15.2% below 2000 levels in 2008. Because the target of the agreement was not reached and as a counterproposal to the popular initiative "for humane vehicles", the parliament amended the CO_2 Act in 2011 to include CO_2 emission targets for newly registered vehicles. These prescriptions came into effect in spring 2012 and are based on the EU regulation. In the first phase, a fleet average of 130 grams of CO_2 per kilometre is set. According to EU-regulation only a part of the fleet will have to meet this standard during the phase-in period 2012–2014, from 2015 the entire new car fleet will have to meet the target. Excess emissions of the new car fleet will be sanctioned by a penalty on the vehicle importer.

As part of the energy strategy 2050, the Federal Council intends to follow the EU regulation proposals for further decarbonising road traffic. A target of 95 grams of CO_2 per kilometre by 2020 for new cars and a new target of 175 grams of CO_2 by 2017 (147 grams by 2020) for light commercial vehicles (LCV) underwent public consultation in 2013.

Energy label for new motor vehicles: Since 2003, the compulsory energy label for newly sold cars informs customers about fuel consumption and CO_2 intensity. It evaluates the energy efficiency of motor vehicles according to the categories A to G. The Federal Department of Environment, Transport, Energy and Communications (DETEC) revised the energy label in 2011. The methodology was extended to include alternatively fuelled vehicles; a well-to-wheel perspective is used for the evaluation. The evaluation criteria now weight absolute fuel consumption more strongly. Evaluation criteria are adapted in intervals of a year to follow technological development in the automotive sector.

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 (fitting of CRT particle filters). The annual cantonal motor vehicle tax depends on different parameters such as vehicle weight and cubic 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 drivetrain type, and specific CO_2 emissions.

Voluntary agreement on the use of biogas in the transport sector: In the year 2003 an agreement between biogas producers and gas distributors regulating the purchase of biogas was reached. Biogas is injected into the natural gas grid and marketed as motor fuel in pure or mixed form. Under this agreement, the biogas purchased by gas distributors is to account for at least 10% of all gas sold as motor fuel.

Compensation of CO_2 emissions from transport fuel use: From 2005 to 2012, the so-called "Climate Cent", a voluntary private-sector initiative setting a levy of CHF 0.015 per litre on transport fuels was in effect. Its revenues went towards financing climate change abatement programmes and were managed by the Climate Cent Foundation. From 2014, the revised CO_2 Act obliges oil importers to offset directly a part of the CO_2 emissions from transport fuel use. The offset will be financed by a levy that shall not exceed CHF 0.05 per litre of fuel. The share of transport emissions to be offset may vary from 5% to a maximum of 40%. The Federal Council determined the share as 2% in 2014-2015, 5% in 2016-2017, 8% in 2018-2019, and 10% in 2020. The revenues and climate change abatement measures will be managed by the private-sector Foundation for Climate Protection and Carbon Offset (KliK).

Mineral oil tax reduction on biofuels and natural gas: The amendment of the Mineral Oil Tax Act that came into force on 1.7.2008 provides tax incentives for low carbon fuels. A budget neutral tax reduction of 40 Swiss cents per litre of petrol equivalent for natural and liquefied petroleum gas (LPG) and complete tax exemption for biogas and other fuels from renewable sources are granted to biofuels fulfilling ecological and social criteria. Revenue losses are compensated by increasing tax rates on petrol. The required ecological criteria for tax exemption are: a minimum of 40% GHG reduction based on LCA; a net environmental burden not significantly exceeding the one of fossil fuels; the cultivation of biofuels must not endanger biodiversity, in particular rainforests. In contrast to other countries, Switzerland has no quotas for biofuels. Minimum requirements for the socially acceptable production conditions are fulfilled, when the social legislation applicable at the production location of raw materials and fuels are respected. At least the fundamental conventions of the International Labour Organization (ILO), have to be respected.

International context: In 2005, Switzerland ratified the Gothenburg Protocol to abate acidification, eutrophication and ground-level ozone (Convention on Long-range Transboundary Air Pollution, UNECE). 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 GHG emissions from gases not regulated under the Kyoto Protocol. The Gothenburg Protocol was revised in 2012. The revised version also addresses particulate matter (PM2.5) and black carbon (BC). It contains national emission reduction commitments for sulphur dioxide, nitrogen oxides, ammonia, volatile organic compounds and particulate matter to be achieved in the year 2020.

Freight / heavy goods transport

Switzerland's freight transport policy bases on article 84 of the federal constitution, which requires transalpine freight transport to shift from road to rail. The central policy element to reach this target is the heavy vehicle fee (HVF) combined with measures to improve competitiveness of international rail transport. The original goal was to limit transalpine road transport volume to 650`000 lorries per year by 2009. Although the HVF and additional measures have been implemented showing initial effects, the target was not reached by 2009. According to new planning, it should be reached by 2018, two years after the opening of the new rail tunnel through the St Gotthard.

Heavy vehicle fee: The HVF is applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight. The fee is calculated according to three criteria: the kilometres travelled on Swiss roads, the vehicle specific maximum authorized gross weight, and the pollutants according to EURO classes. The HVF has been implemented in three stages: the first stage in 2001 introduced a fee of 1.6 Swiss cents per kilometre and tonne, accompanied by an increase in the general Swiss weight limit from 28 to 34 tonnes per truck. With the second stage in 2005, the rate was increased to 2.5 Swiss cents (average), together with an increase in the weight limit up to 40 tonnes. The final stage followed in 2008, after the opening of the Lötschberg railway base tunnel. Two thirds of the revenue are used to finance major railway infrastructure projects (such as the two base tunnels through the Alps), and one third is transferred to the cantons.

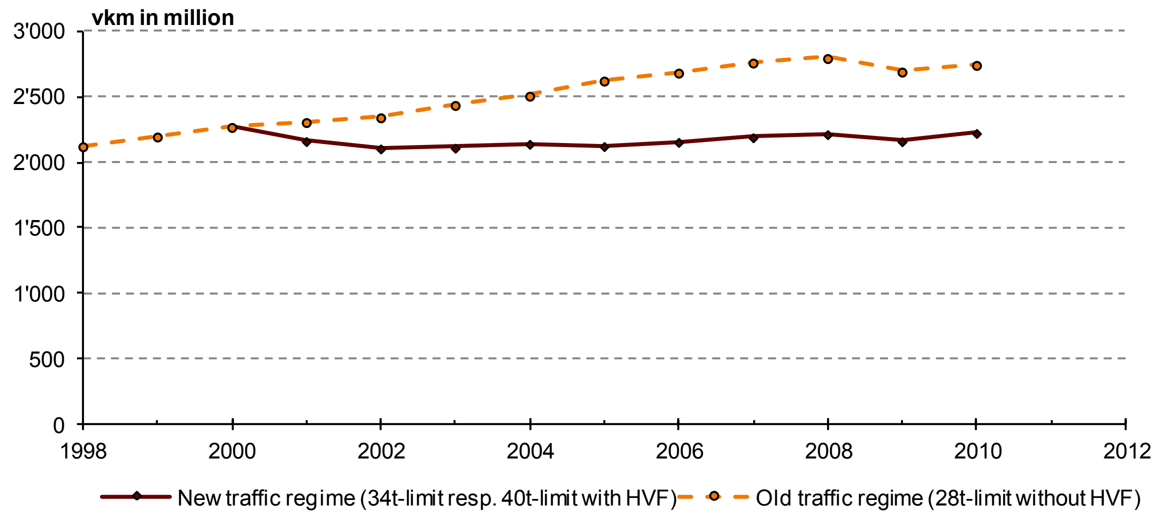
Evaluation of the heavy vehicle fee: Lower traffic levels, less air pollution, reduced GHG emissions

The impact of the new traffic regime (HVF and higher weight limits) was most clearly reflected by changes in traffic levels (truck-kilometres). Following a significant increase of 5–6% per year before the introduction of the fee, the number of kilometres travelled by heavy goods traffic (kilometre performance) decreased between 2001 and 2005 by 6.4%. The fact that road transportation of goods increased in the same period by 6.4% proofs the effectiveness of the system: fewer trucks have transported more goods. Projections have shown that the number of kilometres travelled by heavy goods traffic would have been about 23% higher in 2005 if the old regulations had been retained (Fig. 72).

The fact that the level of the fee depends on the maximum weight and emission standards of the individual lorry already prompted a significant renewal of the fleet in the year before the HVF was introduced. The reduction in emissions per vehicle combined with lower traffic levels lowered pollutants from heavy traffic (estimated based on model calculations). Reduced road freight transport emissions due to the new regime measured against increased rail transport results in a positive overall environmental balance, in particular with regard to air pollution. Air quality has improved by 10% (particle emissions) and 14% (nitrogen oxides) respectively, and CO_2 emissions have decreased by 6% (corresponding to 105'000 tonnes of CO_2 or 325 GWh) compared to the reference scenario (28t-limit, no HVF).

Fig. 72 > Impacts of the new traffic regime

Development of vehicle-km (vkm in million) in the road freight transport in old and new traffic regime



ARE (2012b)

Additional measures to support modal shift of freight traffic from road to rail:

In addition to the HVF, the modal shift policy includes the following elements to promote public transport:

- Modernisation of rail infrastructure: The ongoing general refurbishment and extension of the rail network, including two new base tunnels (NRLA: the Lötschberg (opened in 2007) and the St Gotthard (planned to open in 2016), will increase capacity and shorten travel times. This will increase competitiveness of rail and thus support the shift envisaged;
- To further increase productivity and competitiveness of rail transportation, Switzerland has been progressively implementing reforms (RailwayReform) in the regulations of the rail network and liberalising the freight transport market, in compliance with the relevant EU directive. This improves interoperability and the quality of transnational transport through increased access rights and competition between different operators. These measures also provide increased flexibility for the railway companies and greater entrepreneurial freedom, making rail transport more productive and attractive;
- To bring down slot prices and to provide additional intermodal services (including an efficient truck on train service between Freiburg/Germany and Novara/Italy), Switzerland is funding such services;
- Thanks to sustained subsidies for truck-on-train transport, a further shift towards combined transport is expected. Total funding for the modal shift from road to rail amounts to over CHF 1.6 billion from 2009 to 2018. The subsidies for combined transport are secured until 2018;
- Measures mainly aimed at improving road safety (increased enforcement activities with regard to speed limits and driver rest times) potentially also work in favour of rail transport;
- The land transport agreement between Switzerland and the EU secures the Swiss policy and the modal shift efforts in the European context. The EU respects the Swiss policy objectives and the necessary measures taken (in particular the HVF). Efforts are under-way to negotiate a possible introduction of an international transalpine transport exchange market. However, an agreement must include the entire region of the Alps and comply with regulations of the countries involved, the EU, and Switzerland.

Aviation

With respect to climate change, Swiss aviation policy is focused on international aviation, as the share of Switzerland's domestic aviation emissions is very small. Switzerland joined the International Civil Aviation Organization (ICAO) in 1947 and the European Civil Aviation Conference (ECAC) in 1955. Under the air transport agreement between Switzerland and the EU which came into effect on 1.6.2002, Switzerland adopted European civil aviation legislation that was in force when the agreement was concluded and regularly adapts the agreement to new legislation entering into force in the EU. It is thus on an equal footing with EU members. In 2006, Switzerland joined the European Aviation Safety Agency (EASA). Switzerland's aviation legislation and policy is therefore shaped by ICAO and ECAC regulations, as well as by developments within the EU. Policy is to be coordinated with European aviation and transport policy. Switzerland's foreign relations are also governed by bilateral and multilateral agreements; bilateral aviation agreements were concluded with more than 130 countries.

In a fundamental report on Swiss aviation policy submitted on 10.12.2004, the Federal Council assessed the current state of Swiss aviation (FOCA 2004). This report stresses a coherent, comprehensive and forward-looking aviation policy within a sustainable development framework. Parliament acknowledged the aviation policy report in 2005 and commissioned DETEC and the FOCA to identify necessary measures and to amend the relevant aviation legislation. The report sets the framework for aviation within the overall national transport policy:

- Domestic transport relies predominantly on railway;
- Within Europe, aviation is supplementing the highspeed rail network;
- The aviation sector provides Switzerland with good intercontinental connections.

Sustainable development in the context of aviation policy has the following implications:

- Operating and external costs should be borne by the aviation sector itself;
- Technological optimization of infrastructure and aircraft should be fully exploited;
- Sustainable transport policy should be coordinated and promoted with Europe;
- Adverse environmental impacts of aviation should be reduced to an acceptable level in the long term, and resources should be conserved.

In sensitive environmental areas (noise and pollution), Switzerland has enforced noise dependent operating restrictions and has developed incentive systems of its own (e.g. noise- and emission-dependent landing charges, emission ceilings at certain airports, noise classes for large and small aircraft). These are to be maintained and continuously further developed. As a further element for aviation policy, the Federal Council adopted the sectoral aviation infrastructure plan on 18.10.2000 (FOCA 2000). It requests comprehensive environmental consideration when aviation infrastructure is planned, such as limiting emissions at and in the surroundings of airports, operational measures and airport charges, which take into account the different levels of pollutants emitted by aircraft.

Within the ECAC, EASA and ICAO, Switzerland strives for internationally coordinated measures to limit gaseous emissions from aviation. In concrete terms, Switzerland applies and promotes airport emissions charges systems and works towards stricter internationally accepted emission standards for new aircraft engines. In 2008, the latest ICAO NO_x emission standard with a 12% NO_x reduction came into force. In 2010, a further 15% NO_x reduction relative to the latest standard has been agreed, which will be implemented by 31 December 2013. Optimization for lower NO_x emissions around airports is correlated with lower cruise NO_x emissions, thus reducing short to medium term climate forcing from aviation. In September 2011, ECAC endorsed the Swiss proposal for an improved NO_x classification scheme for aircraft emission charges (FOCA 2011). The model reinforces the polluter pays principle: The higher the absolute amount of emissions, the higher the emissions charges per aircraft movement. In 2011, major Swiss airports introduced this new emissions charges model.

Fuel burn is a direct and important cost factor for airline operators and therefore the primary industry focus for aircraft emission reductions lies in fuel burn reduction. Different measures for fuel burn reduction are often correlated with the adverse effect of increasing NO_x emissions. Therefore, market based measures for NO_x reductions such as emissions related landing charges are still considered important.

Switzerland is also actively supporting work towards introduction of a new aircraft engine emission certification requirement and subsequent standard for particulate matter (PM), taking ultra fine particle mass and number into account. The work is in line with the introduction of supplemental particle number standards for vehicles in Europe in 2014. Apart from public health considerations, control of particle number emissions from aircraft is considered important for addressing global climate effects. New engine technology for medium to large aircraft engines is showing potential for reducing soot emissions from aircraft towards zero levels, once the new regulation is in force. The Swiss activity is coordinated with EASA, ECAC, the EC and ICAO. In 2011, the Swiss Federal Office of Civil Aviation established the first PM measurement prototype for aircraft engine particle emission certification in Zurich, Switzerland. Through international cooperation, a number of test campaigns have been performed in Zurich, finally leading to the specifications for the aircraft engine PM system and its instrumentation. In February 2013, the ICAO Committee on Aviation Environmental Protection agreed to a plan to establish an aircraft PM emissions data base and a process to work towards implementation of the first aircraft engine PM standard by 2016. Switzerland is continuing its support through expertise, active participation and funding.

Since 2012, a new legal framework in Switzerland allows to use revenues from current taxes on kerosene in domestic aviation to finance environmental protection measures related to aviation. Approved measures with respect to reduction of the aviation climate impact so far included: Validation of sensors to further improve aircraft gas turbine efficiency, installation of photovoltaic and solar panels for airport infrastructure energy supply, installation of particle filters on airport ground power units, development of an electrically powered airplane for pilot basic training, funds for testing and research to support the development of the new aircraft engine PM standard as described above.

Switzerland welcomed the encouragement by ICAO Resolution A 37/19 for States to submit action plans outlining their respective policies and actions with respect to aviation and climate change to ICAO. Switzerland has been fully involved in a European wide activity of the 44 ECAC States to develop the structure and supranational contents of European action plans. The Swiss Action Plan was approved by the Federal Council within the framework of the Swiss strategy for sustainable development 2012 – 2015 and was submitted to ICAO by 30 June 2012. (*ICAO Action Plan on CO_2 Emission Reduction*)

Within the basket of measures available to mitigate the effects of aviation on the global climate, reduction at source is certainly a key path. The achievements of the industry in terms of fuel efficiency are already considerable. But the development of standards remains a key priority in this area, and Switzerland is fully supportive of ICAO's endeavour to work towards a CO_2 standard for airplanes.

From an operational point of view, reducing fragmentation in European air traffic management is expected to result in significant efficiency and environmental improvements. A core starting point is the reduction of the current surplus length of flights in Europe, estimated on average to be almost 50 km per flight. The defragmentation of European airspace with new possibilities for more direct routing, and efforts to define a true pan-European network of routes and to implement flexible use of airspace are expected to result in emission reductions of 2% per year. In Central Europe the FABEC members (Belgium, Germany, France, Luxembourg, the Netherlands and Switzerland) have developed and signed in 2010 a treaty relating to the establishment of the Functional Airspace Block "Central Europe". The treaty involves all relevant civil and military authorities that take decisions on the establishment and modification of the FABEC, on establishing specific arrangements in the FABEC and on the ensuing FABEC operations. The treaty is a legal instrument facilitating direct cooperation and coordination among the authorities and Air Navigation Service Providers (ANSP). FABEC will considerably reduce the environmental impact per flight by improving routes, flight profiles and distances flown, in line with broader European programs.

With respect to market based measures, the revised CO_2 Act provides the basis to integrate aviation into the Swiss Emissions Trading System (ETS). Because such integration is only feasible if the Swiss system is linked to the European ETS, Switzerland is currently negotiating an agreement with the EU on the linking of the two systems.

Tab. 20 > Summary of policies and measures in the transport sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in million tonnes CO_2 equivalent)					
						1995	2000	2005	2010	2015	2020
Inclusion of aviation in an ETS	Limit CO_2 emissions of international aviation	CO_2	Market based	planned, negotiated with EU	FOCA, FOEN	[a]	[a]	[a]	[a]	[a]	[a]
Aircraft engine emissions charges	Reduction of local and cruise NO_x emissions	Ozone	Market based	implemented, in 1997 reinforced in 2010	FOCA, Major Swiss airports	[a]	[a]	[a]	[a]	[a]	[a]
Increase of aircraft engine NO_x stringency	Reduction of local and cruise NO_x emissions	Ozone	Technology, regulatory (Engine certification requirement)	implemented in 2011	ICAO, EASA, FOCA	[a]	[a]	[a]	[a]	[a]	[a]
Introduction of particle mass and number standard for aircraft engines	Reduction of nano-sized soot	(Soot & contrails)	Technology, regulatory (Engine certification requirement)	in development, planned for 2016	ICAO, EASA, FOCA	[a]	[a]	[a]	[a]	[a]	[a]
Heavy vehicle fee	Reduction of transalpine traffic, increase of transport rates on rail and limited increase in heavy vehicles on the road. Internalization of external costs.	CO_2	Fiscal, economic, planning	implemented in 2001	ARE, FEDRO	n.a.	n.a.	0.11	0.13-0.18	0.13-0.19	0.15-0.20
EURO emission standards	reduction of air pollutants	NOx,THC, NMHC, CO and PM	Technology	implemented in 1974, regularly reinforced	FEDRO	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Mineral oil tax reduction on biofuels and natural gas	CO_2 - emission reduction	CO_2	fiscal	implemented in 2008	FCA in collab. with FOEN (ecological minimum standards) and SECO (social minimum standards)	n.a.	n.a.	n.a.	0.10	0.10	0.10

Energy label for new motor vehicles	This label is intended to support efforts aimed at reducing the average fuel consumption of motor cars. Reduction of noise and air pollution.	CO_2, ozone	Information, market based	imple-mented since 2003	SFOE, FOEN	n.a.	n.a.	n.a.	n.a.	i.e.	i.e.
CO_2 emissions regulations for new passenger cars	Reduction of average fuel consumption of new cars	CO_2	Regulatory	implemen ted in 2012	SFOE, FEDRO	n.a.	n.a.	n.a.	n.a.	i.e.	i.e.
Obligation for compensa-tion for transport fossil fuel importers	Offset part of the CO_2 emissions caused by the use of transport fuels	CO_2	Regulatory, economic	Imple-mented in 2013	FOEN	n.a.	n.a.	n.a.	n.a.	i.e.	i.e.

a: For domestic flights with a very low share on GHG emissions in absolute terms, the mitigation impact can not be quantified.

4.3.6 Industry (including HFCs, PFCs and SF_6)

Industrial emissions of CO_2 are controlled under the CO_2 Act, with the main instrument being the CO_2 levy, the conditional exemption from the CO_2 levy, and the emissions trading amongst companies exempt from the CO_2 levy as discussed above in section 4.3.3. Synthetic gases are not treated in the first CO_2 Act. A specific policy has been developed for these gases.

Synthetic gases

The Ordinance on Chemical Risk Reduction (SR 814.81) provides for measures to control emissions of persistent substances with a high global warming potential (HFCs, PFCs, SF_6, NF_3, HFEs) in almost all sectors. Since the beginning of the 1990s, the Federal Council has been recommending the greatest restraint in the use of these gases, in line with its integrated product policy. However, their use has strongly increased and in 2011 they represented around 2.7% of anthropogenic GHG emissions in Switzerland.

The effort made since 2003 to control **synthetic GHG emissions** under the generic name of "substances stable in the atmosphere" has shown its first positive effects. The regulation (based on the Ordinance on Chemical Risk Reduction), is focusing on three main lines of action: 1) to limit the use of substances stable in the atmosphere to those applications where there is no preferable alternative; 2) when such substances are used, to reduce emissions as far as possible; and 3) to endorse a voluntary binding agreement developed by the industry (SF_6 in the high-voltage equipment and other sectors). The share of all synthetic GHGs rose fivefold between 1990 and 2011. Despite the regulation, HFC emissions are still increasing, however at a lower rate than until 2005 (Fig. 58). The rise in SF_6 emissions since 1997 could be halted, however the SF_6 consumption shows a large annual fluctuation (Fig. 58). PFC emissions experienced a massive drop since 1990, due to the discontinuation of aluminium smelting in Switzerland. PFC emissions have been increasing anew since 1996, due to their recent application in electronic fabrication, yet PFC emissions dropped by 60 % since 1990 (Fig. 58). Like SF_6, PFC emissions show a pronounced inter-annual fluctuation.

The emissions of fluorinated GHGs are expected to increase until approximately 2015, followed by a decrease after 2018. In 2012, new provisions have been drawn up in consultation with the cantons and the industrial and commercial sectors concerned. They strengthen the existing regulatory framework, allowing sectors to take strategic action promptly in order to limit atmospheric emissions of synthetic GHGs.

Areas affected

In the industrial processes sector, the use of synthetic GHGs (called "substances stable in the atmosphere" and defined as fluorinated VOCs with a half-life longer than two years, plus the non-VOCs SF_6 and NF_3) has been regulated in various areas through a climate-related amendment to the Ordinance of 9.7.1986 on Environmentally Hazardous Substances (revised in 1995 and 2003), which entered into force in stages between July 2003 and January 2004. This Ordinance was succeeded by the Ordinance on Chemical Risk Reduction of 18.5.2005 in which the regulation of of synthetic GHGs was integrally transfered. The regulations cover the following areas:

Compressed gas containers
The mechanism of compressed gas containers intrinsically involves the emission of the propellant gas. In this area, emissions of synthetic GHGs (mainly HFCs) can therefore only be limited by restrictions on use. An analysis of the current state of technology identified the following as the only applications for which exemptions are required: compressed gas containers for cleaning live electrical and electronic equipment, medical and pharmaceutical applications, in particular Metered Dose Inhalers, and polyurethane spray foam in certain situations where safety is critical. The state of technology will be defined in guidelines developed in collaboration with the professional circles concerned. For other applications where these substances may perhaps 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.

Furthermore, the Ordinance of 23.11.2005 on Aerosol Dispensers (SR 817.023.61) prohibits the use of HFCs or PFCs in most spray cans. It only allows the use of HFC-152a as a propellant in spray cans containing cosmetics and household products.

Foams
By 2010, in the absence of regulations, the plastic foams sector would have been likely to become one of the two main sectors emitting synthetic GHGs (mainly HFCs) in Switzerland as this sector is largely emissive (production, use, and disposal). However, the measures currently implemented in Switzerland (restrictions on use, disposal by incineration and recycling) to limit synthetic GHG emissions from plastic foams on the one hand and the general tendency of this industrial sector in Europe on the other hand, have led to the situation where foams without fluorinated gases account for practically the entire Swiss market. The Swiss regulation allows the use of synthetic GHGs (mainly HFCs) only in plastic insulating foams and under severe restraints: Synthetic GHGs can only be used if they offer significant advantages in thermal insulating efficiency in case of spatial constraints, or where non-flammability is required, in agreement with the current state of technology. However, since the technology is rapidly advancing, 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
Solvents containing synthetic GHGs (PFC, HFC, HFE) are currently used almost exclusively by electronic and precision industry, in cases where sound alternative technology is not available. To reduce emissions, consumer goods containing such solvents have been banned and the current provisions of the Ordinance on Air Pollution Control (SR 814.318.142.1) applicable to professional uses have been slightly modified so that they cover all regulated substances. Consequently, synthetic GHGs will be subject to the same provisions as chlorinated organic substances, such as perchloroethylene. These regulatory provisions are accompanied by a 10-year deadline for bringing existing equipment into line.

Refrigerants

The mixed regulatory system implemented since 2003 has been amended lastly in November 2012. The initial components comprising: (a) a ban for certain categories of household appliances (refrigerators, freezers, air conditioners), accompanied by a system of individual exemptions when no alternatives are available; (b) a ban on the use of synthetic GHGs in mobile air conditioners, coming into force when permitted by the state of technology; and (c) measures to reduce emissions (periodic checking for leakage, maintenance records, notification of installations required for mobile and fixed installations containing more than 3 kg of refrigerant) have been kept unchanged whereas the authorisation procedure for fixed installations and for heat pumps working with more than 3 kg of synthetic GHGs has been replaced in November 2012 (entry into force in Dec. 2013) with a partial ban of placing on the market of refrigeration, air conditioning and heat pump fixed installations functionning with synthetic GHGs with cooling capacity above 40, 80, 400 and 600 kW depending upon the sectors of use.

To ensure the transparency and proportionality of this 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 the sector concerned, and with the cantonal authorities. Furthermore, the establishment of voluntary or regulatory agreements with the sectors affected is currently beeing evaluated, in order to encourage the recovery and recycling of refrigerants at lowest GHG emissions possible.

Fire protection

Since 1996 the supply and import of extinguishing agents made of synthetic GHGs and of appliances or stationary equipment containing such agents are banned. 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 authorised in electrical distribution equipment that is hermetically sealed or constantly monitored, and which operates at more than 1 kV. This is governed by voluntary agreements established in 2003 by the high-voltage industry concerned. The level and the volume of annual emissions are limited to 1% of total amount used, but not more than 4 tonnes, and the recovery of SF_6 from decommissioned equipment is guaranteed.

Other application sectors

The use of PFCs and SF_6 in tyres, insulating windows and sport shoes is banned since 2003. SF_6 as protecting gaz in magnesium and aluminium smelting will be banned after 2016. Other uses are authorised insofar as there is no environmentally superior alternative and at minimal emission levels according to the best available techniques.

Furthermore, under Annex 1 of the Ordinance on Lists Regarding the Movement of Toxic Waste (SR 814.610.1), 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.

Tab. 21 > Summary of policies and measures regarding synthetic gases (as of June 2009)

Most important measures implemented. The expected reduction of emissions growth for all synthetic GHGs is 550–1000 $*10^{-3}$ million t CO_2 equivalent by 2015. Values in brackets are subject to a high degree of uncertainty

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact / 10^{-3} million t CO_2 equivalent			
						Year	HFCs	PFCs	SF_6
Ordinance on Chemical Risk Reduction	Reduction in use and emissions of synthetic GHGs in all main sectors	CFCs, ,HFCs, PFCs, SF_6	Regulatory	Implemented in 2003	FOEN, cantons	1995	-	-	-
						2000	-	-	0
						2005	0	0	65–100
						2010	250–300	2–3	(150–300)
						2015	(400–600)	(8–12)	(180–420)
						2020	(500–800)	(13–19)	(200–550)

a: no estimates available yet.

4.3.7 Agricultural policy

Greenhouse gas emissions in agriculture are mainly dependent on the portfolio of activities chosen by the farmers. An important parameter influencing this decision is certainly the relative economic profit of the different activities. Their attractiveness is dependent on the price level of agricultural goods and services as well as 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.

With the revision of Swiss agricultural policy since the beginning of the 1990s support for agriculture has been gradually reduced and decoupled from production. Between 1990 and 2010 total financial aid (price support and budgetary subsidies) was reduced from just over CHF 8 billion to 5.6 billion. Furthermore, the proportion of linked financial aid (price support through import controls and other contributions towards market price support including export subsidies) decreased by around 50% over the same period. As compensation, direct payments decoupled from production volume have been considerably increased to 80% direct support of agriculture.

These direct payments are tied to ecological standards, i.e. farmers only are eligible for payments if they fulfill the so called proof of ecological performance. It is the case when a 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 famers, the diffusion of the proof of ecological performance is widespread.

As part of the agricultural policy 2011 in 2008 a new instrument called resource program was introduced. Through this program, the Swiss Confederation is subsidizing measures for more efficient use of natural resources in the agricultural sector. The 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 programs such as general direct payments. Support is given to measures that need financial support in an introduction phase, but that will run without further payments afterwards. Therefore these payments are restricted to 6 years. Within these years new technologies or organizational structures should have reached a state that is self-sustaining. Up to date, 21 Cantons out of 26 are implementing this program. However, the participation of the farms is generally lower than expected. The current programs focus mainly on ammonia emission reduction and some deal with soil fertility improvement.

The gradual separation of subsidies from production since the beginning of the 1990s and the introduction of the proof of ecological performance, the new resource program, together with many other factors (like measures in other policy areas, technological progress, efforts in research and awareness raising), have led to marked improvements in several aspects: labour productivity has risen by 1.6% per year and gross as well as net calorie production have increased by 10 % and 5 %, respectively; the negative effects of agricultural production on the environment have been reduced (e.g. loss of nitrogen down by 14%, loss of phosphorus down by 70%); the total area of extensively farmed land aimed at encouraging biodiversity has increased considerably and the quality of these areas in terms of biodiversity is constantly rising; the number of livestock kept under particularly animal-friendly conditions has also risen massively.

In parallel, particularly due to reductions in livestock numbers and mineral nitrogen fertilizer application, greenhouse gas emissions from agriculture have dropped by around 8%. Having a closer look on the emissions one can see that the improvements occurred mainly in the 1990s while afterwards they have been on a constant level. The same can be observed for most of the ecological indicators. All in all, in comparison with the targets set out by the Federal Council many aims have not yet been achieved.

Proposal for the period 2014-2017

In order to ensure that the agricultural policy and the direct payments system in particular are as effective and efficient as possible, concrete aims that bear close scrutiny are set out in the Federal Council's message on agricultural policy 2014-17 (AP 14-17). There is no aim concerning climate mitigation, but the intended increase in nutrient efficiency and the reduction of ammonia emissions, as well as the desired trend in the ecological set-aside areas – as described in Tab. 22 - will indirectly affect the agricultural greenhouse gas emissions in a positive way.

Tab. 22 > Aims of the Agricultural Policy for 2014-2017

Field	Aspect	Situation in 2007/09	Aims for 2017
Economy	Productivity	+2.1% p.a.	+2.1 % p.a.
	Renewal of capital	30 years	30 years
Social	Incomes in the sector	-0.7 % p.a.	Reduction in the drop in incomes to below 0.5 % p.a.
Ensuring food supplies	Gross production	24,200 TJ	24,500 TJ
	Net production	21,500 TJ	22,100 TJ
	Farmed land in permanently settled areas	-1,900 ha p.a.	Reduction in loss of farmland to below 1,000 ha p.a.
Natural heritage, environment	N-efficiency	29 %	33 %
	P-efficiency	59 %	68 %
	NH3 emissions	48,600 t N	41,000 t N
	Quantity of ESA*	60,000 ha in lowland areas	65,000 ha in lowland areas
	Quality of ESA	36 % interconnected 27 % high-quality	50% interconnected 40% high quality
Farmland	Farmed land in mountain areas	-1,400 ha p.a.	Reduction in advance of woodland by 20%
Animal welfare	Participation in ROEL programmes	72%	80%

*ESA = ecological set-aside areas

The key element in AP 14-17 is the further development of the direct payments system. Measures with unspecified aims are replaced by specific tools. The current subsidies for livestock encourage more intensive livestock farming and as a consequence result in an undesirable distortion of the market as well as ecological problems. They will therefore be converted into subsidies for ensuring food security, which are dependent on land use. In addition the general acreage subsidy that at present prevents structural development and does not encourage any specific services for the community will be abolished.

The funds thus freed up by the abolishment of the general acreage subsidy will be used for a farm based payment to cover the transition between the changes between the two systems and for expanding direct payments focused on services where the specific aims have not yet been reached: new direct payment types for environmental-friendly production systems and for the efficient use of resources are introduced in addition to the existing resource program. These programs are of special interest from a greenhouse gas mitigation perspective. Owing to rises in payments, it is expected that participation in these programs will become more popular and therefore require increased funding. The additional funds for these tools will be compensated in the farm based payment that will be reduced.

With AP 14-17 progress can be made in all three areas of sustainability. The abolition of unspecific direct payments (livestock subsidies, general acreage payments) will give farmers a greater incentive to make use of potential ways of reducing costs and to join performance-based programs. This should lead to a better basis for successfully dealing with further stages of deregulation and in the future the aims set out in the policy should be better achieved in a more efficient way. This could be shown applying agricultural sector models by the research station Agroscope. These model results expect total livestock numbers to fall by around 10% by 2017 owing mainly to the shift of livestock (per capita) payments to subsidies for ensuring food supplies paid per hectare. Together with the introduction of payments for efficient use of resources, this is expected to result in a drop in nitrates and phosphates as well as greenhouse gas emissions, thus reducing the negative effects on ecosystems. Above all it is expected that greenhouse gas emissions from agriculture will be further reduced, mainly due to this increase in nitrogen use efficiency but also due to the expected decrease in livestock numbers. The progress in the ecological aspects will not be at the expense of production, however. On the contrary: according to the model results, around 3% more calories are expected to be produced, due to, on the one hand, increased yield due to progress in production methods and, on the other, greater promotion of arable farming. Combining the expected decrease in overall greenhouse gas emissions and the increase in production this will lead to a markedly improved greenhouse gas balance per unit of nutritional energy. As far as concerns incomes, AP 14-17 will pay off. Again according to the model results, incomes in the agricultural sector will be around CHF 110 million or 4.2% higher than they would be if today's tools continued to be used. Since structures will continue to develop and productivity to rise, incomes for individual farms should rise by some 7% thanks to AP 14-17.

Climate strategy for agriculture and consecutive activities

By anticipating its adaptation to climate change it should be possible for the Swiss agricultural sector to improve production and provision of public services over the long term. To use this potential in parallel to the elaboration of the AP 14-17, a climate strategy has been developed for Swiss agriculture. This strategy is a declaration of intent and will be a guiding light for agriculture and food production in Switzerland in their efforts to reduce greenhouse gas emissions and adapt to a changing climate. It sets out common guidelines and long-term targets and identifies priorities and possible areas where action can be taken.

As far as the reduction of greenhouse gases is concerned, the aim is to consistently take advantage of the potential for improving efficiency and to reduce the use of non-renewable energy and products. Two complementary targets were set: first, emissions by the agricultural sector are to be reduced by at least one-third by 2050 through technical and organizational measures (referred to the emissions in 1990); and second, further reductions are aspired by influencing consumption patterns as well as production structures. With regard to adaptation to climate change, the resilience of Swiss agriculture is to be improved as a preventive measure to cushion mainly the negative effects of extreme weather events. The targets are ambitious but realistic over the long term. They include the aspect of food security and are based on the commitment of the international community to prevent an increase in global temperatures of more than 2° C. In this way, agriculture and food production will make a contribution to ensuring a sustainable society.

The legal framework of AP14-17 has been designed in a way that it enables the promotion of a climate-friendly agriculture. Especially, it allows to support projects with the goal to improve mitigation or adaptation to climate change. Concrete programs are now in planning and first of them are just before their implementation. In addition agricultural research and extension is intensified. Tools are being developed and fundamental structures are being established to support farmers and other related stakeholders in the fields of renewable energy, energy efficiency and climate change mitigation. Furthermore, different options for the reduction of greenhouse gases are being tested on-farm on a small regional scale. All these efforts might help to incentivize the implementation of additional measures for adaptation and mitigation and to include them in a next stage of the agricultural policy.

Tab. 23 > Summary of policies and measures in the agriculture sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in CO_2 eq)					
						1995	2000	2005	2010	2015	2020
Ecological standards (Proof of Ecological Performance)	Improve ecological performance	CH_4, N_2O, CO_2	Economic, regulatory	implemented early 1990th, continual development and improvement	FOAG	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Resource program (AP 2011; AP2014)	Efficient use of natural resources	CH_4, N_2O, (CO_2)	Economic, other (voluntary participation)	implemented in 2008	FOAG	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Modifications in direct payments system (AP14-17)	Progress in areas of sustainability	CH_4, N_2O, (CO_2)	Economic, regulatory	implemented in 2014; increasing relevance with time	FOAG	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Climate Strategy Agriculture	Mitigation of climate change, adaptation	CH_4, N_2O, CO_2	Information, declaration of intent	implemented in 2011	FOAG	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.

n.e.: not estimated.

4.3.8 Land-use change and forestry

There is a long tradition of forest protection in Switzerland. The first federal Forest Act came into force in 1876, but it only covered the Alpine region. Its aim was to put a halt to deforestation, to secure the remaining forest area and to manage it in a sustainable way, and to promote afforestation. The Forest Act of 1902 covered the whole country. The Forest Act and an enabling overall economic development resulted in an increase of the forested area in Switzerland by nearly 50% compared to the mid 19th century. The Forest Act (SR 921.0) that came into force in 1993 reaffirms the long-standing Swiss tradition of preserving both forest area and forest as a natural ecosystem. It prescribes sustainable forest management, prohibits clear-cutting, and bans deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. The forested area is still increasing, especially in the Alpine region. The growing stock is estimated to have increased from less than 150 in 1880 to 357 m^3 ha^{-1} in 2012.

In 2013 the Swiss Confederation's Forest Policy 2020 was published, which formulates provisions for the optimal coordination of the ecological, economic and social demands on the forest. It ensures sustainable forest management and creates favorable conditions for an efficient and innovative forestry and wood industry. The Forest Policy 2020 defines a total of eleven policy objectives. These concern wood harvesting potential, climate change, protective forest, biodiversity, forest area, the economic efficiency of the forestry sector, forest soil (including drinking water and tree vitality), protection against harmful organisms, the forest-wildlife balance, the leisure and recreational use of forests, and education and research (including knowledge transfer). The Forest Policy 2020 formulates several strategic guidelines and various measures for each objective. The primary responsibility for these measures lies with the federal authorities, however the role of the cantons and other actors is also addressed (forest owners, managers, forestry experts, associations etc.). Finally, the legal and financial impacts of the Forest Policy 2020 are also presented. Forest Policy 2020 replaces the Swiss National Forest Program of 2004.

These objectives also encompass that CO_2 removals by sinks and emissions by sources in the forests shall be recognized in terms of compliance with the Kyoto Protocol while making better use of the potential of forests for timber production and fuel wood through economic incentives and implementing new technologies. A study was carried out confirming that the contribution of the forest and wood sector to Swiss climate goals can be optimized by sustainable forest management warranting a high forest growth being harvested annually. The highest possible substitution effect can be achieved through the principle of cascaded use (Taverna et al. 2007). Taking into account the high growing stock, Swiss forest policy's climate related goal is to reduce CO_2 emissions by substituting fossil fuels rather than enhancing sink capacity.

In November 2006, the Swiss government communicated in its initial report to the UNFCCC that Switzerland will account for forest management under Article 3.4 of the Kyoto Protocol. A revision of the Forests Act was prepared. One goal was to give forest owners the option of trading carbon credits on the basis of the sink service provided by their forests. However, the Swiss parliament rejected the revision of the Forests Act in March 2008. Thus, until further notice, forest owners cannot claim carbon removal units (RMUs) on this basis. However, few forest owners offer carbon credits on the basis of sinks provided by their forests on the voluntary market.

On Average, the sink potential of Swiss forests is dwindling. Switzerland, similarly to most central European countries is characterized by an advanced forest age structure, relatively large and growing forest area and very little deforestation. Moreover, Swiss growing stocks are among the highest in European countries. Due to the age structure large fractions of the Swiss forest are mature for harvesting. Consequently, the levels of harvesting should continue increasing in the near future. The objective of increasing harvesting levels is on one hand to avoid episodic large quantities of GHG emissions originating from decay, should these excessive accumulations of C stocks be disturbed by drought, fires, storms, or insects. On the other hand as the forest, its products and services could be broadly affected by climate change there is need to support forests to adapt to climate change. Adaptation processes in forests are best induced through regeneration with the goal to increase the adaptive capacity and stability of future forests. Although the standing volume in regeneration processes is locally and temporarely reduced, adaptation is necessary to secure the mitigation potential of forests in the long run.

Besides the Forest Policy 2020, the Swiss Federal Office for the Environment FOEN has formulated its wood resource policy (FOEN 2008) which is coordinated with the other relevant sectoral policies (e.g. energy policy, regional development policy, forest policy). This wood resource policy defines, among other things, the direction to be taken by federal policy in relation to wood promotion. A wood action plan has been implemented in the period of 2009 to 2012. The main focus in the implementation of the action plan lied on the ecologically and economically effective use of wood. With a view to the efficient use of wood, cascade use is prioritized. In cascaded use, harvested wood is to the outmost extent possible first converted into wood products, prior to burning the products as far in the future as possible for gaining energy. Moreover, targeted efforts are set into motion to improve the use of fuel wood through state-of-the-art burning technologies, reduced pollution, and a greater overall efficiency in the chain from harvesting to final consumption. Switzerland's Wood Resource Policy aims to promote higher harvesting rates in Swiss forests. Due to the positive results, FOEN had decided in summer 2012 to continue the wood action plan till 2016.

Tab. 24 > Summary of policies and measures in the land use, land use change and forestry sector

Name of policy or measure	Objective and/or activity affected	GHG affect-ed	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in million tonnes CO_2 equivalent)					
						1995	2000	2005	2010	2015	2020
Forest area conservation	No deforestation without replace-ment by affor-estation of the same area	CO_2	Legal (forest legislation)	imple-mented in 1876	FOEN and cantonal forest services	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Sustainable forest management	Sustainable forest manage-ment (harvesting volumes shall not exceed growth increment in the forests)	CO_2	Legal (forest legislation)	imple-mented in 1993	FOEN and cantonal forest services	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Wood action plan	Increase of harvesting; sustainable harvestable wood harvest potentential shall be exhausted)	CO_2	Promotion campaign; information for planners and engineers	imple-mented for 2009-2012; and renewed for 2012-2016.	FOEN and forest industry	-	-	-	0.45 [(a)]	0.80[(a)]	1.20[(a)]
Measures taken within Forest Policy 2020	The sustainable harvestable wood harvest potential shall be exhausted; mitigation of climate change (exploitation of increment, increasing substituation effect)	CO_2	Regulatory, Expert decision support	imple-mented for 2011-2020	FOEN and cantonal forest services	-	-	-	-	0.80[(a)]	1.20[(a)]

n.e.: not estimated
a: The effects of the wood action plan result from substitution for other materials or fossil fuels. In parallel there is a reduction in removals by sinks in the forest, which is not reflected in the figures.

4.3.9 Waste management

In 2011, about 3.68 million tonnes of combustible waste, (municipal solid waste, and combustible construction waste and sewage sludge) were incinerated in the 29 Swiss municipal solid waste incinerator plants (MSWI), almost all producing heat and electricity. As the MSWI are a definite source of CO_2 in Switzerland , they will be submitted under the CO_2 regulation. There are two possibilities of the application of this regulation: The submission of the MSWI to the emission trade or an agreement of all MWSI with the confederation on the goals of the reduction of their CO_2 output.

As these plants have to guarantee the waste disposal, they can not control the waste input in order to reduce their CO_2 output. Therefore, there are only the following means of indirect CO_2 reduction at disposal:

- Increasing the energy efficiency of the incineration plants, i.e. increasing energy output of the MSWI will lead to a reduction in the consumption of fossil fuels or imported electricity from thermal power plants;
- Fully use waste energy for district heating and electricity production and thus substitute fossil fuel consumption;
- Optimisation of the metal recovery from the incineration residues: Bottom ash of the MSWI contain on average about 10% scrap iron and significant amounts of non-iron metals such as aluminium, copper, brass etc. The recovery of these metals is less energy-demanding than producing them from primary sources and therefore reduces fossil fuel use and related greenhouse gas emissions.

In order to promote these measures that lead to a more climate-friendly operation of the incineration plants, the Swiss MSWI are introducing the so-called "MSWI-Climate-Charta".

The principal effort to reduce emissions from waste incineration, however, is to increase the recycling quantities. In 2011, a total quantity of municipal waste of 5.48 million tonnes was generated in Switzerland. 2.73 million tonnes were incinerated, and 2.75 millions tonnes were recycled, which corresponds to a recycling quote of about 50 %.

Tab. 25 > Summary of policies and measures in the waste sector

Name of policy or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas (for a particular year, not cumulative, in million tonnes CO_2 equivalent)					
						1995	2000	2005	2010	2015	2020
CO_2-ordinance	Submission of MSWI to emission trade or to an agreement on goals of the reduction of CO_2-output	CO_2	legislation	implemented in 2013; definition of agreements in progress	FOEN	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Environmental Protection Act (EPA)	waste recycling	CO_2	legislation	implemented, in force since 1997	FOEN	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Technical ordinance on waste (TOW)	Interdiction of landfilling of combustible waste	CH_4, CO_2	legislation	implemented, in force since 2000	FOEN	n.a.	0	0.03	0.11	0.16	0.18
MSWI-Climate-Charta	Minimise emissions of pollutants, optimisation of energy production and metal recovery from incineration residues	CO_2	voluntary	implemented, in force since 2012	association of MSWI-operators (VBSA)	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.

4.4 Monitoring and evaluation of policies and measures over time and description of progress towards target.

4.4.1 System for monitoring and evaluation of policies and measures

Article 40 of the revised Federal Act on the reduction of CO_2 emissions ("CO_2 Act") obliges the Federal Council to "periodically evaluate the effectiveness of the policies and measures required by the act and to consider the necessity of additional measures". These evaluations have to take into account other climate relevant parameters such as economic development, population growth and the expansion of traffic. The results of the evaluation have to be reported to Federal Assembly. The periodicity of these evaluations is, however, not further specified. Since the revised CO_2 Act came into force on January 1 2013, a first all-embracing evaluation will not take place before 2015 or 2016. A comprehensive system for an integrated evaluation of the impacts of the CO_2 Act instruments and policies is currently being elaborated. A first concept including propositions for evaluation methodologies and the required data sources will be finalized by the end of 2013.

Given that the CO_2 Act envisages numerous instruments, interdependencies between those instruments are unavoidable. Sorting out the impacts of the individual policies and their contributions to the observed reductions is in some cases a challenging task, especially for instruments that have an impact in more than one sector. An example in this context is the CO_2 levy, where the amount of emissions that have effectively been reduced as a consequence of the levy is difficult to determine. With respect to the CO_2 levy, the FOEN has commissioned a report in 2011 where different empirical approaches to measure the impacts of the levy (both on a sectoral and on an economy-wide scale) have been developed, tested and critically discussed. The authors propose to use a top-down approach based on time series data as the centerpiece of the evaluation of the CO_2 levy, combined with bottom-up models (i.e. approaches that focus on certain sectors of the economy) to corroborate the results. This methodology is promising and will be further considered and refined.

With respect to the effects of the emissions regulations for motor vehicles, the FOEN has initiated a research project (running until 2015) whose goal is to develop an empirical model to estimate the impacts of these regulations on the composition of the vehicle fleet. The findings of this project will serve as a foundation for regular evaluations of this instrument. Art. 37 of the CO_2 Ordinance requests that the DETEC reports to the corresponding commissions of the Council of States and the National Council on the effectiveness of the emissions regulations every three years, starting in 2016.

Other instruments require regular monitoring and reporting of emissions because they include annual or periodical reduction targets. They are therefore closely monitored on a regular basis:

- Firms participating in the emissions trading scheme and firms with an individual reduction target that are exempted from the CO_2 levy are obliged to monitor their greenhouse gas emissions and to provide an annual report to the FOEN;
- Fossil thermal power plants and importers of fuels are obliged to compensate their emissions. The emissions reductions resulting from the projects undertaken for compensation have to be reported on a regular basis;
- The cantons have to report measures planned and undertaken within the Building Program and the corresponding CO_2 emissions of buildings. They are obliged to agree on a standardized method for the measurement of the CO_2 emissions from buildings until 2018 the latest.

4.4.2 Progress in achieving the quantified economy-wide emission reduction target

Switzerland verifies every year whether it is on track to meet its emission reduction target of 8% below 1990 over the period 2008-2012 (48.6 million tonnes CO_2 as annual mean over first commitment period).

The inventory of greenhouse gas emissions prepared according to the UNFCCC guidelines (section 3) allows to track the evolution of its emissions and to assess the effects of its national measures. The emissions and removals for the period 2008-2011 are reported in Tab. 26 according to the submission of April 2013 (see also annex 2, Table 4). For 2012, a first estimate of the GHG emissions is included.

Tab. 26 > Summary of greenhouse gas emissions of Switzerland over the period 2008-2011

Greenhouse gas emissions (net emissions) and removals from LULUCF (in million t CO_2 eq) under the Kyoto Protocol per year.

Year	Total emissions excluding LULUCF and sector 7 (million tonnes CO_2 equivalent)	Contribution from Art. 3.3 and 3.4 KP (million t CO_2 equivalent)
1990 (base year)	52.791	N.A.
2008	53.668	-1.297
2009	52.336	-1.971
2010	54.073	-2.681
2011	49.995	-2.735
2012	51.500*	N.E.
Mean*	52.314*	-1.700* (see text)
FOEN (2013c)		

* estimated values, FOEN (2013d)

Carbon sequestration effect of forests (Art.3.3 and 3.4 KP)

On the basis of activities under Article 3, paragraph 3, Afforestation and Reforestation and elective voluntary activities under Art. 3, paragraph 4, Forest Management, of the Kyoto Protocol, Switzerland issued removal units that can be used for meeting its commitment (section 3.3). The total contribution of these activities is shown in Annex 2, Table 4a(ii). Taking into account the years 2008-2011, the total removals from forest management (9.374 million t CO_2) exceed the cap on forest management. After subtracting emissions from Art. 3.3 activities (0.687 million t CO_2) from the cap, the carbon sequestration effect of forests is in the order of 1.7 million t CO_2 eq per year during the first commitment period. Estimates for the year 2012 are not available yet (will be published in April 2014), but it is expected that for 2012 the carbon sequestration effect remains at a similar level as 2011, since there were no major climatic deviations from former years and harvesting rates decreased slightly.

Units from market based mechanisms

Switzerland decided to use the Kyoto mechanisms (CDM and JI, section 4.1.1) to meet its quantified emission reduction commitment (Annex 2, Table 4). The Swiss Climate Cent Foundation was mandated by the Swiss government to reduce emissions by 17 million t CO_2 eq over the period 2008-2012, with a maximal contribution of 15 million t CO_2 eq certificates to be reduced with emission reductions abroad from CDM and JI projects. According to estimates, the amount of CO_2 emission reductions abroad (Kyoto certificates) will be in the range of 2.8 to 3 million t CO_2 eq per year (Annex 2, Table 4(b)). Switzerland will use these carbon credits in accordance with the accounting approach of the Kyoto Protocol. The time of purchase and transfer to the relevant State account during the first commitment period is irrelevant, since only the total amount of carbon credits used over the period is determinant for meeting commitments under Kyoto. The exact amount of carbon credits that will be transferred to the State account by the Climate Cent Foundation will be known by 15 April 2014. Therefore, it is not possible to provide yearly amounts of acquired certificates from JI and CDM projects, as requested in Annex 2, Table 4(b).

Carry over to the second commitment period

The achievement of the emission reduction target needs to take into account compliance with the emission reduction objectives by the companies exempted from the CO_2 levy (section 4.3.3 and 5.3). The current knowledge makes it likely that most exempted companies (section 3.5.11) will exceed their reduction targets. This surplus emission rights will be carried over to the subsequent commitment period (banking). This is the reason why some AAUs that were initially allocated to Switzerland will not be used to reach the reduction commitment over the period 2008-2012 (Annex 2, Table 4(b)). The emission allowances carried over to the second commitment period may be between 0.4 and 0.6 million t CO_2 eq per year during the commitment period.

Realization of the objectives (Assessement of the Kyoto Protocol)

Tab. 27 reviews the progress made towards achievement of the Kyoto Protocol target (FOEN 2013c). Be aware that many values are estimates only, therefore a range is given.

Tab. 27 > Realization of the Kyoto Protocol objectives (yearly values for the period 2008 - 2012)

	Greenhouse gases emissions (million tonnes CO_2 equivalent)
Estimated emissions 2008 – 2012 (according to a first estimate of 2012 emissions)	52.3
Emissions reduction certificates acquired abroad (Climate Cent Foundation)	-3.0 to -2.8
Carbon sequestration effect of Swiss forests	-1.7
Carry over to the second commitment period (Banking by companies)	0.4 to 0.6
Net emissions 2008 – 2012	48.0.to 48.4
Kyoto Protocol target (according to the allocation of emission rights)	48.6
Shift (a negative value means that the objective is achieved)	-0.6 to -0.2
FOEN (2013c)	

According to the current estimation, the deviation from the target is slightly negative, i.e. the objective of the Kyoto Protocol will be achieved.

Realization of the objectives (Assessement CO_2 Act)

Tab. 28 reviews the progress made towards achievement of the three targets of the CO_2 Act. The CO_2 Act covers only CO_2 emissions from energy use. It allows the use of flexible mechanisms but it does not include the carbon sequestration effect of Swiss forest and the carry over to the second commitment period.

Tab. 28 > Realization of the CO_2 Act objectives

Overall target	CO_2 emissions (million tonnes CO_2)
Emissions 1990	40.8
Emissions 2008 – 2012 (yearly mean)	39.1
Emissions reduction certificates acquired abroad (estimate, yearly mean)	-3.1
Net emissions 2008 – 2012 (estimate)	36.0
Target (-10 per cent compared to 1990)	36.7
Shift (a negative value means that the objective is achieved)	-0.7
Transport fuel target	
Emissions 1990	15.4
Emissions 2008 – 2012 (yearly mean)	17.4
Emissions reduction certificates acquired abroad (estimate, yearly mean)	-3.0
Net emissions 2008 – 2012 (estimate)	14.4
Target (-8 per cent compared to 1990)	14.2
Shift (a positive value means that the objective is not achieved)	+0.2
Heating fuel target	
Emissions 1990	25.3
Emissions 2008 – 2012 (yearly mean)	21.7
Emissions reduction certificates acquired abroad (estimate, yearly mean)	-0.1
Net emissions 2008 – 2012 (estimate)	21.6
Target (-15 per cent compared to 1990)	21.5
Shift (a positive value means that the objective is not achieved)	+0.1
FOEN (2013e)	

According to the current estimation, the overall target of the CO_2 Act is achieved, but the targets on transport and heating fuel are not achieved by a small margin.

Supplementarity (first commitment period 2008 - 12)

Switzerland accepted to include the Kyoto mechanisms (CDM and JI, section 4.1.1) to meet its quantified emission reduction commitment (QELRC). The principles are defined in the Swiss Ordinance on the Crediting of Foreign Emission Reductions (amended on 1st April 2012) (see CO_2-Anrechnungsverordnung: *http://www.bafu.admin.ch/klima/00493/00494/index.html?lang=de* or Ordonnance sur l'imputation du CO_2: *http://www.bafu.admin.ch/klima/00493/00494/index.html?lang=fr*).

The Swiss government does not host JI and CDM projects and does not acquire assigned amount units in the framework of international emissions trading. Therefore, it has mandated the Climate Cent Foundation to acquire emission reduction units. In addition, companies included in the Swiss emissions trading scheme (ETS) as well as companies exempted from the CO_2 levy that take on binding emission reduction commitments without participating in the ETS are allowed to use a limited amount of Kyoto certificates (from CDM and JI projects). The use of Kyoto certificates is generally restricted to 8% of the total allowances allocated to companies participating in the ETS and 8% of the effective emissions for companies exempted from the CO_2 levy that take on binding emission reduction commitments without participating in the ETS.

The use of CO_2 credits from flexible mechanisms by companies is small, in the order of 0.1 to 0.2 million t CO_2 eq. The Climate Cent Foundation has acquired about 2.8 to 3.0 million t CO_2 eq per year through CDM and JI during the first commitment period. In total, the use of CO_2 credits will be in the order of 2.9 to 3.2 million t CO_2 eq per year in average. Final numbers will become available in the true-up report 2015.

In 2009 Switzerland launched a study (Econcept 2009) to estimate the effect of all domestic measures which came into force after 1990. This estimation is challenging because interdependencies of different measures and instrumants are unavoidable. Sorting out of the impacts of single measures is almost impossible. Nevertheless, the study tried to estimate the overlapping of different measures and finally could give a conservative estimate of the sum of the effects of many measures (some measures could not be quantified at all). The total effect of the quantified domestic measures was estimated to 3.9 to 5.3 million t CO_2 eq per year (in 2010). The effect of the domestic measures is therefore larger than the total amount of CO_2 credits from abroad.

4.5 Policies and measures no longer in place

The policies relevant to mitigate climate change that have been developed over the past years are well established. Some of the measures implemented have been adapted over time, in order to better achieve the set objectives. The measures listed in the previous national communication are still part of the national portfolio. Here are the measures which have been replaced:

The Climate Cent on fuels for transport (0.015 CHF/litre), running from 2005 to 2012, has been replaced by the carbon offset obligation, binding those responsible for releasing fossil motor fuels for consumption to compensate 5-40% of the transport-related CO_2 emissions (max. 5 Rp./lt.), starting 2013.

The regulatory system for refrigerants with synthetic GHGs implemented since 2003 has been amended lastly in November 2012. The authorisation procedure for fixed installations and for heat pumps working with more than 3 kg of synthetic GHGs has appeared as very burdensome, uneffective and unefficient. It has therefore been replaced with a partial national ban (see under 4.7). It must be noted that this change was well received by the professional branch probably due to the penetration of alternative technologies since 2003 probably pulled by the authorization scheme even if not very effective. The use of SF_6 as protecting gaz in Magnesium and Aluminium smelting will be banned after 2016.

The CO_2 emission targets for newly registered vehicles replaced the voluntary agreement between the Swiss automobile importers and DETEC.

To implement the objectives of the national forest programme, FOEN has formulated its wood resource policy (FOEN 2008) which is coordinated with the other relevant sectoral policies (e.g. energy policy, regional development policy). This wood resource policy defines, among other things, the direction to be taken by federal policy in relation to wood promotion. The "Wood 21" wood promotion programme has thus been terminated at the end of 2008, allowing new wood action plans under the national forest programme to take place (see Tab. 24).

4.6 Policies and measures leading to an increase in GHG emissions – rationale for such actions

The current Swiss electricity production is virtually carbon free due to the high percentage of hydropower and nuclear power. Due to the scheduled decommissioning of the existing NPPs at the end of their life time, other options for power generation, such as combined cycle power plants, are currently being considered to cover the increasing demand for electricity. According to the legislative packet of measures which will be submitted to parliament in 2013, power plants are requested to fully compensate for their CO_2 emissions.

At the federal level, a few tax exemptions and reductions provide some form of support to users of fossil fuels. Farmers, foresters and fishermen are exempt from the mineral oil tax that is normally levied on sales of mineral oils, while transport companies benefit from a reduced rate. Some vehicles are also exempt from the performance-related Heavy Vehicle Fee (HFV), e.g. agricultural vehicles, vehicles used for the concessionary transport of persons or vehicles for police, fire brigade, oil and chemical emergency unit, civil protection and ambulances.

4.7 Policies and measures – minimizing adverse effects

Switzerland strives to design climate change policies and measures in a way as to ensure a balanced distribution of mitigation efforts by implementing climate change response measures in all sectors and for different gases. Indirectly, this approach is deemed to minimize also the scope of potential adverse impacts on concerned actors (including developing countries). Due to Switzerland's size and share related to international trade – mainly concentrated on the EU – and greenhouse gas emissions, it is not assumed that Swiss climate change policies have any significant adverse economic, social and environmental impacts in developing countries. Additionally, the policies and measures are very much compatible and consistent with those of the European Union in order to avoid trade distortion, non-tariff barriers to trade and to set similar incentives. All major projects of law in Switzerland are accompanied by impact assessments, inter alia including evaluation of trade-related issues. In accordance with international law, this approach strives for ensuring that Switzerland is implementing those climate change response measures, which are least trade distortive and do not create unnecessary barriers to trade. Consistently, Switzerland notifies all proposed non-tariff measures having a potential impact on trade to the WTO, where specific concerns can be raised by other parties. Moreover, Switzerland belongs to the most important donors in the area of Aid for Trade. SECO's technical assistance for trade promotion amounts to CHF 42 million for the year 2010 (non-reimbursable grant contributions).

The impact assessment is accompanied by a broad internal and external consultation process, inter alia inviting competent actors to provide advice on international economic, social and environmental aspects of proposed policies and measures. The open public consultation process, together with regular policy dialogues with other countries guarantee that all domestic and foreign stakeholders can raise concerns and issues about new policy initiatives, i.e. including those concerns about possible adverse impacts on other countries.

Progressive reduction or phasing out of market imperfections, fiscal incentives, tax and duty exemptions and subsidies in all greenhouse-gas-emitting sectors, taking into account the need for energy price reforms to reflect market prices and externalities.

Environmental policy in Switzerland, including climate change policies, are guided by the "polluter pays" principles, as enshrined in the Federal Law on the Protection of the Environment. Accordingly, the internalization of external costs and adequate price signals are key aspects of Switzerland's climate change policy. Regarding greenhouse gas emissions, market-based instruments, such as the Swiss Emissions Trading Scheme, the supplemental use of Certified Emission Reductions from the Clean Development Mechanism or levies for heating and process fuels are important measures to put a price on emissions of greenhouse gases (see section 4.2 and 4.3.3), thus reflecting market prices and internalizing externalities.

Fiscal incentives, tax and duty exemptions and subsidies

Fiscal incentives are recognized as an essential instrument for promoting the efficient use of resources and to reduce market imperfections. In 2001 Switzerland introduced a heavy vehicle fee (HVF). It is applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight. The impact of the HVF introduction was most clearly reflected by changes in traffic volume (vehicle-kilometres) but also in reduced air pollution, a renewal of the heavy vehicle fleet and an increase of load per vehicle, fewer trucks have transported more goods. Two thirds of the revenues are used to finance major railway infrastructure projects (such as the two base tunnels through the Alps), and one third is transferred to the cantons.

In 2008 Switzerland introduced a CO_2 levy on heating and process fuel to set an incentive for a more efficient use of fossil fuels, promote investment in energy-efficient technologies and the use of low-carbon or carbon-free energy sources. Companies, especially those industries with substantial CO_2 emissions from use of heating fuels, may apply for exemption from the CO_2 levy, provided the company commits to emission reductions. The company has to elaborate an emission reduction target, based on the technological potential and economic viability of various measures within the company. While the proceeds from the CO_2 levy were initially to be fully and equally refunded to the Swiss population and to the business community in proportion of wages paid, a parliamentary decision of June 2009 earmarked a third (up to CHF 200 million per year) of the revenues from the CO_2 levy to CO_2 relevant measures in the building sector (Building refurbishment programme). The cap was liftet from CHF 200 to 300 million per year with the revision of the CO2 Act. The program is partly co-funded out of cantonal budgets and co-managed by the federal government and the cantons;

The economic impact of the Swiss climate policy was analysed in two studies (Ecoplan 2009, BAFU 2010). The impact is considered to be very small.

Switzerland generally does not subsidize fossil fuels. Meanwhile, there are some minor schemes in place that may be regarded as fossil fuel subsidies. In international comparison, however, these schemes are very limited: At the federal level, a few tax exemptions and reductions provide some form of support to users of fossil fuels. Farmers, foresters and fishermen are exempt from the mineral oil tax that is normally levied on sales of mineral oils, while transport companies benefit from a reduced rate. Some vehicles are also exempt from the performance-related Heavy Vehicle Fee (HFV), e.g. agricultural vehicles, vehicles used for the concessionary transport of persons or vehicles for police, fire brigade, oil and chemical emergency unit, civil protection and ambulances. By international convention, fuels for international aviation are exempt from taxes. Any attempt to introduce a national tax could cause retaliation measures. It is to note that during the last ten years, the aviation fuel price through the evolution of the market has basically doubled without affecting demand.

Tax exemption for biofuels is limited to fuels that meet ecological and social criteria. The conditions are set out in such a way that biofuels do not compete with food production and are not causing degradation of rainforests or other valuable ecosystems. In 2010, the Swiss Centre for Technology Assessment (TA-SWISS 2010) published the results of a study on the assessment of social and environmental impacts of the use of second generation biomass fuels. Among others, recommendations were as follows: Improvements in vehicle efficiency and the sustainable use of first generation biofuels should be promoted in parallel – likewise the use of second generation biofuels combined with electrical mobility. The main focus must be the supply of sustainable raw materials, and therefore to promote the use of waste material and wood, as well as the cultivation of crops on areas of land that were previously of relatively little interest to the farming industry. Broadly supported and accepted methods must be developed to record and prevent undesirable and indirect side effects of biofuels. *http://www.ta-swiss.ch/publikationen/2010/.*

The need for energy prices reforms

Worldwide subsidies for fossil fuels are estimated at 300-500 billion USD per annum, depending on the level of energy prices. This huge market distortion does not only produce severe fiscal problems for the countries concerned, it is also a major obstacle for enhanced investments in energy efficiency measures and renewable energies.

Switzerland as a member of the Friends of Fossil Fuels Subsidies Reform group supports the gradual and sustained reduction of unnecessary market-distortions. Switzerland under its Economic Development Cooperation supports partner countries in the design and implementation of energy tariff reforms, as an element of infrastructure financing programs. Switzerland has been an initiator of specialized international programs, including the World Bank's Energy Sector Management Program ESMAP. The Energy Efficiency Governance Handbook has been produced with Swiss financing (IEA/EBRD 2010).

Conflicts between the expansion of renewable energy production and land management.

In 2012, the Swiss Academies of Arts and Sciences published the results of a project to assess possible conflicts and synergies between the expansion of renewable energy production and land management, as many forms of renewable energy (solar, wind, water, biomass, geothermal) require considerable floor space and lead to changes in land use, ecosystems, and the views of places and landscape. Large-scale use of areas for energy production thus have to be planned considering the maintenance of ecosystem services, protection of biodiversity, or natural sceneries which are important for tourism. The project report offers approaches on national, cantonal and communal levels.
http://proclimweb.scnat.ch/portal/ressources/2617.pdf

Removing subsidies associated with the use of environmentally unsound and unsafe technologies
Switzerland doesn't subsidize the use of environmentally unsound and unsafe technologies.

Strengthening the capacity of developing country Parties for improving efficiency in upstream and downstream activities relating to fossil fuels, taking into consideration the need to improve the environmental efficiency of these activities.

Switzerland supports through different projects the enhancement of efficiency in industrial production, i.e. "cleaner production". These cleaner production projects promote eco-efficient means of production and better working conditions attained through technical improvements and behavioural changes in both management and staff in industrial companies and services. The resulting rise of economic and environmental efficiency and improved competiveness is gained through the systematic optimisation of energy use, processing of raw material, more efficient use of resources and thus better protection of the environment.

Furthermore, there is a rising awareness and demand by consumers for environmentally sound products. In order to alleviate potential adverse economic impacts of corresponding national measures Switzerland promotes and supports the development of international standards, especially with regard to the sustainable use of natural resources (including agricultural commodities), e.g. through the creation of sustainability standards, financial incentives and favourable framework conditions in developing countries by consultancy services and technology transfer. Further information is contained in section 7.

Assisting developing country Parties which are highly dependent on the export and consumption of fossil fuels in diversifying their economies

Most developing and transition countries have, in recent years, taken important steps towards trade liberalisation, in order to frame their trade policies in line with multilateral trade agreements. The Swiss State Secretariat for Economic Affairs (SECO) promotes these efforts, because a multilaterally acknowledged and respected set of regulations for international transactions not only strengthens trade as such, but also creates more potent and legally secure markets to the advantage of all the players.

The measures taken by SECO are aimed at creating the necessary conditions for earning additional income in the beneficiary countries and thereby contribute directly to the alleviation of poverty. SECO is focusing on three areas of intervention along the value chain: (i) International competitiveness (ii) Enabling framework conditions for trade (iii) Improving market access.

For example market access: Trade between developing and industrial countries is still insufficiently developed respectively not diversified enough. On one hand, the developing countries lack the necessary production capacities, transport infrastructure and knowhow; on the other hand, tariff and non-tariff barriers to trade make direct access to markets more difficult.

Switzerland promotes access to Swiss markets by granting preferential tariffs on products from developing and emerging countries. In addition, SECO runs programmes for promoting imports to Switzerland and the rest of Europe. The easing of market entry for products from disadvantaged countries is an important contribution to the promotion and diversification of trade, the increase of export revenues and thus to the economic development of the partner countries. Switzerland supports developing and transition countries in the following areas:

- Generalized system of preferences (GSP);
- Swiss Import Promotion Program (*www.sippo.ch*);
- Development of new private voluntary social and environmental standards based on international multi-stakeholder approaches: private sustainability standards Better Cotton, 4C (Common Code for the Coffee Community), Roundtable for Sustainable Biofuels, etc.

Finally, Switzerland is a strong supporter of the EITI (Extractive Industries Transparency Initiative). We share a belief that the prudent use of natural resource wealth should be an important engine for sustainable economic growth that contributes to sustainable development and poverty reduction, but if not managed properly, can create negative economic and social impacts. The sustainable management of natural resource wealth – as supported by EITI principle and criteria incl. regular publication and audit of revenues – is key to mobilize the funds for diversification strategies.

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5 Projections and the total effect of measures

5.1 Projections

The projections of greenhouse gas emissions in Switzerland have been fully revised over the past year. In order to provide consistent scenarios for shaping future energy and climate policies, the recently established energy scenarios (Prognos 2012) are used as framework for the greenhouse gas projections presented here. The relevant parameters that define the energy scenarios are also used to derive the resulting greenhouse gas emissions where applicable. Independent scenarios were developed for the agriculture and the LULUCF sector. These scenarios are different to the ones presented in the 5th national communication that formed the basis in the process leading to the revised CO_2 Act in December 2011.

In the wake of the incident in Fukushima, Switzerland decided to gradually phase-out nuclear power generation. The decision triggered an adjustment of the Swiss energy policy. In September 2013, the planned amendments of the Energy Act have been put up for parliamentary debate (section 4.3.4). The energy policy supports the current and future climate policy and should strengthen the efforts towards reaching mitigation targets.

As the revision of the CO_2 Act has only just been completed (section 4.3.3), and given that the energy policy is now on the top of the political agenda, the greenhouse gas scenarios presented here are driven by the energy scenarios and their underlying assumptions. The greenhouse gas scenarios described here are all based on the current state and diverge from 2010 onwards. The "with existing measures" scenario (WEM) reflects more or less the current state of legislation. As it was developed at the time when the revision of the CO_2 Act had not been finalized yet, it does not match all the measures implemented in the final stages of legislation. The "with additional measures" scenario (WAM), on the other hand, is the long-term target scenario of the Swiss government. The required policies and measures have not yet all been put in concrete terms but are assumed to be developed in order to reach the set target. The "without measures" scenario (WOM) assumes that measures currently implemented are continued at the present level with technological advances diffusing autonomously, leading to a slow gradual improvement of energy efficiency.

Tab. 29 > Key variables and assumptions

Key variables used for modelling energy consumption in Switzerland. Unless stated otherwise, the assumptions are identical for all scenarios.

	2000	2005	2010	2015	2020	2025	2030
Population (million)	7.18	7.44	7.82	8.13	8.38	8.58	8.73
GDP (prices 2010, billion CHF)	464	495	547	584	618	646	671
Oil price (prices 2010, CHF/barrel)	57.8	69.2	79.3	93.7	98.3	101.3	101.7
... Scenario WAM				91.1	89.4	86.8	83.2
Gas price (prices 2010, CHF/tonne)	231	339	321	518	561	598	627
... Scenario WAM				505	512	517	525
Heating degree days	3081	3518	3585	3335	3244	3154	3064
Cooling degree days	115	151	153	169	186	203	219
Energy reference area (million m^2)	624	659	709	754	799	836	863
Passenger transport (billion passenger km)	100	107	114	123	131	136	141
... Scenario WAM				121	127	131	135
Passenger transport road/rail split (%)	85/15		82/18		80/20		79/21
... Scenario WAM					77/23		73/27
Freight transport (billion tonne km)	23.6	25.3	26.9	30.6	34.2	36.7	39.1
... Scenario WAM				30.7	34.5	36.6	38.7
Freight transport road/rail split (%)	58/42		63/37		58/42		56/44
... Scenario WAM					54/46		49/51

Prognos (2012)

The projection parameters have all been adjusted in comparison to the 5th National Communication. Based on the latest estimates, population is assumed to increase further by over 10% between 2010 and 2030. This is one of the factors leading to increases in energy reference area and transport. GDP, another parameter influencing energy consumption and greenhouse gas emissions, is also assumed to increase considerably over the coming decades. While the key variables such as population and economic development are identical for all scenarios, the strong policy intervention assumed in the WAM scenario is reflected in the international energy prices and the transport demand and modal split.

5.1.1 WEM

Energy

Energy consumption for the WEM scenario is based on the energy scenario "political measures", option C&E (central fossil "C" and renewable "E" electricity generation to replace nuclear power generation) of the latest energy scenarios (Prognos 2012). The main measures, instruments and underlying assumptions in the energy scenario are summarised below. These measures and instruments are not entirely reflecting the implementation of the revised CO_2 Act as the energy scenarios were drafted whilst the revision of the CO_2 Act was still under way.

- Building programme: Continuation and intensification of the current programme (Annual funds CHF 300 million in 2014, CHF 600 million from 2015).
- Building codes: Continuously rising building standards, along with technological progress. Energy consumption for new buildings nearing zero by 2020.
- CO_2 levy on heating and process fuels: 2016: 76 CHF/tonne; 2018: 96 CHF/tonne.

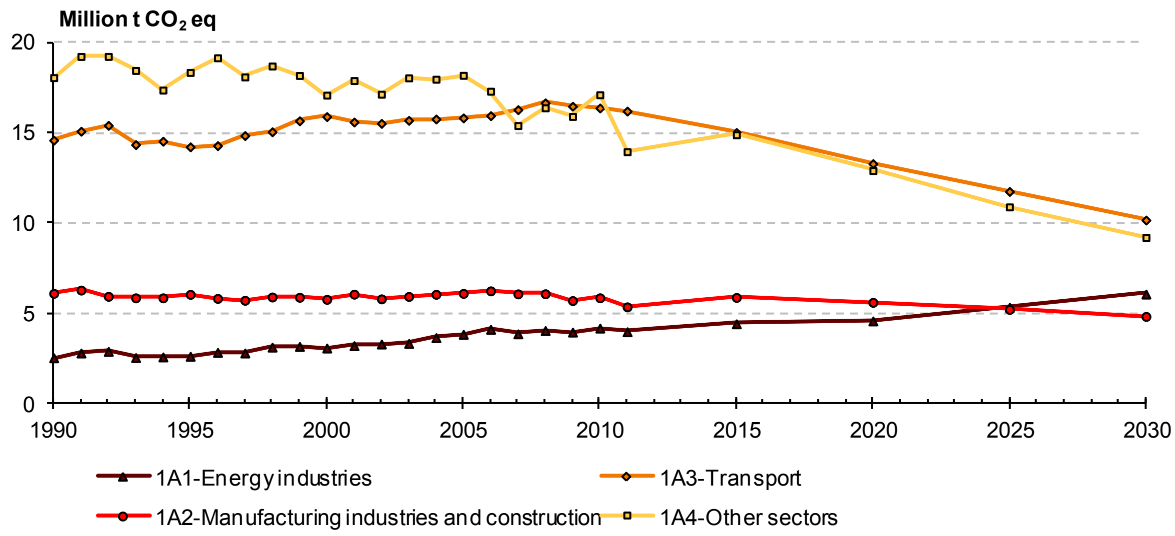
- CO_2 emission standards for new vehicles (passenger cars: 2015: 130g/km; 2020: 95g/km; further reduction towards 35g/km in 2050; light commercial vehicles: 2015: 175g/km; 2020: 145 g/km; 2030: 110 g/km; further reductions towards 85g/km in 2050).
- Competitive tendering for electric efficiency in industry, services and households with an annual budget of CHF 100 million from 2015.
- Continuation of the programme SwissEnergy with moderately increasing funds.
- Feed-in tariff for renewable electricity.

While the climate policy to 2020 (section 4.3.3) has recently passed parliament, the future energy policy (section 4.3.4) is currently being developed (Federal Council dispatch to the parliament in September 2013). It is planned that the energy policy supports the climate policy along its current line. Due to the gradual phase-out of nuclear power generation, the energy scenario "political measures" relies on combined cycle gas power plants from 2022 onwards and electricity imports. However, as stipulated by the CO_2 Act (Swiss Confederation 2011), the CO_2 emissions of gas power plants will need to be compensated in full (50% domestic compensation, 50% international). Furthermore, also importers of fossil transport fuels are legally required to compensate for a fraction of the associated CO_2 emissions. Compensation needs to be made through domestic projects. The rate of compensation for transport fuels is set at 2% for 2014-15, 5% for 2016-17, 8% for 2018-19 and 10% for 2020 (Swiss Confederation 2012). The effect of domestic compensation measures is not explicitly taken into account in the energy scenarios and therefore not reflected in the modelled energy consumption. However, the domestic effect of compensation projects is shown in the national total in Tab. 30.

The greenhouse gas emissions in the energy sector under the scenario "political measures" are shown in Fig. 73. It shows projected emissions without taking domestic compensation into account. Up to now, the subsector "public electricity and heat production (1A1a)" was of only minor importance in Switzerland, with electricity provided largely by hydropower (60%) and nuclear power plants (40%). However, when the first nuclear plant will have reached the end of its lifetime and shut down, alternative power generation and electricity imports will need to fill the gap. The energy scenarios assume that combined-cycle power plants and increasing numbers of decentralized cogeneration facilities will partly replace the nuclear power plants as far as required by future electricity demand. Therefore, emissions in the subsector public electricity and heat production (1A1a) show a large increase in the future. Large emission reductions are projected in the commercial/institutional and residential subsectors (1A4a, 1A4b) and in the transport subsector (1A3). In the industry subsector (1A2), progress in energy efficiency as well as a structural change towards less energy-intensive branches leads to reduced energy consumption and related emissions.

Fig. 73 > Greenhouse gas emissions in the energy sector under the WEM scenario

Total greenhouse gas emissions in the energy sector in CO_2 eq. Data up to 2011 are from the Swiss greenhouse gas inventory (submission April 2013), from 2015 onwards, emissions are based on energy use according to Prognos (2012). The projected energy use is assigned to the categories of the greenhouse gas inventory. While overall energy use is broadly consistent between inventory and projections, the assignment to the individual sectors suffers from small discrepancies. The effect of inland compensation projects is not shown.



Transport

Transport requirements are projected to increase to over 130 billion passenger kilometres in 2020 and over 140 billion passenger kilometres in 2030 (Prognos 2012). The share of rail transport is increasing slightly, reaching 20% in passenger and 42% in freight transport in 2020 and 21% in passenger and 44% in freight transport in 2030 (see Tab. 29) The energy scenario assumes a considerable increase of biofuels, reaching 10% in 2020 and 13% in 2030. Electric mobility is promoted actively, with 2% being electric passenger cars by 2020 and 11% by 2030.

Apart from the measures described above under energy (CO_2 emission standards and compensation duty of transport fuel importers), a couple of supporting measures in the transport sector are considered (section 4.3.5). However, they are difficult to quantify separately and are thus considered as ancillary measures for reaching the projected targets. Efficiency targets for light goods vehicles, energy efficiency labelling, as well as economic incentives for low-emission vehicles are among those ancillary measures. The heavy vehicle fee is maintained.

Domestic aviation, which is of minor importance in Switzerland (1% of transport emissions), is assumed to remain roughly at the levels of 2011, and international bunker fuels are projected to increase by 10-15% between 2011 and 2030.

Industrial processes and solvents

In Switzerland, there are only a few sectors in industry that release relevant amounts of process-related greenhouse gases. Currently, the major emitter is the cement industry (51% of process emissions), followed by emissions from the use of fluorinated gases as refrigerants (28% of process emissions) and steel production (5%). In close correspondence with assumptions on industrial production used in the energy perspectives (Prognos 2012), the cement and steel production are assumed to decline over the coming decades, resulting in decreasing process emissions. Emissions from the use of HFCs as refrigerants, on the other hand, are projected to increase until approximately 2015 and to decrease continuously thereafter due to a gradual replacement of fluorinated refrigerants (Carbotech 2013). Other industrial process emissions (e.g. ammonia/ethylene production, nitric acid production) are assumed to maintain the current production levels.

With the exception of the fluorinated gases, measures in the industrial sector are primarily targeting energy-related emissions (section 4.3.6). For those companies that are included in the Swiss emissions trading system (ETS), there is a gradual reduction of the emissions allocation, which also includes process emissions and gases other than CO_2. However, in view of the subordinate importance of the remaining process emissions, the effect of further efforts in this field will be small.

Agriculture

The basis of the WEM-scenario is the agricultural policy 2014-17 that has recently been approved by the Swiss parliament (section 4.3.7). Direct payments will be decoupled to a certain degree from cropping area and particularly from the amount of animal living on the farms, reducing incentives for intensification that would lead to negative environmental impacts (Swiss Confederation 2009). Consequently the animal population numbers are more directly dependent on price levels and are projected to decline. Zimmermann et al. (2011) investigated the repercussions of the agricultural policy 2014-17 with the dynamic, process-orientated optimization-model SILAS and an additional multi-agent model called SWISSland. Development of animal populations, productivity of dairy cows and development of cropping areas have been projected until the year 2020. For the subsequent years, all values have been kept constant at the levels projected for 2020.

Assumptions on future development

- **Livestock populations:** The Agricultural Policy 2014-2017 will influence animal population as predicted by Zimmermann et al. (2011). Direct payments will be decoupled to a certain degree from cropping area and particularly from the quantity of animals living on the farms reducing incentives for intensification that would lead to negative environmental impacts (Swiss Confederation 2009). Consequently the animal population numbers are more directly dependent on price levels and are projected to decline. Beyond 2020 (the time horizon of Zimmermann et al. 2011) constant population numbers have been assumed for all animal categories due to the lack of further projections.
- **Feeding regime:** With the exception of mature dairy cows, energy intake and methane rates will remain constant as in 2011, i.e. no technical measures concerning animal diets will be implemented. Milk yield and hence gross energy intake of mature dairy cattle is assumed to further increase until 2017 (Zimmermann et al. 2011). Accordingly the CH_4 emission factor for both enteric fermentation and manure management increases proportionally. One possible scenario would be the promotion of more or less extensive milk and meat production basically based on a grassland diet (Swiss Federal Council 2012). Some respective incentives have already been implemented in the agricultural policy 2014-17 but have not been considered here.
- **Manure management:** The current tendency towards more animal friendly livestock husbandry might continue with a steady trend towards more manure excreted on pasture. This would also be in line with the planned program for grassland based milk and meat production (Swiss Federal Council 2012). However, due to the lack of clear projections, the shares of manure excreted on pasture, range and paddock as well as the shares of the individual manure management systems cannot be predicted satisfactorily and are thus left constant as in 2011.
- **Nitrogen excretion by animals:** All nitrogen excretion rates are assumed to remain constant as in 2011 with the exception of mature dairy cows. Nitrogen excretion of mature dairy cows is projected to increase until 2017 due to the higher milk production projected by Zimmermann et al. (2011) which is related with higher feed intake rates.
- **Crop cultures:** Important aspects of the further development of direct payments that influence the development of the crop cultures are an improved targeting of direct payments, particularly for the pro-

motion of common goods and the securing of a socially acceptable development (Swiss Confederation 2009, FOAG 2010). Direct payments will be divided into contributions for an open cultivated landscape, contributions for security of supply, contributions for biodiversity and contributions for landscape quality. Furthermore macroeconomic price levels as well as the need for animal fodder will also determine the portfolio of crop cultures in the future. Taking into account these aspects, Zimmerman et al. (2011) projected the future development of the individual crop cultures. Overall agricultural area is projected to slightly decrease while arable land is slightly increasing. Beyond 2020 constant yields and areas have been assumed due to the lack of further projections.
- **Fertilizers and fertilizer management:** Use of commercial fertilizers is projected to further decrease until 2020 according to Zimmermann et al. (2011). Beyond 2020, constant fertilizer use has been assumed due to the lack of further projections.
- **Nitrogen use efficiency:** 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). Further development of the scheme of direct payments (with adjustments in the Proof of Ecological Performance (PEP)) (Swiss Confederation 2009) as well as programs for resource-efficiency in agriculture are designed to increase nutrient use efficiency in order to fulfill the environmental goals for agriculture (FOEN/FOAG 2008). Consequently the agricultural policy 2014-2017 plans to address the above mentioned issues. However, due to the lack of specific indications all parameters in the inventory model are projected to remain constant.

LULUCF

Greenhouse gas emissions in the LULUCF sector are dominated by activities in the category "forest land remaining forest land" (5A1). Therefore, projections are focussing on the category forest land remaining forest land, assuming that all other LULUCF-categories remain at their current levels.

The category forest land remaining forest land (5A1) is closely related with the KP activity forest management. Forest management scenarios are characterized by defining future harvesting rates. Greenhouse gas balances under different forest management scenarios were calculated using the Swiss model MASSIMO03 (for a description see section 5.4.5). It should be noted, however, that the scenarios presented here show net emissions and removals as reported under the convention. For accounting purposes under the Kyoto Protocol, the net emissions are considered in relation to the forest management reference level.

The forest area as well as the changes in forest area (afforestation, deforestation) are assumed to stay at the level of 2006 (values derived from the Swiss land use statistics AREA (SFSO 2012a).

In order to reach the optimal combination of the objectives identified in the Swiss forest policy 2020 (see section 4.3.8), it is important that Swiss forests are stable and managed in a sustainable way. The WEM scenario, in accordance with the Swiss forest policy 2020, is defined as a scenario where total living biomass remains constant at the level of 2006 (growing stock from NFI3), meaning that gross growth equals cut and mortality. To reach constant biomass, harvesting rates have to increase by 16% until 2025 compared to 1995-2006 (harvesting rate for period NFI2-3; Kaufmann 2011). Without increase of harvesting rates, standing volume in Swiss forests would further increase and lead to unstable forests not fulfilling the objectives of sustainable forest management (see section 4.3.8). From 2025 to 2050 harvesting rates are assumed to stay at this level.

Under the forest management scenario with existing measures, forest management leads to net emissions in the order of 0.1 million t CO_2 eq per year in 2020-2030. The combined effect of afforestation, deforestation and forest management activities, lead to total net emissions in the order of 0.2-0.3 million t CO_2 eq in 2020-2030. The total LULUCF sector produces net emissions of 0.8-0.9 million t CO_2 eq per year in 2020-2030 (see Tab. 30).

Waste

In Switzerland, municipal waste is disposed of in incineration plants. Landfilling of combustible waste was only of secondary importance in waste management and is prohibited completely since 2000. Therefore, emissions from solid waste disposal sites are small and further decreasing in the coming decades. Emissions from waste incineration with energy recovery are reported in the energy sector. These emissions are assumed to scale with increasing population.

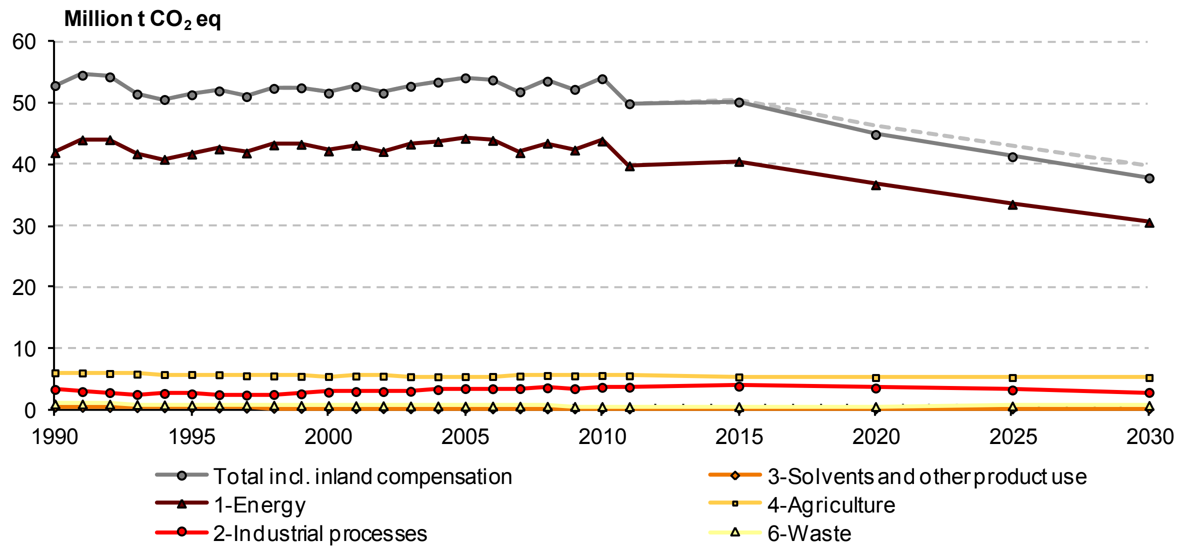
Emissions from waste water handling as well as from digestion of organic wastes for biogas production are assumed to increase substantially over the coming decade due to the increasing demand for biogas.

Aggregate emissions WEM

Tab. 30 and Fig. 74 present an overview of the greenhouse gas emissions of the „with existing measures" scenario. Total emissions will decrease by approximately 15% between 1990 and 2020. While the national total is taking domestic compensation projects into account, the compensation effort is not assigned to a particular sector. This needs to be kept in mind when looking at emission pathways at the sectoral level.

Fig. 74 > Aggregate emissions in the „with existing measures" scenario

Total greenhouse gas emissions in CO_2 eq, shown by sector. Emissions from LULUCF and international bunkers are not included in the national total. The grey dashed line corresponds to emissions without taking domestic compensation into account.



The energy sector is by far the most important sector for total emissions. While the category covering residential and commercial/institutional buildings (1A4) used to be the single largest subsector in 1990, it has reduced emissions gradually and is projected to continue on a decreasing pathway, reaching a reduction of 28% compared to 1990 by 2020 and 49% by 2030. The transport sector, on the other hand, increased considerably (by 14%) between 1990 and 2008, exceeding emissions from residential and commercial/institutional buildings in 2007. Emissions are largely driven by passenger cars and only recently, efforts to reduce specific emissions of passenger cars seem to bear fruit. However, with the emission standards for new cars stipulated in the CO_2 Act, greenhouse gas emissions from the transport sector are projected to decrease over the coming years. The emission reduction achieved by 2020 compared to the highest level in 2008 is considerable (20%), however, in comparison with 1990, emissions are reduced by approximately 10%.

Tab. 30 > Information on updated greenhouse gas projections under a „with measures" scenario

Greenhouse gas emissions in million tonnes CO_2 equivalent. Domestic compensation is taken into account in the total, however, it is not assigned to a specific sector or gas. Therefore, the sum of the individual gases or sectors is larger than the projected national total.

Sector	Base year	1990	1995	2000	2005	2010	2015	2020	2030
Energy (1)	42.0	42.0	41.8	42.3	44.3	43.9	40.6	36.8	30.6
Energy industries (1A1)	*2.6*	*2.6*	*2.6*	*3.1*	*3.9*	*4.2*	*4.4*	*4.6*	*6.1*
Manufacturing industries and construction (1A2)	*6.1*	*6.1*	*6.1*	*5.8*	*6.1*	*5.9*	*5.9*	*5.6*	*4.8*
Transport (1A3)	*14.6*	*14.6*	*14.2*	*15.9*	*15.8*	*16.4*	*15.0*	*13.3*	*10.2*
Other sectors (1A4)	*18.1*	*18.1*	*18.3*	*17.1*	*18.2*	*17.1*	*14.9*	*12.9*	*9.2*
Industrial processes and solvents (2, 3)	3.9	3.9	3.0	3.2	3.7	3.9	4.1	3.8	3.1
Agriculture (4)	6.1	6.1	5.8	5.5	5.5	5.6	5.4	5.3	5.3
LULUCF (5)	-3.2	-3.2	-3.9	-1.2	-4.2	-2.4	0.9	0.9	0.8
Waste (6)	1.0	1.0	0.9	0.7	0.7	0.6	0.6	0.6	0.8
Gases									
CO_2 excl. LULUCF	44.6	44.6	43.6	43.9	46.2	45.9	42.5	38.7	32.2
CH_4 excl. LULUCF	4.7	4.7	4.3	3.9	3.8	3.8	3.6	3.6	3.7
N_2O excl. LULUCF	3.5	3.5	3.3	3.2	3.1	3.1	3.0	2.9	3.0
HFCs	0.0	0.0	0.2	0.5	0.9	1.1	1.3	1.2	0.8
PFCs	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.1	0.1
Total without LULUCF	**53.0**	**53.0**	**51.5**	**51.7**	**54.2**	**54.1**	**50.3**	**45.0**	**37.9**

5.1.2 WAM

The scenario presented here is based on long-term target scenarios that follow the strategic orientation for 2050 in key policy areas (Federal Council 2013, FOAG 2011). Due to the ambitious targets and the long time-horizon considered, these scenarios are not based on concrete policies and measures but rather provide indications of the main thrust of future long-term policies. However, for the time period to 2020, the existing policies and measures will be strengthened in order to reach the emission reduction target defined in the CO2 act. In the following sections, the implications for the relevant sectors are discussed in more detail.

Energy

Energy consumption for the WAM scenario is based on the energy scenario "new energy policy", option E (renewable "E" electricity generation and electricity imports to replace nuclear power generation) of the latest energy scenarios (Prognos 2012). This scenario assumes that international efforts are made to reduce greenhouse gas emissions towards 1-1.5 t CO_2 per capita in 2050 and that policies and measures are coordinated internationally.

Generally, the energy scenario relies on substantial energy efficiency gains in all sectors. This curbs fossil energy use and levels off electricity demand. The building refurbishment rate is raised to 2% by 2020. New as well as refurbished buildings reach very high standards in terms of energy consumption. Heating systems rely more and more on heat pumps rather than gas or oil-fired boilers, and hot water is more and more provided by solar thermal collectors (Prognos 2012). Energy consumption in industry is reduced through rigorous implementation of efficient technologies. The difference in the industry sector compared to the WEM scenario is entirely due to efficiency improvements. Production rate is assumed the same as in the WEM scenario.

Transport

In the WAM scenario, transport requirements are projected to increase more moderately compared to the WEM scenario, reaching just over 125 billion passenger kilometres in 2020 and approximately 135 billion passenger kilometres in 2030 (Prognos 2012). The share of rail transport, on the other hand, is increasing more than in the WEM scenario (Tab. 29). Electric mobility is promoted actively, at the same rate as in the WEM scenario. However, biofuels are introduced faster, assuming 20% by 2020 and 33% by 2030.

Industrial processes and solvents

The production rates used to derive the energy scenarios are identical for all three scenarios. Given that there are currently no specific measures planned which target process emissions, the CO_2, CH_4 and N_2O emission scenarios are identical. However, with regard to the use of fluorinated gases, the WAM scenario assumes a slightly faster phase-out and replacement of fluorinated gases and therefore HFC emissions decline a little bit faster compared to the WEM scenario (Carbotech 2013).

Agriculture

The WAM-scenario in agriculture is consistent with the long-term target. Up to 2020, emissions follow the same course as in the WEM scenario i.e. the development according to the agricultural policy 2014-17 (Zimmermann et al. 2011). After 2020, the scenario is designed according to the target scenario (climate strategy for agriculture, FOAG 2011). Policies and measures have yet to be designed. A substantial reduction of agricultural greenhouse gas emissions until 2050 is aspired. Technical and organizational measures shall reduce greenhouse gas emissions by at least one third. By influencing consumption patterns as well as production structures further reductions of similar scale are aspired (FOAG 2011). The envisaged decrease of emissions is in line with the roadmap for moving to a competitive low carbon economy in 2050 of the European Commission (EC 2011).

It is important to note that the Climate Strategy for Agriculture is rather a declaration of intent and encompasses only some general hints on the future roadmap of a climate friendly agriculture. Up to date no concrete measures are available that could be readily implemented. However, fundamental structures are being established at the moment such as the AgroCleanTech platform that will support farmers and other related stakeholders in the fields of renewable energy, energy efficiency and climate change mitigation. Peter et al. (2009, 2010) as well as publications from the Animal Nutrition Group of the Swiss Federal Institute of Technology in Zürich (e.g. Kreuzer 2012) or the program of IP-Suisse (Mieleitner et al. 2011) list various technical mitigation measures that will be pursued in such a context. Furthermore a possible framework for a programmatic approach to establish an emission trading scheme for agriculture in Switzerland (Zimmermann et al. 2013) might help to incentivize the implementation of mitigation measures.

Assumptions on projection parameters

In order to generate an emission pathway from 2020 towards the goals of the Climate Strategy for Agriculture (FOAG 2011), projection parameters were adjusted freely. As no specific measures beyond 2020 are currently envisaged, the choice of parameters is somewhat arbitrary.

- **Livestock populations:** Generally livestock populations are taken to decrease after 2020 until they reach half of the stocks of 1990. Populations of fattening cattle, mature non-dairy cattle (mother cows) and swine fall to 38% of their 1990 level in order to fulfill the overall 50% reduction target set in the Climate Strategy for Agriculture (FOAG 2011). In the logic of this scenario, a reduction of the consumption of animal products should accompany the reduction of the animal populations in order to prevent the imports of greenhouse gas intensive animal products.
- **Feeding regime:** Energy intake as well as all other related feeding parameters are assumed to be equal to those in the WEM scenario. However, the findings of the Animal Nutrition Group of the Swiss Feder-

al Institute of Technology in Zürich (e.g. Kreuzer 2012) might help to define alternative feeding strategies with low emission intensities in the future.
- **Manure management system distribution and nitrogen excretion rates:** The same assumptions are implemented as under the WEM scenario.
- **Fertilizers and fertilizer management:** The same projections are used as under the WEM scenario until 2020. Afterwards, consumption of commercial fertilizers declines until it reaches half the amount of 1990. As an exception the use of sewage sludge will remain prohibited until 2050.
- **Crop cultures and nitrogen use efficiency:** For crop yields the same projections are used as under the WEM scenario until 2020. In 2050 crop yields are projected to be equal as in 1990 with a steady development between 2020 and 2050. Falling commercial fertilizer levels combined with more or less stable crop yields immediately implies that nitrogen use efficiency must substantially increase. This could be reached through crop breeding, more efficient use of synthetic fertilizers or increasing the nitrogen use efficiency of manure fertilizers by reducing losses of ammonia and nitrate. However, due to the lack of specific information, the fractions of nitrogen lost as NH_3 and NO_3^- have been kept constant in the calculation model which might lead to a somewhat unrealistic situation. For the possibility of reductions of ammonia a report by the School of Agricultural, Forest and Food Sciences is in preparation. The respective findings might be used to refine the WAM scenario projections in the future.
- **Agricultural area:** Total agricultural area follows the projections in the WEM scenario and then slowly increases again until reaching the 1990 level in 2050.

LULUCF

As stated above for the WEM scenario, the projections for the LULUCF sector are focussing on the category "forest land remaining forest land" (5A1). In the WAM scenario, a different approach for forest management is taken into account, while afforestation and deforestation activities remain unchanged compared to the WEM.

Switzerland's wood resource policy (FOEN 2008; see section 4.3.8) promotes higher harvesting rates in Swiss forests. With the excellent image of sustainably produced Swiss wood, the future demand for wood products is expected to increase.

Therefore the aim of Swiss wood policy (scenario with additional measures) is to increase wood production by 2025 in the interest of harvesting the potential wood supply, increasing the harvesting rate by up to 30% compared to 1995-2006 (harvesting rate for period NFI2-3; Kaufmann 2011). From 2025 to 2050 harvesting rates are assumed to stay at this level. The feasibility of such an increase in harvesting was determined in a scientific study, "Switzerland's potential sustainable wood supply" (Hofer et al. 2011). This harvesting scenario was also used as "business as usual scenario" to determine Switzerland's forest management reference level, which will be used for accounting under the Kyoto Protocol.

Under the forest management scenario with additional measures, forest management leads to net emissions in the order of 1.1-1.6 million t CO_2 eq in 2020-2030. The aggregate effect of afforestation, deforestation and forest management activities leads to total net emissions of the order of 1.2 to 1.8 million t CO_2 eq in 2020- 2030. The total LULUCF sector produces net emissions of 1.8-2.4 million t CO_2 eq in 2020-2030 (Tab. 31).

Waste

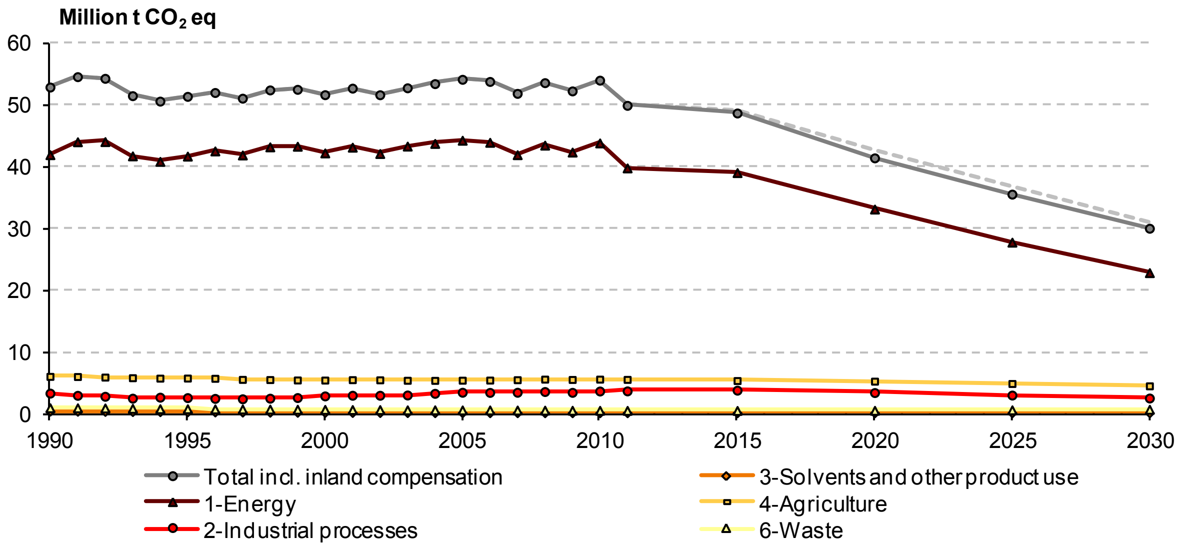
In principle, the projections in the waste sector for the WAM scenario are the same as for the WEM scenario. No specific additional policies and measures are currently under consideration. However, in the energy sector, the end use of biogas is projected differently for the WAM. This has implications for the CH_4 emissions in the waste sector (emissions from biogas production).

Aggregate emissions WAM

Tab. 31 and Fig. 75 present an overview of the greenhouse gas emissions of the „with additional measures“ scenario. Total emissions will decrease by 22% between 1990 and 2020. While the national total is taking domestic compensation projects into account, the compensation effort is not assigned to a particular sector. This needs to be kept in mind when looking at emission pathways at the sectoral level.

Fig. 75 > Aggregate emissions for the „with additional measures“ scenario

Total greenhouse gas emissions in million tonnes CO_2 equivalent, shown by sector. Emissions from LULUCF and international bunkers are not included in the national total. The grey dashed line corresponds to emissions without taking domestic compensation into account.



Tab. 31 > Information on updated greenhouse gas projections under a „with additional measures“ scenario

Greenhouse gas emissions in million tonnes CO_2 equivalent. Domestic compensation is taken into account in the total, however, it is not assigned to a specific sector or gas. Therefore, the sum of the individual gases or sectors is larger than the projected national total.

Sector	Base year	1990	1995	2000	2005	2010	2015	2020	2030
Energy (1)	42.0	42.0	41.8	42.3	44.3	43.9	39.1	33.2	22.9
Energy industries (1A1)	*2.6*	*2.6*	*2.6*	*3.1*	*3.9*	*4.2*	*4.3*	*4.4*	*4.3*
Manufacturing industries and construction (1A2)	*6.1*	*6.1*	*6.1*	*5.8*	*6.1*	*5.9*	*5.6*	*5.1*	*3.8*
Transport (1A3)	*14.6*	*14.6*	*14.2*	*15.9*	*15.8*	*16.4*	*14.0*	*11.0*	*6.7*
Other sectors (1A4)	*18.1*	*18.1*	*18.3*	*17.1*	*18.2*	*17.1*	*14.8*	*12.4*	*7.7*
Industrial processes and solvents (2, 3)	3.9	3.9	3.0	3.2	3.7	3.9	4.1	3.7	2.8
Agriculture (4)	6.1	6.1	5.8	5.5	5.5	5.6	5.4	5.3	4.6
LULUCF (5)	-3.2	-3.2	-3.9	-1.2	-4.2	-2.4	1.2	1.8	2.4
Waste (6)	1.0	1.0	0.9	0.7	0.7	0.6	0.6	0.6	0.8
Gases									
CO_2 excl. LULUCF	44.6	44.6	43.6	43.9	46.2	45.9	41.0	35.1	24.5
CH_4 excl. LULUCF	4.7	4.7	4.3	3.9	3.8	3.8	3.6	3.6	3.2
N_2O excl. LULUCF	3.5	3.5	3.3	3.2	3.1	3.1	3.0	2.9	2.7
HFCs	0.0	0.0	0.2	0.5	0.9	1.1	1.2	1.0	0.6
PFCs	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.1	0.1
Total without LULUCF	**53.0**	**53.0**	**51.5**	**51.7**	**54.2**	**54.1**	**48.8**	**41.5**	**30.1**

5.1.3 WOM

The bifurcation point of the scenarios presented here is the year 2010. The reason for chosing this year for bifurcation lies in the available energy scenarios (Prognos 2012). In order to provide a consistent set of energy and greenhouse gas scenarios, the WOM scenario is developed based on the energy scenarios available. This means, that the WOM scenario presented here is not completely "without measures" but rather a continuation of the policies and measures as of 2010 and a moderate further evolution of these policies and measures as predetermined by the energy scenarios. In the 5th National Communication, a different approach for developing a WOM scenario has been chosen, trying to map an emission pathway without measures from 1990. The effect of those measures is implicitly included in the WOM scenario presented below. However, as the two scenarios are based on a completely different approach, it is difficult to merge them into a consistent WOM scenario starting in 1990.

Energy

For the WOM scenario, the energy consumption is based on the energy scenario "business as usual" ("weiter wie bisher"), option C (electricity generation from large gas-fired power plants to take over from nuclear power generation) (Prognos 2012). This scenario assumes the continuation of policies implemented in 2010 and a moderate autonomous improvement of energy efficiency.

The assumptions on which the scenario is based are summarised below.

- Building programme: Continuation of the current programme (annual funds CHF 200 million), refurbishment rate remaining unchanged.
- Building codes: Building standards for new buildings follow technological progress.
- CO_2 levy on heating and process fuels: 2016: 72 CHF/tonne.
- Climate Cent on transport fuels.
- CO_2 emission standards for new vehicles: 2015: 130g/km; 2030: 95g/km.
- Competitive tendering for electric efficiency in industry, services and households with an annual budget of CHF 27 million from 2015.
- Continuation of the programme SwissEnergy at current level.
- Feed-in tariff for renewable electricity.

Under this scenario, electricity demand will increase considerably. As the nuclear power stations in Switzerland are phased out, combined-cycle power stations are introduced from 2019. The power stations will cause additional CO_2 emissions, however, according to current legislation, these emissions need to be compensated (50% domestic compensation). The effect of the domestic compensation is not taken into account in the emission scenarios.

Transport

Transport requirements are identical to those in the WEM scenario, i.e. increasing continuously, and also the modal split is assumed to be equal for the WOM and WEM (Tab. 29). However, biofuels are not introduced at significant levels, reaching 2% by 2020 and staying at this level from there onwards. Electric passenger cars increase moderately to 1% by 2020 and 7% in 2030. Electrification of goods vehicles is starting later, reaching a share of 3% electric goods vehicles in 2030.

Industrial processes and solvents

The production rate used to derive the energy scenarios are identical for all three scenarios. Given that there are currently no specific measures planned which target process emissions, the CO_2, CH_4 and N_2O emission scenarios are identical. However, with regard to the use of fluorinated gases, the WOM scenario assumes no forced phase-out and replacement of fluorinated gases and therefore HFC emissions keep increasing (Carbotech 2013).

Agriculture

The WOM scenario for agriculture is based on the continuation of the Agricultural Policy 2011. Particularly it is expected that the scheme of the direct payments and the requirements under the Proof of Ecological Performance (PEP) will not be adjusted. Projections are calculated according to Peter et al. (2010) as expected after the implementation of the Agricultural Policy 2011. Peter et al. (2010) project the future development of the agricultural portfolio according to calculations made with the S-Integral model. S-Integral is a comprehensive agricultural supply model which simultaneously takes into account economic, agronomic and ecological aspects and interrelationships (Peter, 2008). Projections have been made for three agricultural price-scenarios of which the high price level scenario has been chosen here. The portfolio of agricultural operations (i.e. the production levels of the individual livestock animals and crop cultures) will develop according to the macroeconomic development that is given exogenously as model input. Technical, organizational and structural framework conditions are assumed to remain largely unchanged. The time horizons of the projections reach in most cases until 2022. For the subsequent years until 2050 all values are kept constant.

Assumptions on future development

- **Livestock populations:** Overall Peter et al. (2010) expect rather constant livestock populations until 2022. Beyond 2022 constant population numbers have been assumed for all animal categories due to the lack of further projections.
- **Feeding regime:** With the exception of mature dairy cows, energy intake and methane rates will remain constant as in 2011, i.e. no technical measures concerning animal diets will be 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 remain more or less at the level of 2011.
- **Manure management:** Manure management system distribution is assumed to remain constant as in 2011 although a trend towards more animal friendly livestock operations might continue into the future.
- **Nitrogen excretion by animals:** Nitrogen excretion rates of all animal except mature dairy cattle are assumed to remain constant as in 2011. Nitrogen excretion rates of mature dairy cattle are dependent on milk production and are assumed to level off around 2011 (Peter et al. 2010).
- **Crop cultures:** Development of crop cultures is calculated according to Peter et al. (2010) until 2022. Between 2022 and 2050 areas and yields are assumed to remain constant.
- **Fertilizer management and nitrogen use efficiency:** The total amount of applied commercial fertilizer is assumed to remain constant as total agricultural area and total dry matter production is not changing significantly after 2011. Since total nitrogen available from animal manure is not changing either, this means that no increase in nitrogen use efficiency will be achieved which is compatible with the WOM scenario.

LULUCF

Also for the WOM, the projections for the LULUCF sector are focussing on the category forest land remaining forest land (5A1). Without political measures, Swiss forests would act as a considerable CO_2 sink because growing stock in Swiss forests would further increase (see section 4.3.8) thereby leading to an unsustainable forest structure. Under the scenario WOM harvesting rates stay at the level of 1995-2006 (NFI2-3; Kaufmann 2011) until 2050. Afforestation and deforestation activities remain unchanged compared to the WEM.

Assuming no political measures, forest management leads to net removals of -1.5 to -2.0 million t CO_2 eq in 2020-2030. The total forest category (i.e. afforestation, deforestation and forest management activities) acts as a net sink of CO_2 of -1.4 to -1.9 million t CO_2 eq in 2020-2030. The total LULUCF sector produces net removals of -0.8 to -1.3 million t CO_2 eq in 2020-2030 (see Tab. 32).

Waste

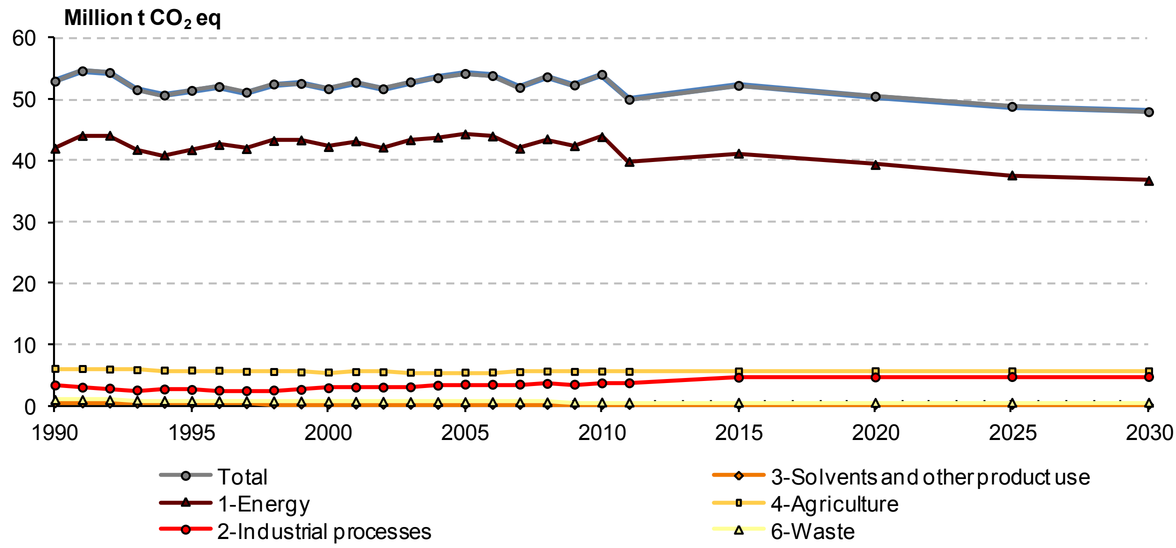
In principle, the projections in the waste sector for the WOM scenario are the same as for the WEM scenario. However, in the energy sector, the end use of biogas is projected differently for the WOM, leading to lower CH_4 emissions in the waste sector (emissions from biogas production) compared to the WEM scenario.

Aggregate emissions WOM

Tab. 32 and Fig. 76 present an overview of the greenhouse gas emissions of the „with additional measures" scenario. Total emissions will decrease by 5% between 1990 and 2020.

Fig. 76 > Aggregate emissions for the „without measures" scenario

Total greenhouse gas emissions in CO_2 eq, shown by sector. Emissions from LULUCF and international bunkers are not included in the national total.



Tab. 32 > Information on updated greenhouse gas projections under a „without measures“ scenario

Greenhouse gas emissions in million tonnes CO_2 equivalent.

Sector	Base year	1990	1995	2000	2005	2010	2015	2020	2030
Energy (1)	42.0	42.0	41.8	42.3	44.3	43.9	41.2	39.4	36.8
Energy industries (1A1)	*2.6*	*2.6*	*2.6*	*3.1*	*3.9*	*4.2*	*4.4*	*5.3*	*8.4*
Manufacturing industries and construction (1A2)	*6.1*	*6.1*	*6.1*	*5.8*	*6.1*	*5.9*	*5.9*	*5.7*	*4.9*
Transport (1A3)	*14.6*	*14.6*	*14.2*	*15.9*	*15.8*	*16.4*	*15.6*	*14.7*	*12.5*
Other sectors (1A4)	*18.1*	*18.1*	*18.3*	*17.1*	*18.2*	*17.1*	*15.0*	*13.4*	*10.6*
Industrial processes and solvents (2, 3)	3.9	3.9	3.0	3.2	3.7	3.9	4.8	4.9	5.0
Agriculture (4)	6.1	6.1	5.8	5.5	5.5	5.6	5.7	5.7	5.7
LULUCF (5)	-3.2	-3.2	-3.9	-1.2	-4.2	-2.4	-0.3	-0.8	-1.3
Waste (6)	1.0	1.0	0.9	0.7	0.7	0.6	0.6	0.6	0.6
Gases									
CO_2 excl. LULUCF	44.6	44.6	43.6	43.9	46.2	45.9	43.1	41.3	38.3
CH_4 excl. LULUCF	4.7	4.7	4.3	3.9	3.8	3.8	3.7	3.7	3.7
N_2O excl. LULUCF	3.5	3.5	3.3	3.2	3.1	3.1	3.1	3.1	3.1
HFCs	0.0	0.0	0.2	0.5	0.9	1.1	2.0	2.2	2.6
PFCs	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.2
Total without LULUCF	**53.0**	**53.0**	**51.5**	**51.7**	**54.2**	**54.1**	**52.3**	**50.5**	**48.0**

5.2 Aggregate effect of policies and measures

The aggregate effect of measures presented here is calculated based on the WEM and WOM scenarios. However, this relates to the aggregate effect of measures implemented since 2010, as this is the bifurcation point of the scenarios (Fig. 77). The estimate given in the 5th National Communication is based on a different methodological approach (see 5.1.3 above and also 5.2.1 in NC5).

Domestic compensation in the WEM scenario contributes by approx. 1.5 million t CO_2 eq in 2020. This effect is not taken into account in the sectoral discussion of the effects of policies and measures below.

5.2.1 Energy

The aggregate effect of policies and measures in the energy sector is strongly influenced by the future electricity generation and electricity demand. With the phase-out of nuclear power, gas-fired power stations and electricity imports are required to maintain electricity supply from shortly before 2020 onwards. Therefore, efforts to reduce electricity demand and concurrent subsidies for renewable electricity production in the WEM scenario lead to emission reductions of almost 0.7 million t CO_2 eq in 2020 and 2.3 million t CO_2 eq in 2030. Furthermore, energy efficiency of buildings contributes emission reductions of further 0.4 million t CO_2 eq in 2020 and 1.4 million t CO_2 eq in 2030. Energy efficiency measures in industry are estimated to contribute with around 0.1 million t CO_2 eq annually over the period 2020-2030.

5.2.2 Transport

Substantial emission reductions are assigned to the transport sector, with 1.4 million t CO_2 eq in 2020 up to 2.3 million t CO_2 eq in 2030. The difference between the WEM and the WOM scenario is to a large extent due to the rapidly increasing share of biofuels in the WEM scenario, compared to the small share in the

WOM scenario. Furthermore, the emission standards are phased-in more sluggishly in the WOM, leading to a later penetration in the entire passenger car fleet.

5.2.3 Industrial processes and solvents

As the process emissions of CO_2, CH_4 and N_2O are identical for all scenarios, no aggregate effect of policies and measures can be derived for this category. However, policies and measures with regard to fluorinated gases, in particular the forced phase-out of fluorinated refrigerants, leads to a substantial effect of the order of 1.1 million t CO_2 eq in 2020 and possibly 1.9 million t CO_2 eq in 2030.

5.2.4 Agriculture

The aggregate effect of policies and measures in the agriculture sector is calculated by comparing the WEM and WOM scenarios. The measures implemented in the WEM scenario will lead to reduced emissions of the order of 0.4 million t CO_2 eq. Both CH_4 and N_2O emission reductions contribute more or less equally to the overall reduction.

5.2.5 Forestry

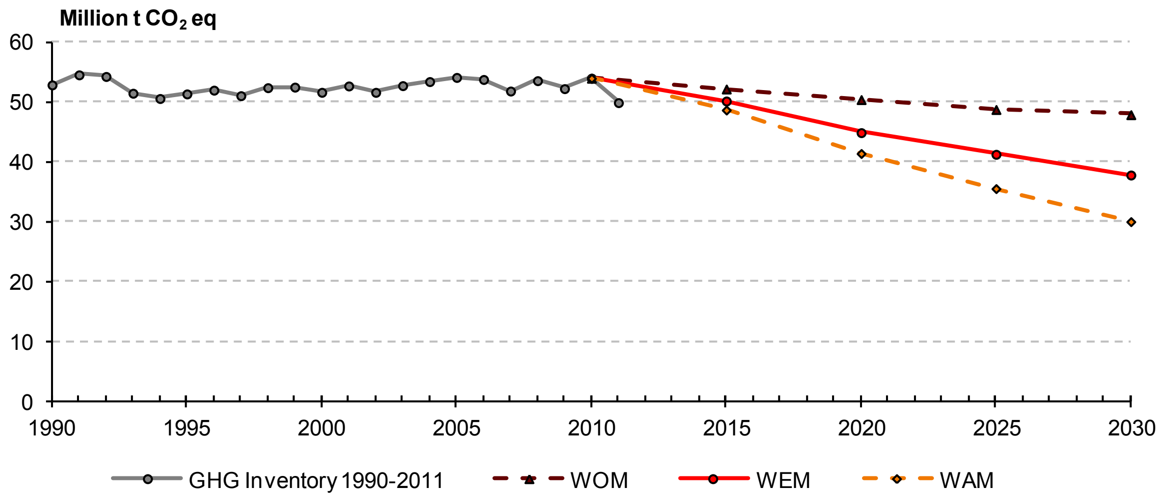
The aggregate effect of policies and measures in the forestry sector is calculated by comparing net emissions and removals under the scenario with existing measures (WEM) with the scenario without measures (WOM). The difference between the WEM and the WOM scenario lies in the forest management practices, all other parameters are identical for all scenarios. As harvesting is assumed to increase under the WEM scenario, the LULUCF sector is becoming a net source. The difference between the two scenarios, which could be considered the aggregate effect of policies and measures, amounts to 1.7 to 2.1 million t CO_2 eq in 2020-2030. However, the low harvesting rates assumed in the WOM scenario would lead to an unsustainable forest stand in the long-term and amongst other effects jeopardize 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 viable policy option.

5.2.6 Waste

The emission projections in the waste sector are largely based on the same underlying assumptions. The only difference between the scenarios is the production of biogas and related fugitive emissions. In the WEM scenario, there are incentives for increasing biogas production. This has the negative side effect of increasing CH_4 emissions. In the WEM scenario, emissions are increased by 0.1 million t CO_2 eq in 2020 and 0.2 million t CO_2 eq in 2030 compared to the WOM.

Fig. 77 > Projections of total greenhouse gas emissions for all three scenarios

The total greenhouse gas emissions are shown in CO_2 equivalents. LULUCF and international bunkers are not included. Detailed information for each scenario is provided in the corresponding sections above.



5.3 Supplementarity (Second commitment period, 2013-2020)

The reduction pathways in this chapter represent domestic reductions only. The target of the revised CO_2 Act is defined as a 20 per cent domestic reduction by 2020 compared to 1990. In the second commitment period the focus is on domestic measures and not on purchase of carbon credits from abroad. However, carbon credits for emission reductions achieved abroad will play a role in the case of:

- compensation of CO_2 emissions from newly built fossil fuel power plants;
- the Emissions Trading Scheme (ETS);
- companies exempted from the CO_2 levy that are not involved in the ETS

and in the sanction mechanism. Furthermore, Switzerland may use additional carbon credits generated under the Kyoto Protocol in the assumed case of a starting point by QELRO 2010.

Supplementarity issues during the first commitment period (2008-12) are discussed in section 4.4.2.

5.4 Methodology

The projections are developed along the same methodology as the greenhouse gas inventory. This means, that the same sectors and gases are considered in a way that is as consistent as possible with the greenhouse gas inventory. For the energy sector, energy consumption is based on the latest energy scenarios (Prognos 2012). Where possible, the general parameters used for the energy scenarios (e.g. population, production parameters in industry) were also used for other sectors.

While the general model setup is fairly similar to the one used for emission scenarios in the 5th national communication, updated information regarding population, GDP, energy prices and transport have been used. Based on the latest scenarios, population and GDP are projected to increase more strongly than anticipated four years ago. Also, energy prices are now considered to remain at a much higher level than previously thought. The new scenarios are calculated at the same level of disaggregation as the greenhouse gas inventory, while the emission scenarios of the 5th national communication were only provided at a highly aggregated level.

Tab. 33 > Overview over sectoral background scenarios

Greenhouse gas emissions in the different sectors are based on various sectoral scenarios that were used to calculate resulting emissions according to the methodology used for the greenhouse gas inventory.

Sector	Scenario	Sectoral scenario	Reference
Energy (1)*	WEM	Energy scenario "political measures", electricity generation option C&E	Prognos (2012)
	WAM	Energy scenario "new energy policy", electricity generation option E	Prognos (2012)
	WOM	Energy scenario "business as usual", electricity generation option C	Prognos (2012)
Industrial processes (2A-2E)	all	Scenario based on key parameters related to industrial production as used in the energy scenarios	Prognos (2012)
Industrial processes (2F)	WEM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	Carbotech (2013)
	WAM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	Carbotech (2013)
	WOM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	Carbotech (2013)
Solvents and other product use (3)	all	Scenario based on key parameters (e.g. population) as used in the energy scenarios	Prognos (2012)
Agriculture (4)	WEM	Agricultural policy 2014-2017	Swiss Federal council (2012)
	WAM	Climate strategy for agriculture	FOAG (2011)
	WOM	Agricultural policy 2011	Peter et al. (2010)
LULUCF (5)	WEM	Constant living biomass, increased harvesting (+16% compared to 1995-2006)	Kaufmann (2011)
	WAM	Wood resource policy, increased harvesting (+30% compared to 1995-2006)	FOEN (2008); Hofer (2011)
	WOM	Constant harvesting at the rate of 1995-2006, leading to temporarily increasing growing stock	Kaufmann (2011)
Waste (6)	WEM	Individual scenario based on key parameters (e.g. population, biogas use) as used in the energy scenarios	Prognos (2012)
	WAM	Individual scenario based on key parameters (e.g. population, biogas use) as used in the energy scenarios	Prognos (2012)
	WOM	Individual scenario based on key parameters (e.g. population, biogas use) as used in the energy scenarios	Prognos (2012)

*Numbers in parentheses refer to the category codes used in the greenhouse gas inventory.

5.4.1 Energy scenarios

The energy scenarios are based on an aggregation of various bottom-up models. Energy demand is determined using separate models for private households, industry, transport, services/agriculture and electricity supply (Prognos 2012). The use of these bottom-up models allows to replicate past developments and to derive the key drivers for particular segments of energy demand. Future energy demand is then projected based on assumptions on the evolution of the key drivers. The energy demand is then assigned to the relevant categories at the same level of disaggregation as used for the greenhouse gas inventory. Where the energy consumption was not available at the required level of detail, the split was derived proportionally to the one in the greenhouse gas inventory 2011.

Households: Energy demand in this sector is modelled based on energy use for heating, hot water, household appliances, lighting and other electrical equipment. The model consists of a dynamic building stock in various classes (age, type, usage, heating technology and fuel type). The projection is then based on population growth, average floor space per person, average household size as well as technological developments of old and new buildings.

Industry: Energy demand in industry is based on 164 industrial production processes and 64 building and facility management processes, 12 energy sources and 12 industry branches. Energy use is then projected based on activity data for the branches and specific energy use per process. Technological progress can be taken into account via the specific energy for this particular process or by replacing it with a more efficient process. In contrast to the greenhouse gas inventory, energy use for autoproducers is not included in the industry sector, but under energy transformation. On the other hand, energy use for off-road transport activities in industry is registered under transport in the energy scenarios, while it is included under industry in the greenhouse gas inventory.

Transport: The transport sector is segmented into on-road traffic (passenger and freight traffic), off-road traffic (rail, water, aviation, other vehicles), and off-road non-traffic (agriculture and forestry, construction machinery and equipment). Tonne-kilometres, passenger-kilometres, vehicle-kilometres, specific energy use, and substitution effects (e.g. mode of driving, modal shifts between private and public transport) were determined on the basis of model estimations. The model is focusing on on-road traffic and rail transport, as these two categories dominate transport activities in Switzerland. In the energy scenarios, all off-road transport is included in the energy demand for transport, whereas in the greenhouse gas inventory, parts of the off-road are allocated to the sectors where the activity takes place (e.g. industry and construction, agriculture and forestry).

Services and agriculture: Energy demand is based on energy use for 7 purposes (heating, hot water, air conditioning, lighting, office appliances, engines and other uses), split for 9 different energy sources (electricity, fuel oil, gas, coal, district heat, wood, solar heat, ambient heat, biogas/sewage gas) and 7 different trades and services (retail and wholesale trade, banking and insurance, health service, education, hotel and catering trade, other services, agriculture). Projections are then driven by gross value-creating activity, number of employees, energy reference area and technical standards. In contrast to the greenhouse gas inventory, energy use for cogeneration of heat and power is not included in the services and agriculture sector but under energy transformation. On the other hand, energy use for off-road transport activities in services and agriculture is registered under transport in the energy scenarios, while it is included under services and agriculture in the greenhouse gas inventory.

Electricity supply: With a bottom-up approach, the electricity production of the existing power plant park (hydro power, nuclear power, combined-cycle power plants, cogeneration (CHP) and waste incineration plants, renewables, electricity import) is projected, taking into account the life-time of the power plants. Electricity demand is driving power generation in the different technologies, according to their potential. With the decision to phase-out nuclear power, a substantial share of electricity generation needs to be replaced in the coming decades and nuclear power generation is no longer considered as an option to meet future demand. Various scenarios for future electricity supply and their costs are compared and presented as options to the relevant scenarios.

5.4.2 Transport

Greenhouse gas emissions from transport activities in the greenhouse gas inventory are based on the same model as the one used to derive energy demand for the energy scenarios (see above). In order to provide consistent estimates of all greenhouse gases, the evolution of the vehicle fleet as used for the energy scenarios was also used to calculate CH_4 and N_2O emissions. Compared to the scenarios presented in the 5th national communication, updated perspectives for future transport developments were taken into account.

5.4.3 Industrial processes and solvents and other product use scenarios

In contrast to the scenarios presented in the 5th national communication, the process emissions are estimated in the same way as for the greenhouse gas inventory. In Switzerland, a couple of industrial processes dominate the industrial process emissions. The relevant activity data for calculating process emissions are inferred from the production data that were used in the energy perspectives. In particular, production of mineral products (cement, bricks and tiles) and metal production are consistent with the corresponding categories in the energy sector. For other processes, for which detailed production data is unavailable, it was assumed that activity remained at the level of the recent years. Emissions from solvent and other product use are scaled with population growth or production indices as appropriate.

With regard to fluorinated gases, the projections are based on a bottom-up model which covers the period from 1990 to 2050 (Carbotech 2013). It is the same model as the one used to produce the annual greenhouse gas inventory for fluorinated gases. For the period 1990-2011, the model is based on import statistics and supplemented by available information from the associations and companies concerned. The model makes assumptions about product lifetime and emission factors for assembly, operation and disposal. For the projections, the two most important applications of fluorinated gases (refrigeration (2F1) and electrical equipment (2F8)) have been considered in detail, while all other categories in the model have been left unchanged. The main factors defining the scenarios are the phase-out of HFCs and reduced emission factors in refrigeration and the limit set on SF_6 emissions in the agreement with the relevant industry.

5.4.4 Agriculture scenarios

The agriculture scenarios are calculated by the same method as the greenhouse gas inventory. Models provided projected activity data, e.g livestock numbers, crop production parameters (amount of crops harvested, areas of crop cultures and meadows and pastures) and fertilizer use (synthetic fertilizers and recycling fertilizers). Most production parameters and emission factors have been kept constant as in 2011. An important exception is the productivity of the dairy cows which was projected to develop according to the projection models used.

Generally time series beyond 2011 have been extended by updating the trends according to their development in the used models relative to a base year period. As base year period the mean of the years 2008-2011 has been chosen in most cases. Particularly crop yield data can show considerable year to year variability and consequently a single year reference value for the projections (e.g. 2011) would have led to rather unrealistic developments. In some rare cases where the 2008-2011 mean did not satisfactorily represent the general behavior of the time series, another base year period has been chosen.

Animal livestock population: The development of livestock population numbers is dependent on price scenarios and consequently on policies concerning free trade agreements with the European Union (Peter et al. 2009, Peter et al. 2010, Zimmermann et al. 2011). Furthermore, the mode of direct payments is an important driver for livestock population numbers.

Feeding regime: Feeding regime is generally assumed to remain unchanged with the single exception of dairy cows whose energy intake depends on milk production.

Manure management: Different modes of (financial) incentives might influence the livestock management and subsequently the type of manure management. Manure management is governed by the stable system which is again largely influenced by requirements for animal friendly livestock husbandry and the respective incentives. Furthermore the need for low-emission stable- and manure management systems might be of a certain influence in the future. Nevertheless, no concrete projections have been implemented in this area due to the lack of solid scenarios.

Nitrogen excretion by animals: Nitrogen excretion rates determine the amount of manure nitrogen managed and hence N_2O emissions. N-excretion rates have been changing in the past due to changing production modes and particularly due to the feeding of protein reduced animal feeds. These trends might extend into the future. However, with the exception of mature dairy cows, nitrogen excretion rates have been kept constant due to the lack of concrete projections.

Crop cultures: Important aspects of the further development of the cropping areas and the respective agricultural portfolio is the mode of future direct payments. Accordingly trends in the development of different crop cultures may differ due to differential governmental incentives. Furthermore macroeconomic price levels as well as the need for animal fodder will also determine the portfolio of crop cultures in the future.

Fertilizers and fertilizer management: Fertilizer management depends on the standards of the Suisse-Bilanz (fertilizer management plan) that have to be observed in order to fulfill the Proof of Ecological Performance (PEP) and to get access to direct payments (Swiss Confederation 2009; Herzog and Richner 2005). The "Suisse-Bilanz" has been revised recently with only small changes. Consequently no major changes are immediately foreseeable in this area. However, the Suisse-Bilanz might be a convenient tool to promote nitrogen use efficiency in the future by altering the level of maximum fertilizer use. Furthermore, the enforcement of the standards defined in the Suisse-Bilanz might be improved with a possible effect on fertilizer management.

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). Nitrogen use efficiency will be affected by the programs for resource-efficiency (Ressourcenprogramme, Ressourceneffizienzbeiträge; e.g. Swiss Confederation 2009) as well as by the general requirements under the Proof of Ecological Performance (PEP, e.g. Suisse-Bilanz).

The model used for the projection in the 6th National Communication was also used for projections in the 5th National Communication. However, in the 5th National communication, only a WEM scenario based on the agricultural policy 2011 was provided for the agriculture sector (Peter et al. 2010). The basis of the 5th NC WEM scenario builds now the foundation of the scenario without measures, after adapting the baseline according to the most recent development until 2011. The WEM scenario of the 6th NC accounts additionally for the new agricultural policy AP 2014/17 which builds on the past agricultural policy 2011 and implements new additional measures. Namely the further development of the agricultural subsidy system and the programs for resource-efficiency are new developments that will have effects on greenhouse gas emissions and other ecological parameters (Swiss confederation 2009).

5.4.5 Forestry scenarios

MASSIMO3 is a stochastic empirical single tree forest management scenario model, which was derived using data from the three successive National Forest Inventories (NFI). The major model components are a single tree growth component, wood harvesting component and a component on natural regeneration. These model components as well as in-growth and mortality rates are empirically derived from NFI data (Hofer et al. 2011).

Single tree growth is estimated using a single tree model. It depends on the diameter at breast height (DBH), 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 estimation of stand age is based on a model that has been derived from tree ring analysis on the NFI sample plots. Also ingrowth rates are considered.

Wood harvesting component: The amount of harvested wood is derived from the baseline scenario BAU (see section 5.4.5). To calculate annual clear-cut areas in even-aged forest (80% 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 also reflected in the NFI data. Stands are thinned as soon as their basal area has increased by 10% 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 NFI data.

Mortality rates and management strategies as observed in the last few years: MASSIMO3 is based on data of the 3 NFIs covering the time period 1985-2005, comprising all management activities with significant impact on that period.

Information for plots with **natural regeneration** is extracted from a database containing NFI-regeneration plots.

The Massimo model produces a time series of carbon stocks, harvest rates, and gross growth for Swiss forest per decade starting in 2006. The model thus gives information about changes in CO_2 stored in forests (Forest Land remaining Forest Land, closely related to the area under Forest Mangement). Changes in emissions or removals from non-CO_2 gasses are not calculated by the model. In our scenario, we assume that these non-CO_2 gasses stay at the level of 2006 since we don't expect changes in the occurrence of wildfires nor in afforestation and deforestation (see section 5.1.1). There are no projections for the other categories in the LULUCF sector.

MASSIMO03 is a model based on data from the Swiss NFI and is therefore perfectly designed to reflect the specific characteristics of Swiss forests. On the other hand, direct comparability with other countries is not possible. At the moment, the model MASSIMIO03 is under reconstruction in order to enable outputs and inputs on a yearly basis. First results are expected for summer 2014. The results will have the same order of magnitude. The main advantage of this improvement is that the output doesn't have to be interpolated anymore in order to produce yearly results or results for a specific time period.

The projections in NC5 where based on different scenarios for harvesting, where all the other forest characteristics such as gross growth, mortality, stand structure, natural regeneration have been extrapolated at the level of NFI2-3 (1996-2005). Since the latest submission, the forest management model MASSIMO03 has been further developed and improved. This model is also used for the calculation of the Swiss Forest Management Reference Level for accounting for Forest Management under the Kyoto Protocol for the period 2013-2020.

5.4.6 Waste scenarios

Traditionally, waste is treated in waste incineration facilities with combined energy production, thus emissions are reported under public heat and electricity generation in the energy sector. Landfilling of combustible waste is prohibited in Switzerland, and it is assumed that this will also be the case in the future. Waste generation is assumed to remain at the current levels per capita. However, in agreement with the energy scenarios, digestion of organic waste is increasing according to the use of biogas and sewage gas in the energy scenarios. While the use of biogas and sewage gas reduces the greenhouse gas emissions in the energy sector, it increases emissions in the waste sector, as the ramping up of biogas production leads to increased CH_4 emissions. Emissions are calculated with the methodology used for the greenhouse gas inventory.

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6 Impacts, vulnerability assessment and adaptation

In recent decades, natural assets have modified in response to the changes in the climate and, in particular, the increase in air temperatures. The retreat of glaciers and the thawing of permafrost frequently illustrate the direct impacts associated with this phenomenon, however the warming effects are being felt in many other environments. The hydrosphere, vegetation, human health, the economy or the society are also affected by the evolution of the climate. In order to provide the basis for decisions regarding the necessary actions, the interaction between the climate and the natural and anthropogenic environment has generally been assessed in a multitude of scientific studies. Expected impacts of climate change over the coming decades are thus summarized in the first part of this chapter. In the second part of the chapter, a method for the assessment of climate-related risks and opportunities at the national level is presented as a basis for decision-making, as well as results of a first case study. In Switzerland, adapting to these impacts is vital already today, and will become even more important in future. To this end, the Federal Council has elaborated an adaptation strategy presented in the third part of this chapter.

6.1 Observed and expected impacts of climate change

6.1.1 Climate

Scenarios

The recently released Swiss Climate Change Scenarios "CH2011" (CH2011 2011) provide a new assessment of how climate may change in Switzerland over the 21st century. Under the aegis of the Swiss Federal Institute of Techology Zurich (ETHZ) and MeteoSwiss, several scientific research centres in Switzerland have cooperated to generate this report with a consolidated view on climate change in Switzerland. The new scenarios are based on a new generation of global and European-scale regional climate models provided by several international projects. New statistical methods were used to generate multi-model estimates of changes and associated uncertaintites in seasonal mean temperature and precipitation for three representative Swiss regions and three scenario periods. CH2011 uses two non-intervention emission scenarios (A2 and A1B) that anticipate increases in emissions, and one climate stabilization scenario (RCP3PD) that supposes emissions are cut by about 50 % by 2050. Besides regional and seasonal mean changes, the new scenarios also provide changes in daily mean values at individual meteorological station sites.

To serve as a basis for a variety of climate change impact studies in Switzerland, the new scenario data are available in digital form at *www.ch2011.ch*. In Switzerland a subsequent national assessment initiative (led by the Oechger Center of Climate Change Research OCCR, University of Bern) is currently underway focusing on ecologic, economic and social impacts ("CH2014-IMPACTS") based on the CH2011 scenario data (see some of the following sub-sections). Well established national climate scenarios allow end users to explore possible impacts and adaptation strategies in a coherent and quantitative manner.

Climate models and statistical methods will undergo further significant developments in the years to come. In addition, more observational data will become available. As a result, regular updates to climate change scenarios will be required with intervals of a few years.

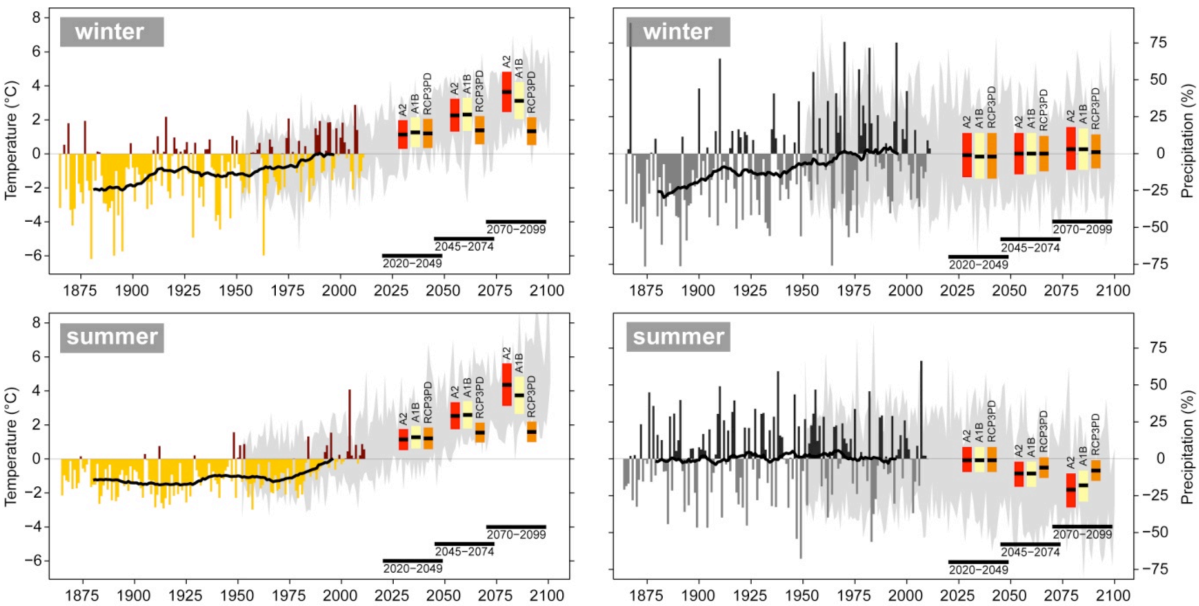
Temperature and Precipitation

In the course of the 21st century, Swiss climate is projected to depart significantly from present and past conditions. Mean temperature will very likely increase in all regions and seasons. Summer mean precipitation will likely decrease by the end of the century all over Switzerland, while winter precipitation will likely increase in Southern Switzerland for the investigated emission scenarios A2, A1B and RCP3PD. In other regions and seasons, models indicate that mean precipitation could either increase or decrease. The projections of future temperature and precipitation are consistent with past observations.

Toward the end of the 21st century, Swiss climate will be strongly affected by the future course of global greenhouse gas emissions. Fig. 78 shows observed seasonal temperature changes in northeastern Switzerland, as well as projected changes for the three different emission scenarios and selected time periods. Compared to the period 1980-2009, and for all Swiss regions considered, the best estimates for the non-intervention scenarios project increases of seasonal mean temperature of 3.2-4.8°C by the end of the century for the A2 scenario and 2.7-4.1°C for the A1B scenario. Summer mean precipitation is projected to decrease by 21-28% for the A2 scenario and 18-24% for the A1B scenario. For the climate stabilization scenario (keeping global temperature change below 2°C relative to pre-industrial levels), Swiss climate would still change over the next decades, but is projected to stabilize at an annual mean warming of 1.2-1.8°C and a summer drying of 8-10% by the end of the century. Uncertainties due to climate model imperfections and natural variability typically amount to about 1°C in temperature and 15% in precipitation.

Fig. 78 > Past and future changes in seasonal temperature (°C) and precipitation (%) over northeastern Switzerland

The changes in temperature and precipitation are relative to the reference period 1980–2009. The thin colored bars display the year-to-year differences with respect to the average of observations over the reference period; the heavy black lines are the corresponding smoothed 30-year averages. The grey shading indicates the range of year-to-year differences as projected by climate models for the A1B scenario (specifically, the 5–95 percentile range for each year across the available model set). The thick colored bars show best estimates of the future projections, and the associated uncertainty ranges, for selected 30-year time-periods and for three greenhouse gas emission scenarios



CH2011 (2011)

The projected increase in temperature for Switzerland is consistent with large-scale warming over Europe for all seasons. In winter, the warming is amplified in Northern Europe, partly due to decreased snow cover. In summer, stronger warming is projected in Southern Europe, partly driven by drier surface conditions. Northern Europe will likely get wetter and Southern Europe will get drier, which is consistent with the global picture of drier subtropics and wetter high latitudes. In between those opposing trends, precipitation in the Alpine region could either increase or decrease in all seasons – except summer, when Mediterranean drying likely encompasses the Alps and Central Europe.

6.1.2 Climate extremes

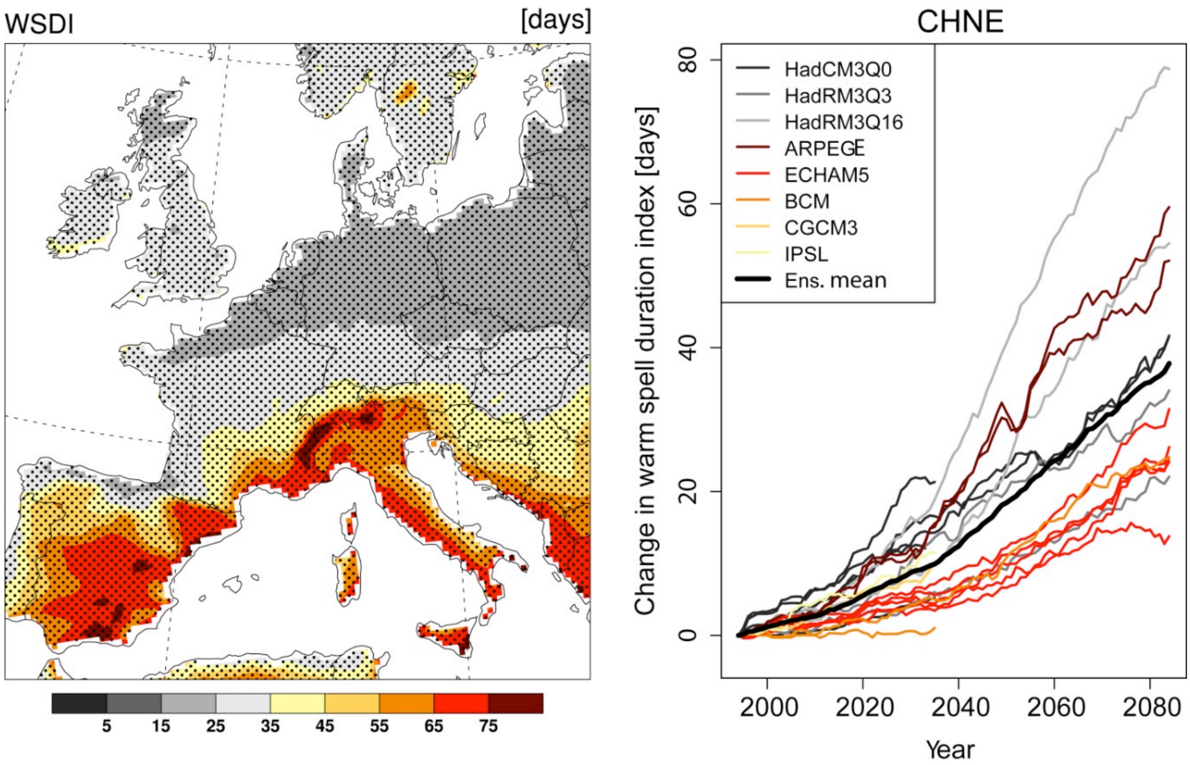
Future scenarios in frequency and intensity of extreme events are still very uncertain. Due to their limited number, statistical trends of extreme events are difficult to establish (Frei and Schär 2001). So far, they have been detected for a few categories of extreme events only. Here, we will synthesize information on climate extremes from CH2011 (2011) that is predominantly based on a review of the literature for Switzerland and Central Europe.

Temperature extremes

By the end of the 21st century, and for the range of scenarios considered, it is very likely that the frequency, duration and intensity of summer warm spells[9] and heat waves in Switzerland will increase significantly. As an illustrative example, changes in the warm spell duration index (WSDI) per summer were calculated in each of the considered climate models from CH2011 (2011). Fig. 79 shows that the multi-model ensemble projects an increase in WSDI of 10-80 days per summer by the end of the century in northeastern Switzerland. Southern Europe is expected to experience stronger increases in warm spells and heat waves than Switzerland, and northern Europe somewhat weaker increases.

Fig. 79 > Projected changes in warm spell duration.

Spatial changes in the warm spell duration index (WSDI; May–September) in 2070-2099 (with respect to 1980-2009) for the multi-model mean (left) forced with the A1B emission scenario. Stippled areas indicate significant changes (95 % confidence level) in more than 66 % of the climate models. 30-year running means of WSDI are shown on the right for the individual models and the multi-model mean (black line) for northeastern Switzerland



CH2011 (2011)

[9] A warm spell is defined as a period of at least six consecutive days with maximum temperatures exceeding the local 90th percentile for days in the reference period.

During winter, the number of cold winter nights and days is likely to decrease. Over northeastern Switzerland, the considered climate models from CH2011 (2011) project a strong reduction in cold winter nights of 50-90% by the end of the century.

Heavy precipitation and droughts

Projections of the frequency and intensity of precipitation events are more uncertain than in case of temperature, but substantial changes cannot be ruled out. Competing physical mechanisms drive these changes which may yield net effects of different sign depending on season and region. The climate models analysed in CH2011 do for instance not show a consistent climate change signal in heavy winter precipitation events. However, depending on region and season, a shift from solid (snow) to liquid (rain) precipitation is expected with increasing temperatures, with potential implications for the frequency of floods (section 6.1.5). Despite a decrease in total summer precipitation amounts, several studies suggest a potential increase in extreme daily summer precipitation over central Europe (Frei et al. 2006, Rajczak et al. 2013). Yet, substantial uncertainties remain on the magnitude of the changes and the spatial scale.

According to CH2011 (2011), the length of summer dry spells is likely to increase. Switzerland is part of a larger area experiencing an increasing risk of drought and dry spells along with a decrease in the number of precipitation days (Frei et al. 2006), particularly over the Mediterranean region.

Winter storms

Confidence in projections of windiness in Central Europe remains relatively low and hence no robust projection for extreme wind storms in Switzerland can be made. Yet, it does not rule out the possibility of severe changes, too. North of Switzerland, a tendency toward more intense cyclones is simulated by one model despite a decrease in the total number of cyclones (Pinto et al. 2007).

6.1.3 Cryosphere

Freezing level

In wintertime, the seasonal freezing level (altitude, where surface air temperature is 0°C) has risen by about 200 m per degree of warming from approximately 600 m in the 1960s to approximately 900 m in the 1990s (Scherrer and Appenzeller 2006). If warming in winter continues as expected, the freezing level will further rise by about 280 m until 2060 in case of a mitigation scenario (~ +1.4 °C, best estimate), by about 460 m in case of a non-intervention scenario (~ +2.3 °C, best estimate) (CH2011 2011).

Snow

The occurrence of a snow cover on the Swiss plateau, where the majority of the population lives, shows a high inter-annual variability. Due to the already observed warming, precipitation falling as snow has been decreasing (Serquet et al. 2011). Together with effects of snow melting, a reduction of snow depth and snow duration has been observed in the past decades. For example, on the plateau the number of days with a snow depth of at least 5 cm has been 50 % lower in the last 20 years than in the decades before (Marty, 2008). On the other hand, despite the warming trend winter temperatures above about 2000 m a.s.l. are still predominantly below freezing and changes in snow cover have thus not yet been observed.

From a recent analysis (Bavay et al. 2012) it can be concluded that the snow season will get shortened in Switzerland under future climate scenarios by 2-4 weeks per year. As the lower limit of the snow cover corresponds roughly to the freezing level, an upward shift of the snow line until the mid of this century is expected. The reduced snow pack will result in reduced runoff in spring and summer, although in highly glacierized catchments increased runoff from glaciers in summer may partly compensate this reduction during the next few decades. This might no longer be the case towards the end of this century when numerical models project a reduction of the snow water equivalent by 50% (best estimate), which will of course also imply a corresponding decrease in runoff

Glaciers

The retreat and massive loss of volume of glaciers in the Alps is the best visible indicator of the recent increase in atmospheric temperature. In recent years evidence of vigorous impacts on glaciers has been accumulated, including collapse structures on the glacier surface, disintegration into pieces, separation of glacier tongues from the main ice body at steep slopes, leaving dead ice in formerly covered areas. At various locations all over the Swiss Alps glacier lakes have recently formed or grown as a result of continuing glacier retreat. From the ca. 2'900 km^2 of glacier area in the mid-1970s, only about 2'100 km^2 remained in 2003 (Paul et al. 2011) and an estimated 1'900 km^2 in 2013. Annually measured mass balances on 30 glaciers in the Alps yield a mean specific mass loss of -1.6 m water equivalent per year for the 2010/11 period (*www.wgms.ch*), corresponding to an annual mass loss of about 3 Gt per year.

Several studies indicate that Alpine glaciers are far out balance with the current climate. Due to delayed response effects, glaciers would continue to shrink even without any further increase in temperature. If temperatures are going to increase further as projected by climate models (e.g. CH2011 2011), the loss of glaciers will be much more dramatic. Recent modelling studies (Fig. 80 and Fig. 81) indicate a strong future area loss of 50-90% (for a temperature increase between 2°C and 6°C) by 2100 for Switzerland (Linsbauer et al. 2013) and the entire Alps (Huss, 2011). Evidence on impacts of vanishing glaciers on the high-mountain landscape and processes has increased in recent years and will further increase in the future, including effects on the water cycle, sediment processes, slope stability, thus affecting tourism, energy, and natural hazards sectors (Haeberli et al. 2013).

Fig. 80 > Future changes in glacier extent

Modelled glacier area for the Aletsch region based on a 4° C temperature increase by 2100 and no change in precipitation.

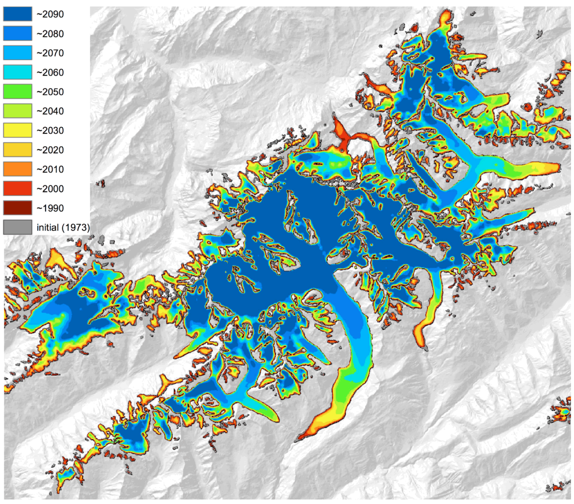
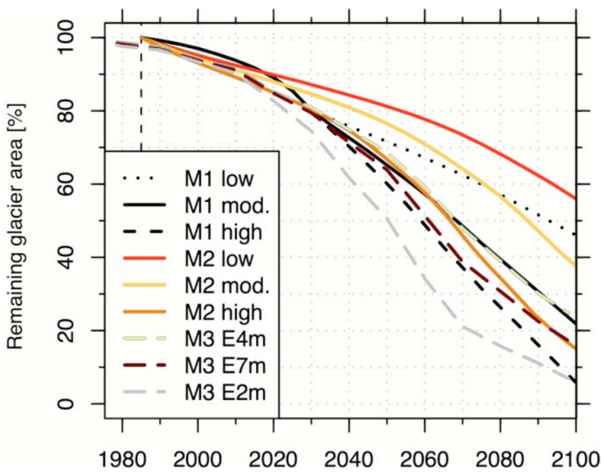


Fig. 81 > Area loss of Swiss glaciers

Modelled development of the glacier area in Switzerland using three different approaches (M1, M2, M3) and climate change scenarios (low/E4m, moderate/E7m, high/E2m) (see Linsbauer et al. (2013) for explanation).



Modified from Linsbauer et al. (2013)

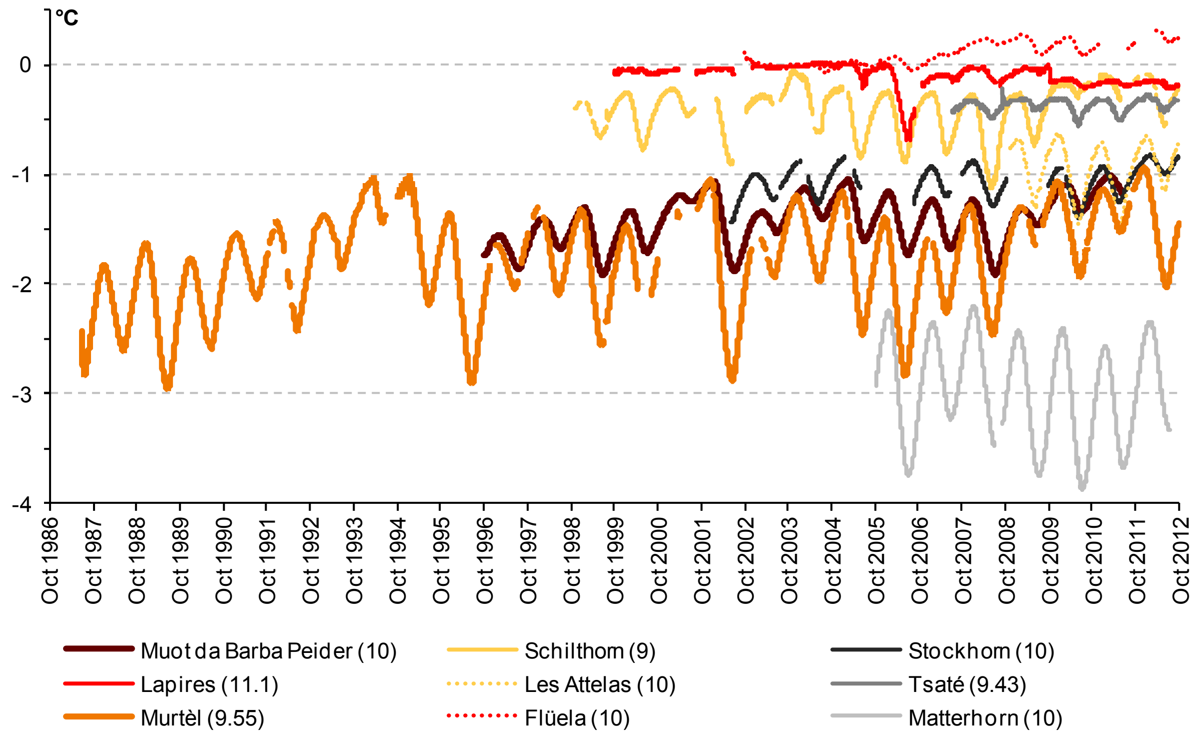
Permafrost

The warming of permafrost in high mountain regions such as the Swiss Alps is a slow process with long-term implications. While first measurements of permafrost in rock glaciers have started in Switzerland in the late 1980s, systematic monitoring is performed since 2000 by the Swiss Permafrost Monitoring Network (PERMOS) and now also includes other landforms like debris or steep rock slopes. The evaluation of significant trends is difficult because time series mainly cover the past 10 very warm years and temperature anomalies associated with extreme warm years (such as 2003, 2009, 2011) are superimposed over the longer-term trend. Further, several factors (surface and subsurface properties, snow cover) may alter the magnitude and delay of the changes in ground temperatures compared to atmospheric changes resulting in high regional and local variability. However, in relation to the 12 years of operational observation (Fig. 82), current conditions are above average warm with active layers at record depths for most of the sites in the past 3–4 years (PERMOS 2013). In addition, temperature trends at greater depth show clearer warming trends for a number of sites (PERMOS 2013). Further remarkable are the increasing rock glacier creep velocities as well as decreasing ice contents that are measured with increasing ground temperatures at many sites. Analyses of documented rock fall events (PERMOS 2013) with starting zones in high elevations indicate that the frequency of events with volumes of 1 mio km^3 or more has increased in the past ca. 20 years, as compared to the 20th century (Huggel et al. 2012, section 6.1.5).

A further temperature increase according to the CH2011 scenarios (CH2011 2011), will cause warming or complete thawing of cleft ice in rock faces as well as further warming and increasing active layer depths of ice rich debris slopes and rock glaciers (Haeberli et al. 2010). The warming of the outer ca. 50 metres of frozen rock faces is already an effect of the temperature rise in the 20th century. It will penetrate into greater depths and increase the thermal imbalance. For summits and ridges such effects will be particularly pronounced as the warming may penetrate from different sides (Fig. 83, Noetzli and Gruber, 2009). Processes related to warming of permafrost (Hasler 2011) may increase the frequency and magnitude of rock fall. Combined with the increasing availability of sediment due to rock fall, deepening of active layers, glacier retreat and the possibility of mass movements into high mountain lakes, new and complex hazard situations may emerge in regions where they have not been reported from before (section6.1.5). A prominent example is Guttannen (Grimsel region), where cascading effects and mass movement processes (e.g. debris flows) were observed since 2009 and have implied prevention costs in the order of tens of millions of Swiss Francs.

Fig. 82 > Borehole temperature

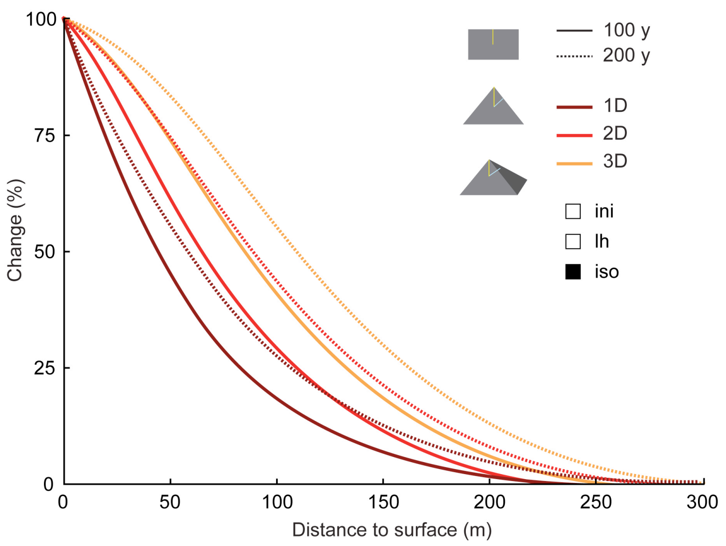
Synthesis results of more than 20 years of borehole temperature monitoring at the Reference Sites of the PERMOS network. Here, the temperatures at ca. 10 m depth are shown (the exact depth is given in parenthesis). The results are very heterogeneous, essentially because effects due to latent heat or surface cover (snow, coarse blocks) strongly influence the penetration of changes in climate conditions into the ground.



Swiss Permafrost Monitoring Network (PERMOS)

Fig. 83 >Penetration of a temperature signal in steep topography

Percentage of a temperature signal at the surface that has penetrated to depth: This effect is shown for a one- (flat terrain), two- (ridge), and three-dimensional (pyramid) situation after 100 (solid lines) and 200 years (dotted lines). In the two- and three-dimensional situations values are plotted versus the shortest distance to the surface.



Noetzli and Gruber (2009)

6.1.4 Hydrological cycle and water resources

Within the project "Climate Change and Hydrology in Switzerland" (CCHydro) run by the Federal Office for the Environment (FOEN), the effects of climate change on the water balance in Switzerland during the 21th century were studied (FOEN 2012). The aim of this project was to present scenarios with enhanced spatial and temporal resolution for the hydrological cycle and runoff in the different climate regions and altitudes in Switzerland for the periods around 2035 and 2085, based on the latest climatic data. This would provide a basis for analysing changes in extreme discharge values (high and low water), water temperature, and water resources and their annual distribution (regimes) (Volken 2010).

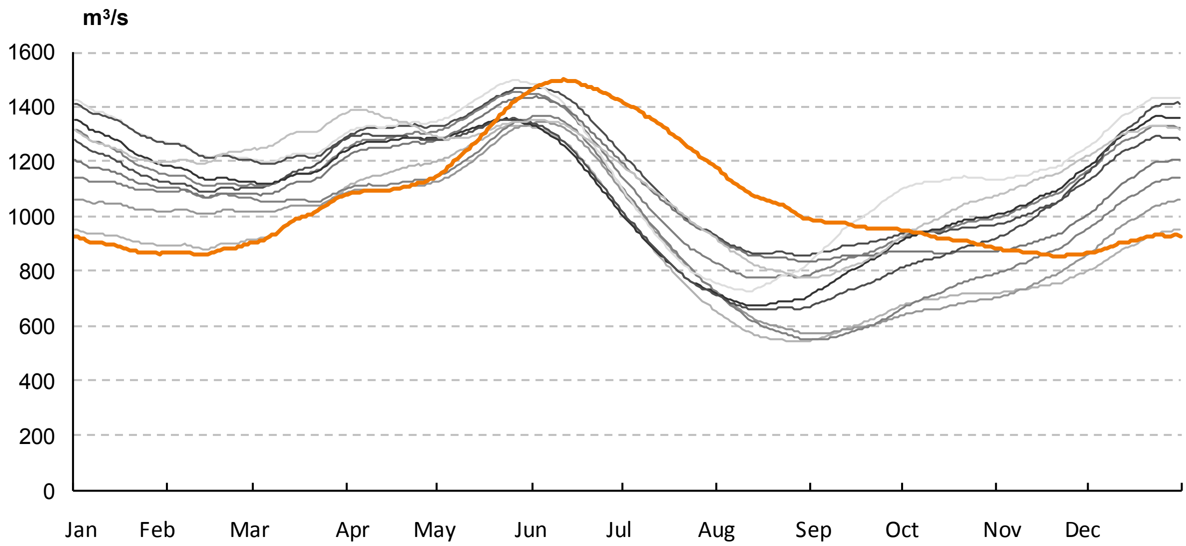
From the European ENSEMBLE project ten climate model chains were selected. They corresponds to an increase in GHG emissions based on the A1B emissions scenario. The delta change method was used for regional downscaling of the climate scenarios. The 10 climate scenarios used in this study are described in CH2011 (2011). The PREVAH model was used to model the water regime and runoff.

Stream flow scenarios

In the near future (until 2035), annual runoff in Switzerland will change very little, apart from temporary increases in runoff in heavily glacierized regions. In the long term (by 2085) the annual runoff will fall slightly, particularly in the Lake Maggiore basin (FOEN 2012). However, the seasonal distribution of runoff (runoff regime) will shift almost everywhere in Switzerland. By the end of the century, catchments with a glacial and snowmelt driven runoff regime will only be found in isolated areas and the seasonal distribution of runoff will follow the rainfall distribution. In the not glacierized regions, runoff is expected to be higher in winter but lower in summer. On the Rhine for example, a second seasonal runoff maximum will develop over time in winter in addition to the existing one in early summer (Fig. 84). On the Swiss Plateau a distinct minimum runoff in August and two seasonal peaks in January and March are expected. Runoff during low flow events will decrease considerably and these periods will be longer. For instance runoff in the Aare in late summer will gradually fall below those currently experienced in winter. In the catchments of the northern slope of the Alps and the Alps, low flow events will shift from winter to late summer and will be less pronounced.

Fig. 84 > Discharge projections in River Rhine at Basel.

The orange line indicates the control period, grey lines the ten climate scenarios over the period 2070-2099.

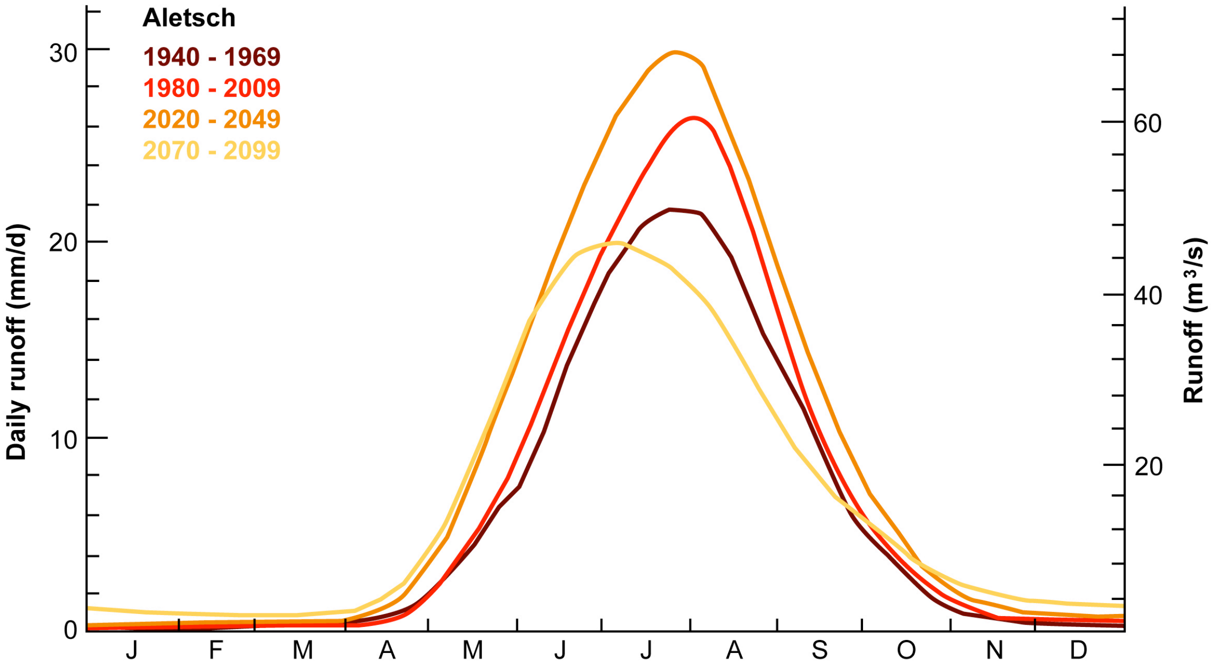


FOEN (2012)

Effects of climate change on water reservoirs

The runoff regime changes which have already been observed over the past decades, can be explained by the changes in climatic conditions (Collin 2006). Since the rise in average annual air temperature in Switzerland (more than 1.5° C over the past decades, section (section 2.5) is expected to increase further (section 6.1.1), it is likely that this will have an impact on seasonal hydrological reserves in Switzerland. The increase in temperature will lead to an increase in evapotranspiration. Therefore, less water will be available for runoff. The temperature increase will also be accompanied by a rise in the snow line. The average area covered by snow will be continually reduced, as is the depth and duration of the snow cover (section 6.1.3) resulting in decreasing amounts of snow available for melting. Some 40% of runoff out of Switzerland during the 1980–2009 consisted of snow melt. This proportion will fall to about 25% by 2085. This will lead to an increasing proportion of rainfall being free to drain away immediately, particularly in winter. Less than 2% of annual runoff is currently derived from the summer glacier ice melt, but in summer the proportion is much greater in streams in the vicinity of glaciers. Because glaciers – which react only slowly to environmental changes – are not in balance, they will continue to melt rapidly. This will lead at first to more runoff in the Alpine catchments due to increased melt and in a later period to less runoff. Whilst smaller glaciers are already demonstrating decreasing runoff levels, the peak of melt runoff will be reached around 2040 for glaciers with greater volume. By 2100, the remaining volume of ice will be very small (section 6.1.3). Fig. 85 shows changes in the seasonal runoff of the Aletsch glacier catchment (large, middle and upper Aletsch) in Valais. Since the 1940s, summer runoff in the Aletsch region has increased and will increase further. Maximum runoff in summer will occur already in July instead of early August. In the long-term future dramatic changes are expected: the maximum seasonal runoff will drop below 1940–1969 levels because the glacier surface area will decrease markedly, from today's 123 km² to a mere 39 km². In addition, the seasonal maximum will shift to June.

Fig. 85 > Development over period of thirty years of seasonal runoff in the Aletsch glacier catchment (glacier surface area 123 km², average altitude of catchment 2925 m).



FOEN (2012)

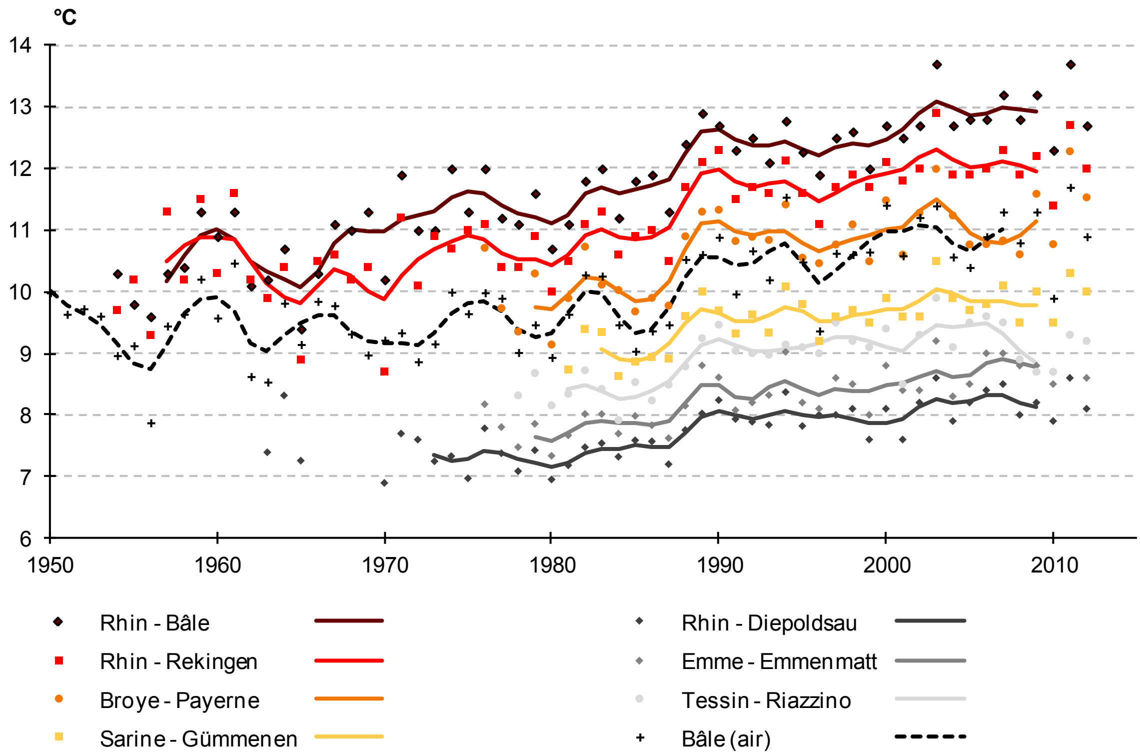
Change in the pattern of precipitation regime could have serious consequences for the natural enrichment of groundwater and water supply. The hot summer of 2003 and the prolonged precipitation deficit from 2003 to 2005 resulted in unusually high values for the groundwater levels and discharge rates at most of the monitoring stations of the National Groundwater Monitoring (NAQUA). Conversely, the floods of 1999 and the prolonged precipitation surplus from 2000 to 2002 resulted in very high groundwater levels and discharge rates. Based on the CH2011 climate scenarios, it must be assumed that precipitation intensity and strength will tend to increase on the long term and high groundwater levels and spring discharge rates may thus occur more frequently. However, summer droughts should happen more often and last longer in the future. Therefore low groundwater levels and spring discharge rates may occur more frequently. Currently, no trend has been clearly identified for both the groundwater levels and the discharge rates.

Impacts on water temperature and water quality

Swiss waters are in a good chemical situation (FOEN 2013b). Up to now there is no evidence that the water quality has altered due to climate change. This is not the case regarding water temperature. Indeed, the significant rise in air temperature (section 2.5) has simultaneously been followed by that of the water temperature. Water temperatures of various rivers and streams have been continuously recorded since 1963 within the framework of the national temperature measurement network (Fig. 86). This allows highlighting the effects of various natural and anthropogenic influences on the annual development of water temperatures. The analyses of those measurements show clear tendencies towards increased annual mean temperatures of up to 1.2 °C, and 1.5 – 3 °C in summer, particularly in lower altitudes, as well as in areas affected by lakes (Jakob et al. 2010). In alpine regions the increase in the annual mean is apparent to a lesser extent, due to the compensating influences of melt-water from glaciers. A rapid increase in temperature is noticeable in spring, irrespective of the altitude. The causes of this temperature change cannot always be clearly identified. Anthropogenic and natural climate change induced effects have a combined influence on the water temperature regime. The temperature changes impact decisively on the development and on the composition of aquatic life. A further rise of the water temperature in the future, especially at times of low flows, could probably also lead to a detoriation of the chemical water quality. The quality of drinking water resources could also change if groundwater temperatures increase. Indeed, the water temperature is one of the most important regulators of life processes in aquatic groundwater ecosystems. Temperature regulates the metabolic and redox processes and defines the evolution, the growth rate and the composition of biocenoses.

Fig. 86 > Change of yearly water temperature at different measuring stations 1954-2012

For comparison reasons the air temperature at Basel is included in the graph. Yearly moving average over 7 years is represented (line).



FOEN (2012), MeteoSwiss (2012)

6.1.5 Natural hazards

Floods

Floods in Switzerland are dominantly caused by extreme precipitation, sometimes in connection with snowmelt and/or high lake water levels. During the last 500 years, periods with many and few floods alternated in Switzerland. Since the 1970s, Switzerland is in a period of high flood frequency. However, no direct relationship was found between flood frequency and mean air temperature (Schmocker-Fackel and Naef 2010). The comparision of flooding patterns in different European contries suggests though that changes in large scale atmospheric circulation are responisible for the flood frequency fluctuations. Unfortunately it is not yet possible to make any clear statements about future changes in atmospheric circulation and therefore of changes in extreme and very rare precipitation events in the Alpine area (CH2011 2011).

For major floods in the alpine catchments and the large Swiss rivers, a high zero degree line during the event is necessary. Otherwise the precipitation falls as snow over large parts of the catchment and does not contribute to runoff. This is the reason why in todays climate in the majority of Swiss catchments floods occur mainly in summer and fall. With the warming of the atmosphere also the zero degree line will rise. Additionally snow and glacial melt will decrease and occur earlier in the year (section 6.1.4). All these factors will lead to a shift and an extension of the potential flooding period.

Not all catchments are equally sensitive to changes in extreme precipitation, depending on the storage capacitiy of the soils and the geology. Naef (2011) distinguishes three types of catchments:

- Catchments with a small storage capacity which is often exceeded during flood events. An increase of extreme precitpitation will lead to a linear increase in flood discharge;
- Catchments with medium storage capacity in which no filling of the storages could be observed until now but where even a slight increase in rainfall amount or intensity during a flood event might lead to the filling of the storages and an unlinear and unproportional heavy flood runoff reaction;
- Catchments with a very large storage capacity. In these catchments a more extreme precipitation event can still be stored partely and will only lead to a slightly increase in flood runoff.

Rockfalls slope, debris flow and landslides

Changes in temperature and precipitation are likely to have a range of secondary effects on the occurrence of natural hazards, in particular in mountain environments. However, while theoretical understanding exists for increased mass-movement activity as a consequence of projected climate change, impacts can only hardly be detected in observational records for the time being (Stoffel and Huggel, 2012).

One of the most obvious consequences of climate change at higher elevations is the glacier downwasting and related formation of ice-marginal lakes, ice avalanches and gravitational processes originating from the debuttressing of previously glacierized walls and hillslopes. Glacier downwasting is likely to promote many rock slope failures at rather short future time scales, probably in the order of decades. Important effects of climate change on slope stability are also related to the warming and thawing of permafrost (section 6.1.3). Slopes currently underlain by degrading permafrost will probably become less stable at progressively higher altitudes with ongoing climate change. The probability of rock instability and the incidence of large ($>10^6$ m^3) rockfalls will likely increase in a warming climate (Huggel, 2009). Quite a large number of recent slope failures have been documented in permafrost areas and have been related to increasing temperatures.

Changes in sediment supply and land-use are further key determinants for mass-movement frequency and magnitude. Recent observations in the Swiss Alps indicate that sediment supply can in fact change significantly as a result of permafrost degradation of rock and scree slopes or mass movements related to other processes (Huggel et al. 2012). As such, warming has been reported to exert indirect control on debris-flow magnitude and frequency through the delivery of larger quantities of sediment into the debris-flow channels under current conditions than in the past (Lugon and Stoffel 2010). The volume of debris flows in many parts of the Swiss Alps has risen by one order of magnitude since the early 20th century (Stoffel 2010) and is likely to further increase with ongoing permafrost degradation. The actual triggering conditions of debris flows have been shown to occur less frequently today as compared to the most of the 20th century (Schneuwly-Bollschweiler and Stoffel 2012), and are not expected to increase in the future (Stoffel et al., in press). Despite uncertainties, recent developments at high-elevation sites have shown clearly that the sensitivity of mountain and hillslope systems to climate change is likely to be acute, and that events beyond historical experience will continue to occur as climate change continues.

At lower elevations, the temporal frequency of landslides might be affected by climate change, and the events could occur more frequently in winter and spring as a result of warmer temperatures and larger precipitation sums (Lopez Saez et al. 2013). The occurrence of debris flows and shallow landslides at lower elevations (Prealps, Plateau, and Jura) depends on the incidence of intense thunderstorms or long-lasting, persistent rainfalls. Such conditions are likely to become scarcer in future summers and more frequent in winters and springs. As a consequence, a shift might be expected in the seasonality of debris flows and shallow slides, and the occurrence of such events might increase in the decades to come.

6.1.6 Biodiversity

The observed impacts of climate change on biodiversity and some perspectives for the future at the national level were recently reviewed (Vittoz et al. 2013). For all taxonomic groups considered, the following impacts are already evident: elevation shifts of distribution towards mountain summits, spread of thermophilous species, colonisation by new species from warmer areas and phenological shifts. Additionally, in the driest areas, increasing droughts are affecting tree survival and fish species are suffering from warm temperatures in lowland regions.

Plants

Climate warming is already affecting the phenology of plants. In the region of Basel, the wild cherry (Prunus avium L.) now blooms, on average, 16 days earlier than in 1950 (North et al. 2007), and the growing season has lengthened an average of 2.7 days every decade since 1951 (Defila & Clot 2005; OcCC 2008). Longer growing seasons enable plants to grow at higher elevations. Many botanists have been resurveying plant species on mountain summits above 2'800 m (e.g. Frei et al. 2010, Stöckli et al. 2011, Vittoz et al. 2009) and observed increases in plant species richness on most of the summits, with only a few summits showing a stable or decreasing species richness. As the direct anthropogenic influence on ecosystems increases towards lower elevations, it is increasingly difficult to disentangle the impacts due to direct human activities from those induced by climate change. However, Moradi et al. (2012) observed recently in Swiss montane fens an increase of thermophilous, rich-soil-indicator and shade-indicator species. These changes were interpreted as a higher productivity in warmer conditions, on drier soils and/or under airborne nitrogen deposition. Similarly, the 12% increase of xerophilous species in the last 10 years observed by a national monitoring program in lowlands is possibly the consequence of drier conditions because of the warmer temperatures (Bühler, 2012).

Birds

The Swiss Bird Index SBI® Climate Change is an indicator developed by the Swiss Ornithological Institute to document the population trends since 1990 of 20 breeding birds for which an extension of range is expected by the end of the 21st century (e.g. thermophilous species) and of 20 species for which a shrinking distribution range is expected (e.g. alpine species). The combined index for species with an expected range extension showed a strong increase (Keller et al. 2012). For example, the European bee-eater (Merops apiaster) has become a regular breeder in Switzerland and its population is increasing. A recent study identified a significant upward shift between 1999–2002 and 2004–2007 in the distribution for 33 out of 95 species, with an average shift of 94 m for the leading edge (Maggini et al. 2011). Conversely, the species for which a decrease of the range is expected under future climatic conditions did so far not show a declining trend on average (Keller et al. 2012). For some species of this group, however, significant population trends since 1990 have already become apparent (Revermann et al. 2012).

Insects

As poikilothermic[10] animals, insects depend strongly on warmth for their development and reproduction. Hence, warmer temperatures accelerate their growth. In the Swiss lowlands, Altermatt (2012) observed that

[10] *Organism having a body temperature that varies with the temperature of its surrounding*

24 out of 28 butterfly species advanced their seasonal appearance over a 13-years monitoring period. This earlier onset allowed a longer reproduction period and 72% of the multivoltine[11] butterfly species increased the frequency of supplementary generations (Altermatt 2010). Changes in the elevational distribution were also observed in the comparison of old (1920–1941) and recent inventories in the Swiss National Park (Pasche et al. 2007). These distribution shifts are in agreement with projections of species distribution models. In Switzerland, an increase in mean temperature of 2°C by 2050 might lead to a decrease of 3–15 species per km2 in lowlands because of the upward shift and to a slight increase above 1200 m (Bureau de coordination du Monitoring de la biodiversité en Suisse 2009). But, on subalpine–alpine ridges, this increase will correspond to an almost complete species turnover (Pearman et al. 2011). Many thermophilous aquatic species took advantage of the warmer temperatures to expand their distribution. Some species that were only sporadically observed at the beginning of the 20th century are now colonising Switzerland (e.g. the dragonflies Aeshna affinis and Sympetrum meridionale). According to models, this could lead to increased species richness in ponds but also to the rarefaction or even extinction of species limited to cold, alpine lakes (Rosset & Oertli 2011).

Projections for biodiversity

On the basis of existing observations and model results, it is possible to make some projections concerning the future climate change impacts on biodiversity in Switzerland. Species will certainly move towards higher elevations, and new species will colonise Switzerland. Some species will probably disappear at the regional scale, partly in high mountains because of the decreasing area of the alpine and nival belts, partly in the lowlands because of the increasing summer droughts and existing obstacles to dispersal (landscape fragmentation). Moreover, disruptions in species interactions caused by individual migration rates or phenological shifts are likely to have consequences for biodiversity (Walther 2010). Conversely, the inertia of the ecosystems (species longevity, restricted dispersal) and the local persistence of populations will probably result in lower extinction rates than expected with some models. The adaptation capacity of many species with respect to climate change will depend on their ability to colonise new favourable sites. However, dispersal will be limited by the strong fragmentation of the Swiss landscape (Meier et al. 2012) and this fragmentation forces many species to persist only in small, isolated populations, with low genetic diversity, which will limit their ability to adapt to new climatic conditions (Lavergne et al. 2010). It is thus important to reconnect populations by developing networks of suitable ecosystems with supplementary protected areas scattered across the whole country, along topographic gradients and connected to the larger European networks (Hannah 2008).

6.1.7 Forest and Forestry

In forest ecosystems different natural and anthropogenic environmental factors are acting together, partly enhancing or diminishining their effects, and modified by natural site factors. The identification of one individual factor for an observed effect or its quantification is often not possible. However, due to increased research efforts the contribution of climate change on the forest dynamic becomes clearer.

Tree growth and vegetation shifts

Climate change acts in different ways on the tree species and the composition of forests. It weakens the vigour of drought sensitive tree species and favours the competitiveness of more drought resistant species. Because the tree line is mainly determined by summer temperatures (Körner & Paulsen 2004), warmer conditions induce an upward shift of its limit. As tree line in the Alps is lowered by cattle grazing, the upward shift that is observable since 1900 is simultaneously driven by climate changes and pasture abandonment (Gehrig-Fasel et al. 2007; Vittoz et al. 2008). Due to changes in minimum air temperature in spring (less extreme cold events), European ash (Fraxinus excelsior), Silver Fir (Abies alba Mill.), Wild cherry (Prunus avium L.), Sycamore (Acer pseudoplatanus L.), Sessile oak (Quercus petraea) and European

[11] *A species that has two or more broods of offspring per year*

beech (Fagus sylvatica L.) are successfully regenerating at and beyond the upper elevational limits of adult individuals (Vitasse et al. 2012).

In the inner-Alpine dry valleys the climate variability is now the main driving factor for vegetational changes (Rigling and Dobbertin 2011, Rigling et al. 2013). Whereas the Scots pine (Pinus sylvestris L.) now shows high mortality rates, related to enhanced drought events, the sub-mediterranean pubescent oak (Quercus pubescens Willd.) has locally increased in abundance. Moreover, the natural regeneration of Scots pine is now more restricted to the wetter areas of the Rhone valley, whereas in the driest eastern parts it is more or less absent. On the contrary, saplings of pubescent oak were found in the entire region (Rigling et al. 2013). The growth of pines in drought events is not only reduced, but also the quality of the wood built under water stress is lower, as the hydraulic properties are more vulnerable to drought (Eilmann et al. 2011).

In the Swiss lowlands, the Norway spruce (Picea abies L.) covers wide areas outside their natural limits. The natural conditions for Norway spruce are a colder and wetter climate. Today, the Norway spruce stands on climatic unfavourable sites in the lowlands and suffers from drought conditions, leading to a lesser foliation. In dry years like 2003 the growth in the lowlands was reduced, whereas it was enhanced at higher and hence colder elevations (Dobbertin 2005).

In some cases climate change enhances the ability of neophytes to invade into forests and to act as "invasive aliens". At the moment, the tree-of-heaven (Ailanthus altissima) becomes more and more invasive in the south-Alpine region of Switzerland (Ticino and Grisons). They are especially successful on shallow and dry sites, where other tree species are less competitive (Arnaboldi et al. 2002). Additionally, the leaves of the tree-of-heaven are toxic and game avoid to feed on them. This is an additional advantage for the tree-of-heaven, leading to an invasive spreading into the forests.

One important factor enhancing the severity of drought periods is the eutrophication by the nitrogen deposition. In a long-term field experiment, the water use efficiency, i.e. the relation of assimilated carbon to water, was reduced with increasing nitrogen doses, leading to drought symptoms (Braun et al. 2012). The mean annual nitrogen deposition in forests in Switzerland is about 25 kg (Augustin and Achermann 2012), with much higher rates in agricultural regions in the lowlands.

The reported findings are consistent with current knowledge on the ecophysiology of trees and – as far as known yet - the reactions of forest stands under warmer conditions. However, the future forest composition is difficult to predict, since the influence of climate change on the forests is modified by a lot of other factors, like the site conditions, the regional peculiarities of the development, the influence of pests, diseases, insects, and especially at higher elevations, changes in agricultural practices. All these factors were affected by climate change, but the influences of each of them and their interactions at a given site is not easy to predict. If the development proceeds as predicted by climate models in many regions, a substantial shift in the tree species composition will occur, favouring more drought tolerant trees like oak species, whereas trees adapted to colder and wetter climate like the Norway spruces will be restricted to more feasible sites at higher elevations.

6.1.8 Agriculture

In general, climate change in Switzerland is expected to entail a shift of suitable areas for agricultural production, and to involve both positive (e.g. a longer vegetation period) and negative aspects (e.g. increasing incidence of [insect] pests owing to the milder winters). Changes in the nature of extreme weather events, in particular more frequent, intense and longer-lasting summer heat waves, could also challenge agriculture e.g. by reducing the reliability of harvests. The extent by which climate change will affect agriculture will depend, however, on the regional settings, the overall political framework and the specific economic background of the farms. Economic considerations are expected to play a crucial role for the adoption of adaptation measures.

Water demand and supply for agriculture in a changing climate

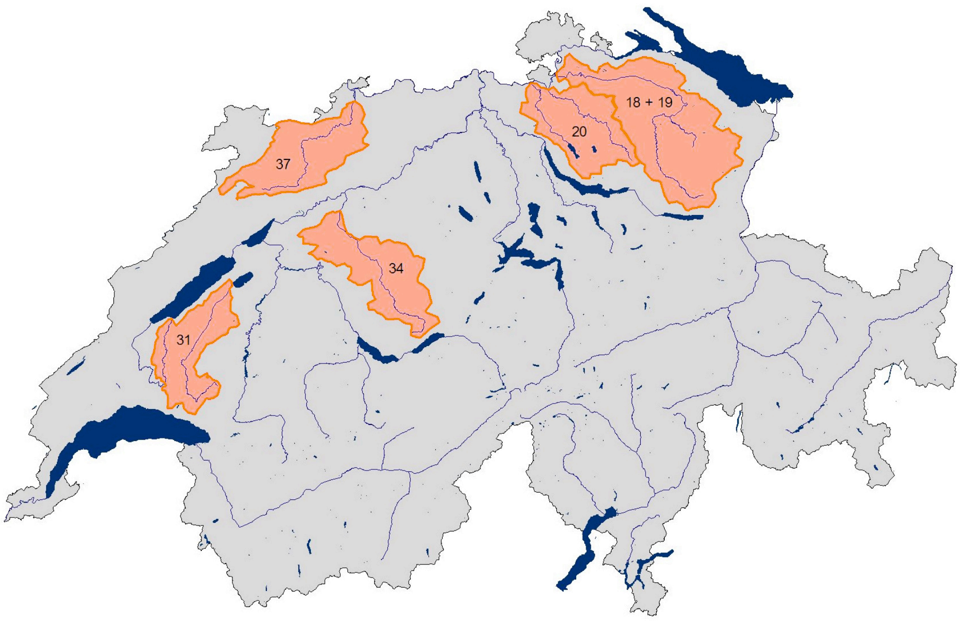
Drought is a major threat to agricultural production. Even in Switzerland, where drought is not a recurrent phenomenon under current climatic conditions, water scarcity can induce considerable damages. This was the case in 2003, when losses of about CHF 500 million were suffered by the agricultural sector from an unprecedented heat-wave.

To cope with water limitation, a large fraction of the agricultural area worldwide is equipped for irrigation. In Switzerland only 55'000 ha of agricultural land, the majority of which in the Valais, are currently irrigated (Weber and Schild 2007). Annual water requirements are of about 130 million m^3 on average, but were as high as 570 million m^3 in 2003 (Fuhrer and Jasper 2012). Because water abstraction has to comply with legislation regarding minimum discharge levels in rivers, irrigation is not always possible. For example, in the western part of the Central Plateau (Canton of Vaud) abstraction had to be discontinued in 8 out of 14 years since 1998.

Climate scenarios for Switzerland propose decreasing precipitation amounts during the summer season (CH2011 2011). Accordingly, results of hydrological simulations carried out for selected river catchments (Fig. 87) using two climate change scenarios representing the range of projections given in CH2011 (2011) indicate that already by 2060 average water requirement in parts of Switzerland could represent as much as 50% of the river water supply (Fig. 88, Fuhrer 2012). In extreme years water demand could even easily exceed the supply, suggesting that conflicts concerning the utilization of water resources are likely to arise more frequently in the future if preventive measures are not taken.

Fig. 87 > Geographic location of the six river catchments considered for the analysis.

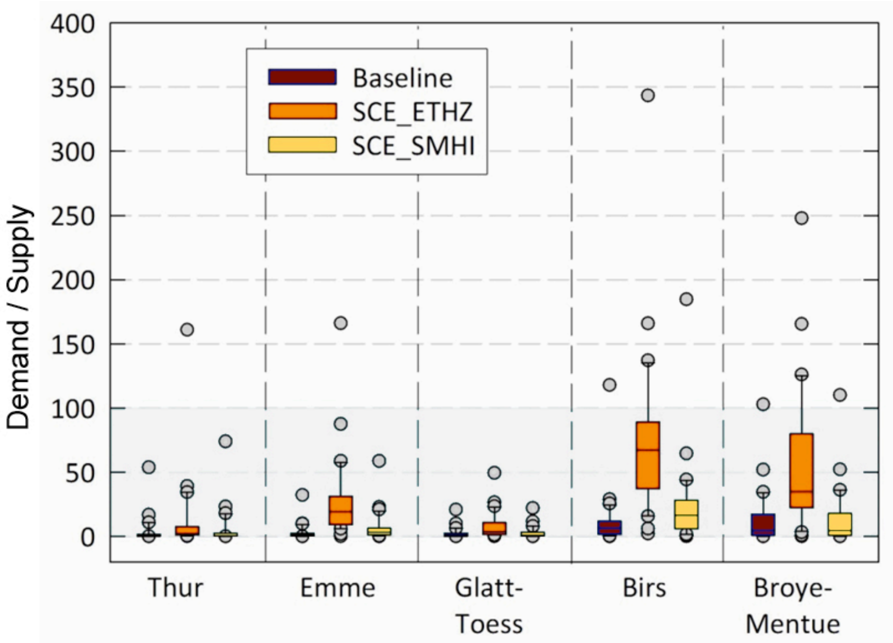
From south-west to north-east: Broye-Mentue (31), Birs (37), Emme (34), Glatt-Töss (20), and Thur (18 + 19)



Fuhrer (2012)

Fig. 88 > Average ratio (%) between water demand for irrigation and supply under current (brown boxes) and future (orange and yellow boxes) climatic conditions, for the six catchments highlighted in Fig. 87.

For both scenarios, median, 25/75%-quantiles (box), 10/90%-quantiles (whiskers) und extreme values are given. Two climate change scenarios (SCE_SMHI and SCE_ ETHZ) for 2060 representing the lower and upper end of the range of projections given in CH2011 (2011) were considered for the analysis.



Fuhrer (2012)

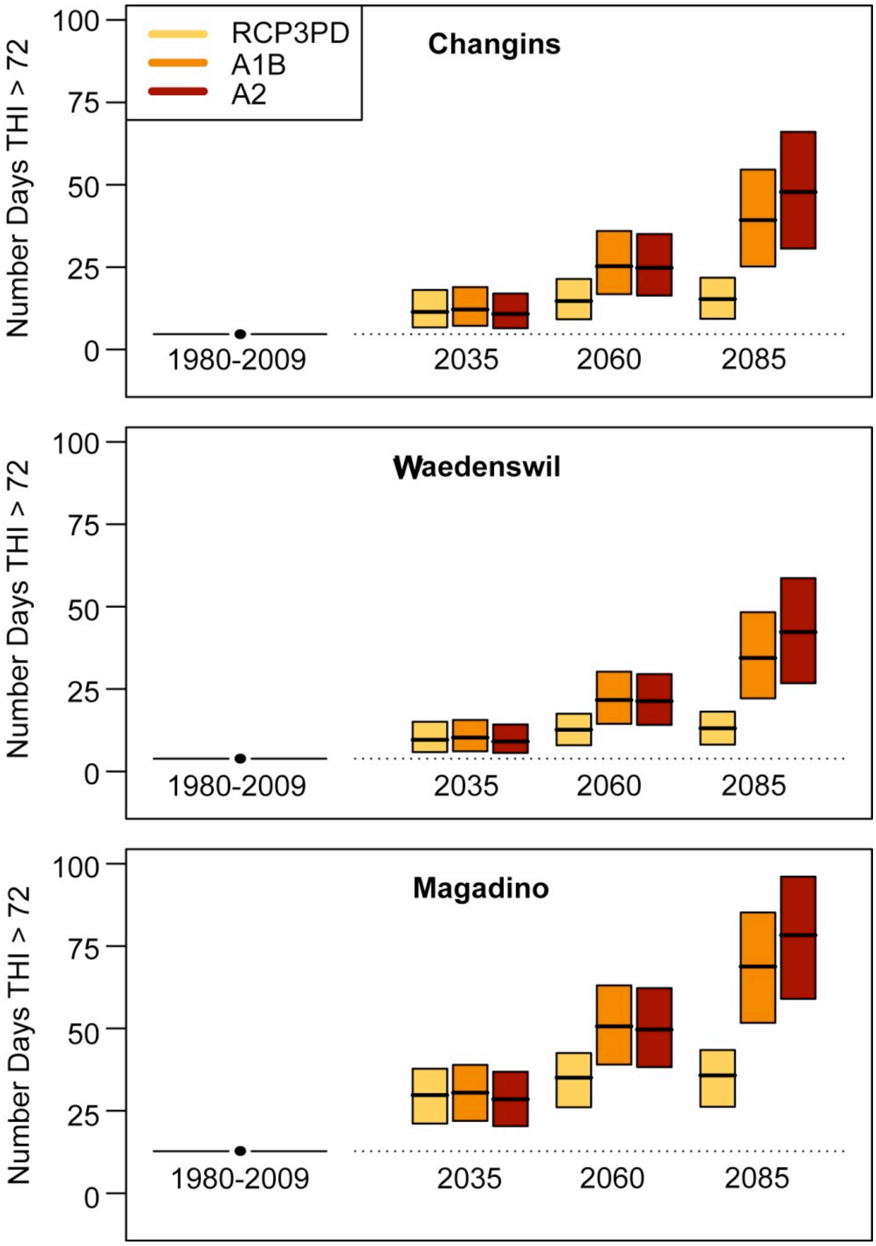
Implications of increasing summer temperatures for animal performance

Heat stress caused by elevated daytime temperatures and high humidity levels has the potential to considerably affect animal performance and health (Johnson 1994). For Swiss agriculture the risk of reduced animal performance is of concern especially in relation to milk production. A retrospective analysis of the so-called temperature-humidity index (THI, Thom 1958) has revealed that under current climatic conditions an important risk of heat stress for dairy cows (THI > 72°C) exists in the long-term only for Southern Switzerland (Fig. 89 See also Fuhrer and Calanca 2012).

This situation could change in the future, though, because according to the newest climate change scenarios for Switzerland (CH2011 2011) summer temperatures could increase in average by up to 4°C until 2060 and up to 6°C until 2085, depending on emission scenario. As seen in Fig. 89, the consequences are a marked increase in the average number of days with THI > 72°C. The increase is more distinct for the second half of the century under the A1B and A2 emission scenarios. As a result, critical conditions under the A1B and A2 emission scenarios are expected to persist on average for two (Northern Switzerland: Changins, Wädenswil) to three months (Southern Switzerland: Magadino) by the end of the century. This calls for the adoption of protective measures, both in relation to indoor and outdoor environments.

Fig. 89 > Change in the temperature humidity index

Projected changes between reference period 1980-2009 (horizontal bar on the left) and future time slices (box plots on the right) in the long-term average number of days per year with THI > 72°C at Changins (top), Wädenswil (middle) and Magadino (bottom) for the three emission scenarios RCP3PD (yellow), A1B (orange) and A2 (brown).



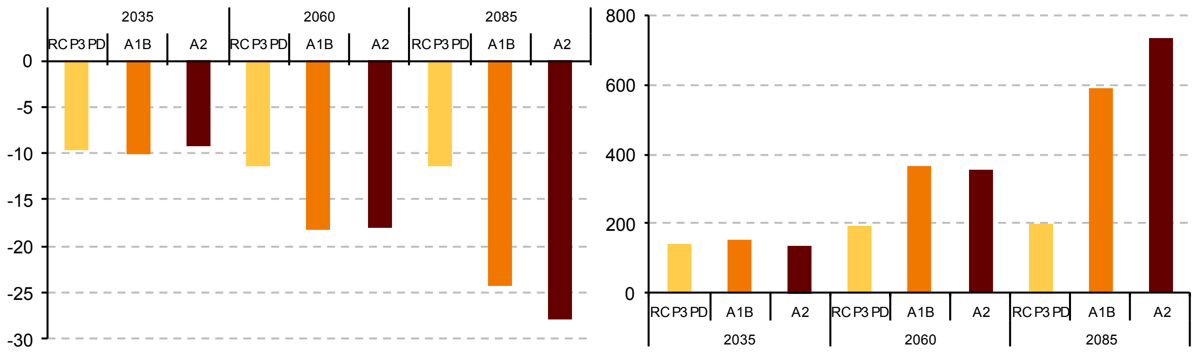
Agroscope Reckenholz-Tänikon (2013)

6.1.9 Energy

Impacts on heating degree day and cooling degree day

Heating degree day (HDD) provides a measure that reflects the energy needed to heat a building. It is based on a reference temperature below which a building requires heating. For a day, if the average outside temperature is below this reference temperature, the HDD represents the difference between the reference temperature and the average outside temperature, otherwise HDD is equal to zero. The sum of HDDs over a year provides an indication of the total heating requirements for that year. Cooling degree day (CDD) are directly analogous to HDD but estimates the energy demand for air conditioning. It can be expected that climate change will modify these two measures. Fig. 90 shows the evolution of the HDDs and CDDs computed from the Swiss climate change scenarios CH2011 (CH2011 2011) for the years 2035, 2060 and 2085 and using the three emissions scenarios (RCP3PD, A1B and A2).

Fig. 90 > Changes in % of HDDs (left) and CDDs (right) in respect to the reference period (1980–2009)



Faust et al. (2012)

In 2085, the heating energy demand is expected to decrease between 20.6% and 8.2% depending on the global emissions scenario. The impact on CDDs is much more important than the impact on HDDs, one must take into account that the use of air conditioning in building is very limited at present in Switzerland compared to warmer regions. Thus, the final impact on electricity consumption is highly dependent on the penetration of air conditioning in Switzerland for the futures decades.

Impacts on energy consumption and economic welfare

A recent study (Faust et al. 2012) simulated with an economic model the impacts of the future changes of HDDs and CDDs for the year 2050. Tab. 34 presents the Swiss-wide results of these simulations for the three global emissions scenarios. Decrease in heating demand will lower the energy consumption of oil and natural gas that are mostly used in Switzerland for heating. On the contrary, the increase of space cooling demand will boost electricity consumption. The aggregated impacts are a decrease of oil, and an increase of electricity and natural gas, as natural gas will be used to generate the additional electricity. From an economic point of view, the effect of decreasing heating energy consumption strongly outweighs the effect of increasing cooling energy demand. Thus, the net effect is positive, with a welfare gain ranging from CHF 720 to 999 million in 2050 depending on the underlying emissions scenario. This welfare gain comes mainly from the money which is not spent anymore on imported oil. In addition to the economic improvement, CO_2 emissions are reduced by a percentage ranging from 1.9% to 2.6%. These results are in line with the findings of other studies that states climate change leads to decreasing energy demand in the colder regions and increasing energy demand in the warmer parts of the world (Isaac and van Vuuren, 2009).

Tab. 34 > Impacts of climate change on the Swiss economy in 2050

* percentage change with respect to the baseline scenario

	RCP3PD	A1B	A2
Energy consumption*			
Oil products	-2.4%	-3.3%	-3.1%
Natural gas	0.2%	0.4%	0.4%
Electricity	1.5%	2.2%	2.1%
CO_2 emissions	-1.9%	-2.6%	-2.5%
Welfare impact in millions CHF2010	720	999	955
Welfare impact as % of total household consumption	0.11%	0.16%	0.15%
Faust et al. (2012)			

Influence of climate change to hydroelectric power production in Switzerland

The implications of changes in runoff and runoff regime on hydraulic power production due to climate change were investigated in a comprehensive study by different research Institutes in Switzerland (SGHL & CHy 2011; Hänggi et al. 2011). Results from the CH2011 report, emissions scenario A1B, have been used for the modeling of runoff changes in small and meso-scale catchments in different climatic regions of Switzerland. These results were combined with management models for different types of hydroelectric power plants in order to estimate changes of the production of electricity and of the turnover of the selected typical plants. Due to the fact that runoff regimes will be more balanced in the seasons, in many power-plants – namely in run-of-river power plants - winter runoff and hence electricity production will increase. Whereas in summer even with slightly lower runoff, production will not or only slowly decrease because the water flow will mostly still be higher than the capacity of the turbines. However, in highly glacierized regions, where runoff will decrease considerably in the summer season and by the end of the century, electricity production will decrease as well. In case studies four different types of power plant schemes have been investigated (Tab. 35). Prättigau is a serie of power plants without reservoirs and only little glaciation (3%). The other three schemes have large seasonal reservoirs. Löntsch has few glaciers (3%) whereas Mattmark (39%) and Oberhasli (29%) are heavily glacierized. Due to the high altitude of Mattmark, runoff from melt water still contributes much water until 2050, in Oberhasli melt-water will already be strongly diminishing, therefore summer production is declining as well.

Tab. 35 > **Changes in mean production of hydro-electricity**

Relative changes of the mean production of hydro-electricity for 4 different hydro power plant schemes for 2021-2050 related to the period 1980 (1998) - 2009 following emission scenario A1B (CH2011 2011)

Power plant	Winter (Oct – March)	Summer (April - Sept)	Year (Oct.- Sept)
Prättigau	+26.5%	+0.4%	+9.3%
Löntsch	+9.3%	-3.3%	+2.2%
Mattmark	+3.2%	-10.1%	-0.6%
Oberhasli	+0.8%	-25.2%	-11.4%

Hänggi et al. (2011)

It was found that considering today's production schemes and electricity markets the hydropower production in Switzerland during winter would increase by 10 % in 2012-2050 compared to the control period 1980-2009 (Tab. 36). For summer a slight decrease was calculated. The annual production would slightly increase by 0.9 to 1.9 %. For single hydropower sites changes may be rather different. In southern Wallis as well as in Ticino a general decrease was estimated due to less rainfall and diminished glaciers.

Tab. 36 > Changes in mean production of hydro-electricity

Relative changes of the mean production of hydro-electricity for 4 different hydro power plant schemes for 2021-2050 related to the period 1980 (1998) - 2009 following emissions scenario A1B (CH2011 2011). The optimistic option assumes that in small and mesoscale catchments the decrease in summer runoff does not go below the limit of the existing water intake capacities and therefore summer production remains stable. Whereas in the pessimistic option it falls below the water intake capacity, with the consequence that summer production decreases.

Option	Winter (Oct – March)	Summer (April - Sept)	Year (Oct.- Sept)
optimistic	+10.1%	-4.4%	+1.9% (0.7 TWh)
pessimistic	+10.1%	-6.3%	+0.9% (0.3 TWh)

Hänggi et al. 2011

6.1.10 Health

The projected increase in the frequency and intensity of heat waves (section 6.1.2) in combination with high tropospheric ozone concentrations represents the greatest direct risk that climate change poses to people's health in Switzerland. The potential extent became clear during the heat wave of 2003 when almost 1'000 deaths were attributed to the extraordinary heat. The heat wave in 2003 hit the elderly and the very young and was more pronounced in cities intensifying the urban heat island effect.

Since then, the federal and cantonal authorities have developed measures to inform the population about expected heat waves and about protective measures to be taken. Humans can mitigate the effect of heat waves on health as they are not defenceless exposed to extreme heat. Experiences from other countries indicate that the effect of a heat wave on mortality on a population level can be significantly reduced when heat action plans are put in place.

Additional direct effects of climate change on health are expected from the increase of other extreme events such as floods, mudslides and, possibly, storms. Given the well developed immediate disaster control measures in Switzerland, health effects are likely to be manageable. However, extreme events may entail severe psychological consequences for the directly affected population which may last longer and are often underestimated.

An increase in annual mean temperature between 1969 and 1996 in Switzerland has been paralleled by an increase in total counts of hazel, birch and grass pollen. The starting season of pollen flowering has shifted to earlier periods of the year, especially for hazel trees which started to flower in January / February as compared to March as observed previously. Timing of life cycle events in vegetation (budburst, flowering) is generally sensitive to temperature if not water-limited. Increasing temperature might therefore be a possible driver of pollen production. In addition, factors such as higher atmospheric CO_2 concentration have been shown to increase pollen production. Yet, the relation between a biological system such as vegetation and external drivers is complex and often non-linear. The role of climate change for the observed increase in pollen production is thus not yet elucidated. People sensitized to a variety of different pollens may start suffering earlier from hay fever or asthma symptoms and for a prolonged period of the year when pollen production starts earlier in the year and the amount of pollen increases. However, there is no clear evidence that the increase in the occurrence of allergic diseases which was observed in many westernized countries including Switzerland since the 1960 is causally linked to pollen concentrations in the air. Research shows that environmental factors such as pollen which trigger symptoms in already diseased people are not necessarily the same as those causing the development of the disease.

Another important potential health risk of climate change is the occurrence of vector-borne diseases. The diseases result from a transmission of an infectious agent through an animal vector (mosquito, ticks) usually through biting or touching. Increasing temperatures favor growth of vectors and replication rates of infectious agents, e.g viruses. In Switzerland, the most common vector-born diseases are tick-borne encephalitis (FSME) and lime borreliosis. In recent years, outbreaks of some vector-borne diseases, such as Dengue and Chikungunya fever have been observed in neighboring countries such as Italy and France, and the respective vector (aedes mosquito) is present in Switzerland, too. Yet, it is still highly uncertain what future developments are to be expected as many other factors such as human behavior, population density, international trade and global tourism affect disease transmission. Surveillance of disease outbreaks and vector spread are the first steps to develop adapted plans for intervention and prevention.

6.1.11 Water management

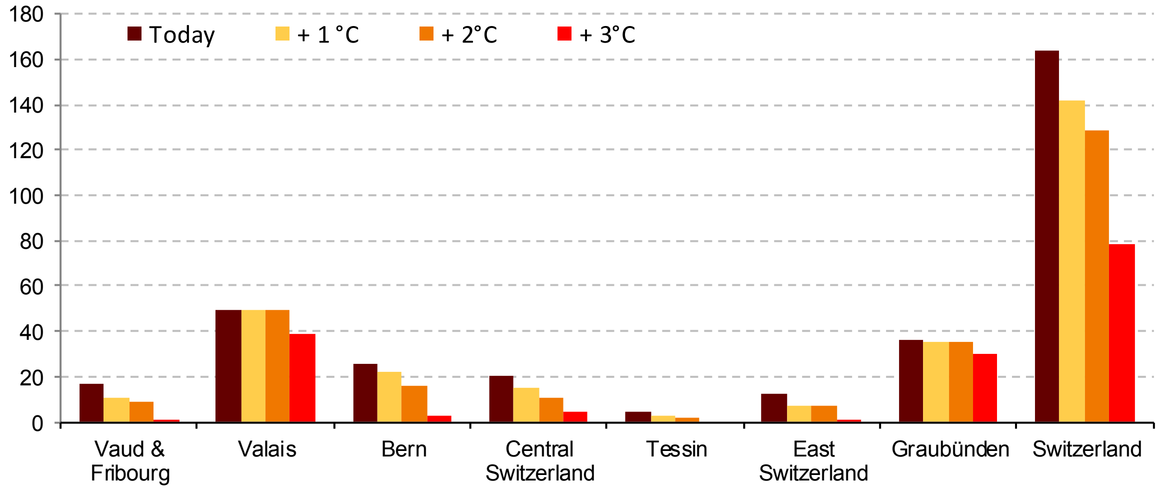
Knowledge regarding the future impacts of climate change on the water balance and on water management in Switzerland is generally limited to a qualitative understanding. The reason for this is that only relatively uncertain scenarios for climate change (precipitation, extreme events) are available and that the spatial-temporal resolutions of these scenarios cannot adequately cope with the heterogeneous nature of the Alps. With the study "Climate Change and Hydrology in Switzerland" (FOEN 2012) for the first time quantitative hydrological projections up to 2100 are available. According to these projections, the water resources in terms of availability and quantity will only change slightly by the end of the century. However, as a result of the rise of the snow line associated with increasing air temperature, the volumes of snow and ice stored in the Alps will greatly decrease. The redistribution of precipitation patterns (drier in summer, possibly wetter in winter) will at the same time cause seasonal flow redistribution. High and particularly low flow events will probably occur more frequently. While currently hydropower production benefits from these changes, a detailed impact analysis of the changing flow regimes on other sectors of the water management is still subject to the research (NRP 61 „Sustainable Water Management", *www.nfp61.ch*). The effect of climate change on the runoff and the groundwater tables will have consequences on water management. The existing flood protection measures must be reviewed. The water temperature has already significantly increased, in parallel to the air temperature. This restricts the cooling capacity of the rivers in dry and hot periods with regards to the discharge of heated water. The Swiss Water Protection Act limits such discharges at a water temperature of 25°C. For the above reasons the legal provisions in various areas (inlet of cooling water or waste water, lake control regulations, residual flows) must be reviewed. The potential need for additional (multipurpose) reservoirs must be clarified. More frequent and serious low water events and higher winter flows could increasingly affect navigation on the Rhine. Finally, the ecosystems in the rivers will be doubly affected by climate change, i.e. by both the higher air temperature and the seasonal redistribution of river flows. Higher air temperatures together with the associated higher water temperatures and lower water levels in summer are likely to put pressure on river ecology and thereby also on water use (agriculture, heat input from industrial cooling) and fishing.

6.1.12 Tourism

In Switzerland, tourism is one of the most important sector directly affected by climate change.This implies that ski resorts in the foothills of the Prealps may not operate profitably in the future (Universität Bern 2011). Due to a lack of wintery atmosphere in the absence of snow, winter sports will lose their appeal to tourists. With climate change progressing, the altitudinal threshold for snow-reliability will continue to rise. The number of ski resorts with current guaranteed natural snow in Switzerland has been assessed for an increase of 1°C, 2°C and 4°C based on the altitude of the station. It appears that the share of ski resorts with guaranteed national snow conditions may drop by at least a fifth for a temperature rise of 2 °C, the tourism importance of these resorts is however not so significant on the national level (Fig. 91). In case of a 4°C rise in temperature, low elevation ski resorts will be extremely affected, but the large number of high-altitude ski resorts will remain snow-reliable. Therefore, the loss expected in Switzerland is below average in comparison with neighboring Alpine countries.

Fig. 91 > Snow-reliability in Swiss ski resorts

Number of ski resorts that are snow reliable under an increase in temperature of 1°C, 2°C and 4°C compared to today.



Abegg et al. 2007

On a larger spatial scale and in the medium run, the highest winter tourism stations in the Alps, many of which are located in Switzerland, will have an advantage over competing stations at lower altitudes, as the latter will suffer first from declining snowfall (OECD 2007). New opportunities for the tourism sector may arise by changing conditions in summer. Pleasant temperatures at higher altitudes and a tendency towards less rainfall may contribute to market the alpine region as a summer holiday destination. At the same time, numerous places at lakes and rivers might become an alternative to seaside holiday resorts at the Mediterranean Sea, which tend to lose attractiveness as excessive heat and drought conditions become more frequent. However, more tourists in summer will not compensate for the loss of income of mountain resorts in winter. At present, these resorts heavily depend on winter tourism to maintain profitability.

Destinations dependent on glaciers as tourist attractions will be affected as glacier retreat continues (see section 6.1.3). Other changes in natural scenery (rivers running dry in late summer, lack of wintery atmosphere in the absence of snow) may further reduce the attractiveness of some alpine tourist areas. However, in some cases, the formation of new mountain lakes by retreat of glaciers may be positive for tourism. This is the case in the Swiss alpine Valley of Gadmen, where a lake formed behind a glacial barrier towards the end of the 1990s, and increased the number of tourists hiking to the hut nearby. Researcher have shown that the suspension bridge, inspired by Nepalese rope bridges and built to avoid the obstacle, became an attraction and largely compensated the irreplaceable loss in term of natural scenery, caused by the glacier retreat (*www.nfp61.ch*).

Changes in natural hazards are another element relevant to mountain tourist destinations. Melting permafrost destabilises ground conditions. This may affect infrastructures which are placed at high altitude. Hotel and restaurant buildings, masts of cable cars, avalanche barriers a.s.o. are vulnerable when anchored in permafrost ground (Müller 2003). These phenomena are known in Switzerland, but the surveys start to deliver preliminary figures.A related problem is the frequency of rock fall and debris flows which will increase due to the combination of melting glaciers, melting permafrost, rising snow line and more intense precipitation (see section 6.1.5). This may present an additional risk to climbers and hikers at high altitudes. Furthermore, the threat to alpine routes from rockfall und rockslides will increase.

6.2 Assessment of climate-related risks and opportunities in Switzerland

The global climate is changing. Also in Switzerland, society, economy, and nature are affected, and must start already today to prepare for the changes. In addition to the urgent reduction of greenhouse gas emissions, adaptation to the impacts of climate change is becoming increasingly important. That is why the Federal Council adopted the first part of its strategy to adapt to climate change on March 2, 2012 (see section 6.3.1). This adaptation strategy sets the framework for a coordinated approach to adapting to climate change at the federal level. At the same time, the Federal Council gave the mandate to develop an action plan to achieve the objectives of the adaptation strategy (see section 6.3.1). With targeted measures, Switzerland shall take advantage of opportunities arising as a result of climate change and minimize the risks of climate change.

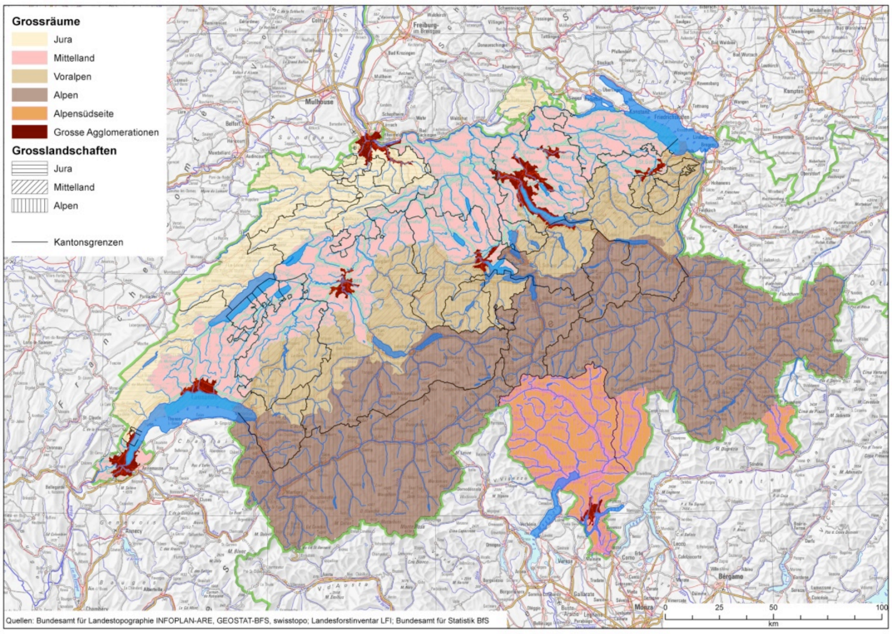
The assessment of climate-related risks and opportunities[12] for Switzerland across sectors will provide an important basis for achieving this objective. It will allow determining adaptation priorities and the resulting need for action. In a pilot project (Holthausen et al. 2013a), a method was developed to assess and compare risks and opportunities transparently. This includes effects in the sectors of health, agriculture, forestry, energy, tourism, infrastructures and buildings, water management, biodiversity as well as open spaces and green areas.

6.2.1 Approach

The assessment is carried out in six steps for the six large areas: Mittelland, Alps, Foothills of the Alps, Jura, South of the Alps and the large urban zones (Fig. 92). For each area, a representative canton was selected to be assessed in detail. The detailed results are then scaled up to the corresponding area. Assembling the six case studies provides the big picture for all of Switzerland.

Fig. 92 > The division of Switzerland into six large areas

These are Mittelland, Alps, Foothills of the Alps, Jura, South of the Alps and the large urban zones (dark red).



WSL (2011)

[12] A risk is defined as the product of the probability of an event and its consequence or, when referring to a gradual change, the product of its yearly probability and its yearly consequence. An opportunity is defined as the product of the probability and the positive consequence of an event or a gradual change. The risks and the opportunities are determined for different time horizons (today and 2060). These are the risks and opportunities of the hazards and effects. When speaking about the risks and opportunities of climate change, one considers the change of the risks between today and 2060 (see also Holthausen et al 2013a).

The first application of the method took place in the canton of Aargau, as representative of the Mittelland area. It provides the first building block for the nationwide examination of climate-related risks and opportunities. The assessment of the canton of Uri and the corresponding area of the Alps will be completed by end 2013. The remaining areas will be completed by end 2016.

6.2.2 Method

Two climate scenarios and a socio-economic and demographic scenario for the 2060 time horizon (2045-2074) served as the basis for the assessment. To show the possible range of impacts, a 'weak' and a 'strong' climate scenario[13] were selected. The 'weak' scenario corresponds to the expected climate, if worldwide greenhouse gas emissions are reduced by almost 90% by 2100. The 'strong' scenario corresponds to that of a continuation of current emission trends.

For the canton of Aargau, temperature and precipitation change as follows:

- In the 'weak' scenario, the annual mean temperature increases by 1.4°C and precipitation reduces slightly in the summer (-5%);
- In the 'strong' scenario, the annual mean temperature increases by of 3.1°C and precipitation reduces strongly in the summer (-20%) and increases strongly in the winter (+15%).

To focus the assessment, the main impacts of the case study were first determined in consultation with representatives of cantonal departments. To this end, experts determined whether they expected the given hazards and effects to have a substantial climate-induced impact on the considered sectors. The following matrix (Fig. 93) shows the results of this process for the canton of Aargau.

In the next step, the areas identified in the matrix (Fig. 93) are assessed in detail. The relevant risks and/or opportunities are either quantified on the basis of indicators, or assessed on the basis of qualitative classes. The assessement is carried out for the situation today, the two climate scenarios and the socio-economic and demographic scenario. A complete overview of the method and the terminology used through this chapter is given in Holthausen et al (2013a).

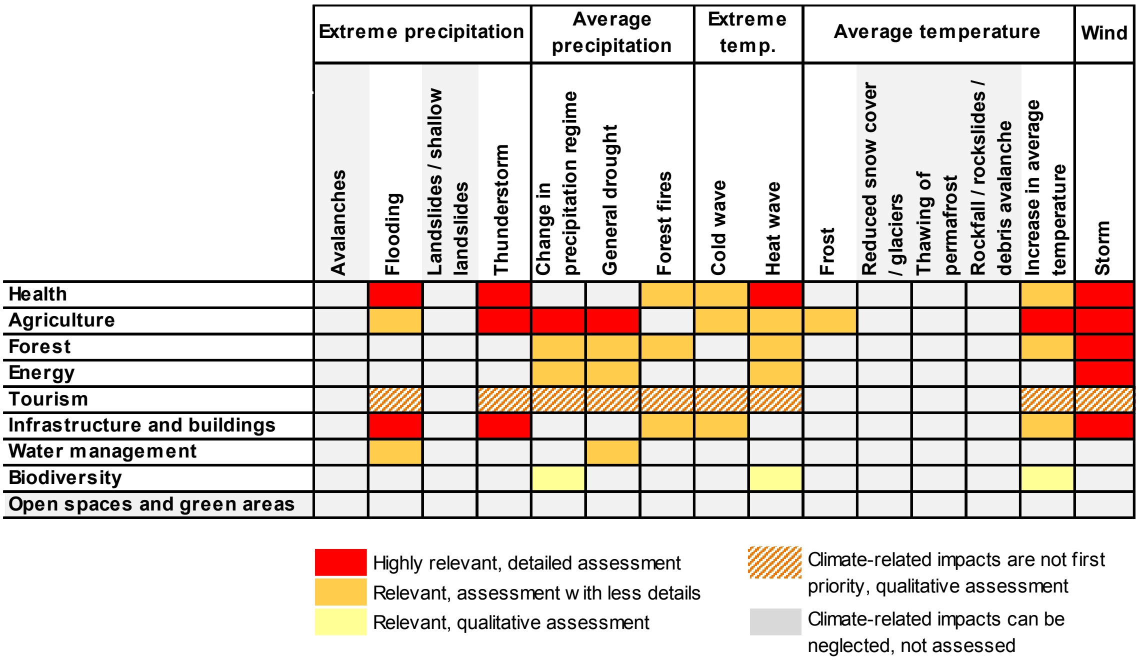
In order to interpret the results, two aspects have to be considered:

- In determining the risks, the assessement assumes no adaptation measures. Although this scenario is unlikely because many of the risks can be reduced with relatively simple measures, it enables the identification of areas in which policy options and measures must be developed and/or embraced;
- The uncertainties associated with this assessement are significant, as we take a look 50 years into the future. Because no scientific facts are available in many instances, plausible assumptions have to be made in place of missing data. The selected approach, however, allows for subsequent correction of the assumptions and updating the assessement.

[13] A 'weak' and a 'strong' climate scenario refers to the terminology used in the specific study in place of ‘high’ and ‘low’ emissions scenario.

Fig. 93 > Relevant areas assessed in the Canton of Aargau case study.

Please note that the matrix indicates a first expert assessment to determine the areas which are then assessed in more detail in a second step. Results of the detailed assessement are shown in the next figure!

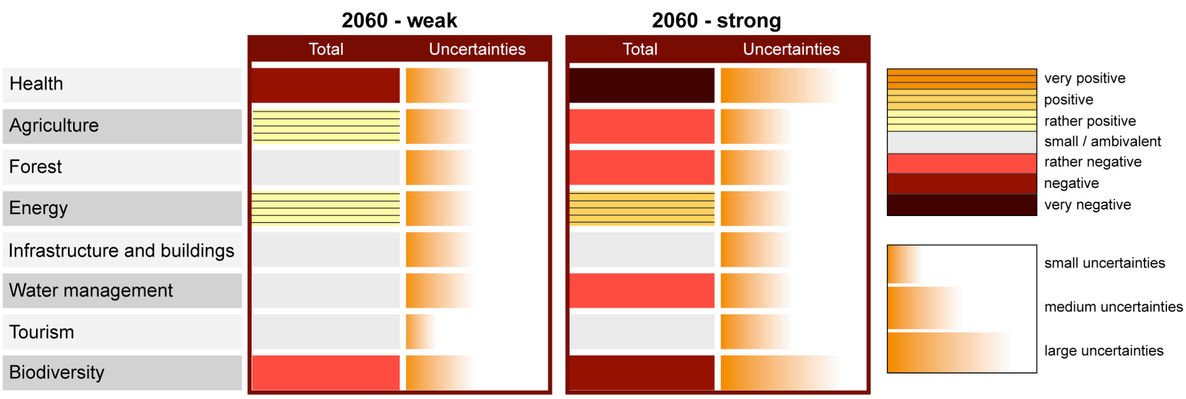


Holthausen et al (2013b)

6.2.3 Case study Canton Aargau: Overview of the results

The following overview (Fig. 94) summarizes all the risks and opportunities of climate change considered for the two climate scenarios investigated. The differences between the aggregate risks in a future climate ("2060 weak" and "2060 strong") and the aggregate risks in today's environment are presented. Boxes showing increased risk are coloured brown/red, those showing decreased risk are coloured orange/yellow. Boxes showing increasing (decreasing) opportunities are coloured orange/yellow (brown/red). Uncertainties are shown in shaded orange.

Fig. 94 >. Aggregate risks and opportunities and associated uncertainties for the various sectors in the canton of Aargau.



Holthausen et al (2013b)

The climate scenario "2060 weak" leads to relevant health burdens in the canton of Aargau. The considered impacts were those of heat waves (including premature deaths and adversely affected persons) and rising average temperature (leading to an extended pollen season, but also to the decline in traffic injuries and fatalities in winter). In the energy sector, the positive impact of a reduction in demand for heating energy is noteworthy. In the other sectors, only moderate impacts are expected in the canton of Aargau. The underlying scenario assumes a significant reduction of global greenhouse gas emissions, but from today's point of view this assumption seems overly optimistic.

The climate scenario "2060 strong" leads to severe health burdens upon the population of the canton of Aargau by the year 2060. Heat waves like those in 2003 would become normal, especially impacting the health of the elderly and people in need of care, but also of a large part of the rest of the population. As a result of the extension of the growing season, an increased health burden can be expected on individuals allergic to pollen. In the field of biodiversity, problematic developments caused by changed ecosystems can be expected under this scenario by 2060. The impact of climate change will also be clearly felt in most other sectors.

6.2.4 Conclusion and next steps

The first application of the method, which took place in the canton of Aargau, as representative of the Mittelland area, showed that thanks to the pragmatic and systematic approach and on the basis of current knowledge, one can make comparisons of several sectors and holistically assess the most important climate-related risks and opportunities. The Canton of Aargau case study showed that significant impacts of climate change are expected in several sectors. It provides the first building block for the nationwide examination of climate-related risks and opportunities, as well as important information for the cantonal administration with regard to adaptation planning.

The assessment of the canton of Uri and the corresponding area of the Alps will be completed by end 2013. The nationwide assessement will be completed by end 2016. It will serve as a basis for the Federal Council's adaptation strategy, and help to achieve its general goal of taking advantage of the opportunities that arise as a result of climate change and of minimizing the risks of climate change. This nationwide assessement shall also allow to determine adaptation priorities and the resulting need for action.

6.3 Adaptation

6.3.1 Development of a Swiss national adaptation strategy

Climate change impacts provide both, risks and opportunities to Switzerland (see sections 6.1 and6.2). In order to minimize the risks posed by and to benefit from the opportunities provided by climate change adaptation measures need to be planned and implemented in the coming decades.

The Swiss federal council is working on an adaptation strategy which will serve as a framework for the federal offices to adopt a coordinated course of action in responding to the expected changes. The adaptation strategy is divided into two parts. The first part was adopted by the Federal Council on 2 March 2012 (Swiss Confederation 2012a). It describes the goals, challenges and fields of action in adapting to climate change in Switzerland. In the second part, adaptation measures are presented and coordinated in a joint action plan. It will be completed by the end of 2013 and is expected to be adopted in early 2014.

First part of the Federal Council's adaptation strategy - goals, challenges and fields of action

Key elements of the first part of the Federal Council's adaptation strategy (Swiss Confederation 2012a) are (1.) general objectives and principles, (2.) sectoral strategies for those sectors most affected by climate change in Switzerland, and (3.) a summary for the most significant challenges the country is facing in adapting to climate change. In brief:

1. General goals and principles of adaptation:

The overall goals of adaptation are described as follows: Switzerland makes the most of the opportunities that arise as a result of climate change. It minimizes the risks of climate change, protects the population, public assets and natural life support systems and improves the adaptive capacity of society, the economy and the environment. Ten principles are defined which apply when pursuing the overall adaptation goals: (1.) to organize adaptation in line with sustainability goals, (2.) to work in partnership with all institutional levels, (3.) to implement adaptation as a complementary process to reduction of greenhouse gases, (4.) to base adaptation on a sound scientific basis, (5.) to apply a risk approach in adaptation, (6.) to consider existing uncertainties in the planning of adaptation, (7.) to consider the differences in response timescales among different systems, (8.) to take part in the international exchange of experience, (9.) to evaluate progress in adaptation, and (10.) to continuously improve the adaptation strategy.

2. Sectoral strategies:

The impacts of climate change on humankind, society and economy are either direct by changes in temperature, precipitation or pressure, i.e. storms, or indirect by changes in water, soil air and biodiversity (Fig 95). Based on analysis of these direct and indirect impacts (e.g., OcCC 2007; UVEK 2007) nine sectors were identified that are seriously affected by climate change in Switzerland and in which the Confederation has the competence to take action in adapting to climate change. The selection of sectors was double-checked in the impact matrix shown in Fig 95.

Fig 95> Effect matrix: Direct and indirect effects of climate change and the affected sectors.

Adaptation measures	Climate change (temperature, precipitation, wind)	Water precipitation discharge groundwater water quality snow ice	Soil carbon sink fertility erosion	Air ozone aerosols particulate matter	Biodiversity phenology colonisation extinction migration invasive species ...
Water management	●	●	●		●
Natural hazard management	●	●	●		●
Agriculture	●	●	●	●	●
Forestry	●	●	●	●	●
Energy	●	●			●
Tourism	●	●		●	●
Biodiversity management	●	●	●	●	●
Health	●	●		●	●
Spatial development	●	●	●	●	●

(Swiss Confederation 2012a)

For the selected sectors, sectoral sub-strategies were developed according to a standard procedure or - as in the case of agriculture and tourism - summarized from existing sectoral strategy documents. Within the sectoral sub-strategies, fields of action for adapting were identified, sectoral adaptation goals were formulated and possible ways of achieving these goals were outlined. Altogether, a total of 48 fields of action were identified for all nine sectors.

3. Cross-sectoral challenges:

Based on the sectoral strategies, twelve cross-sectoral challenges were identified. A distinction is made between the challenges arising from the effects of climate change and those that are intended to improve the bases for adapting to climate change. Challenges arising from the effects of climate change are:

- greater heat stress in agglomerations and cities;
- increasing levels of summer drought;
- greater risk of flooding;
- decreasing slope stability and more frequent mass wasting;
- rising snowline;
- impaired water, soil and air quality;
- change in habitats, species composition and landscapes;
- spread of harmful organisms, diseases and alien species.

Challenges arising from efforts to improve the bases for the planning and implementation of adaptation measures are:

- monitoring and early detection;
- reducing uncertainties and closing the knowledge gap;
- rising awareness and improving information and coordination; and

- resource requirements and funding.

Both, the challanges arising from the climate change impacts as well as those arising from improving the bases for adaptation action require a coordination of the different sectoral adaptation measures in the action plan.

Second part of the Federal Council's adaptation strategy - action plan

In the second part of the adaption strategy, adaptation measures are presented and coordinated in a joint action plan. As key elements, the action plan contains (1.) a summary of the Federal Offices' measures to achieve the sectoral adaptation goals as defined in the first part of the strategy, and (2.) an outline of coordinated approaches to tackle the cross-sectoral challenges. The action plan is to be completed by the end of 2013 and is expected to be adopted by the Federal Council in early 2014.

Legal basis for adaptation

The revised CO_2 Act, which came into effect on 1 January 2013, addresses adaptation to climate change in article 8 on coordination of adaption measures (Swiss Confederation 2011). It mandates the federal government to coordinate measures to prevent and cope with damages to people and assets caused by increased greenhouse gas concentrations in the atmosphere, and to ensure that the basis for adaptation are made available. This article serves as legal basis for adaptation activities by the federal government.

6.3.2 Adaptation in the sectors most affected by climate change in Switzerland

Natural hazard management

Natural hazards have always had great significance and far-reaching consequences in Switzerland, because in many parts of the country they pose a major threat to human life, infrastructure and material assets. The increase in the value of infrastructure, settlement expansion in hazordous areas and the impact of climate change all increase the potential devastating effects of existing hazards. The main climate change factors influencing natural hazards are an increase in hydro-meteorological extreme events (frequency and intensity of heavy rainfall) and the effects of higher temperatures.

In the Federal Council's adaptation strategy (Swiss Confederation 2012a), five fields of action for the sector natural hazards management are identified. These fields of action address floods in the Alpine region as well as in the Mittelland and the Jura, torrential processes and gravitational processes in the Alpine region, and impact on the protection forests in the Alpine region.

The lessons learned and findings from the events of the last decades are the basis for current legislation and the "Swiss natural hazards strategy" (PLANAT 2004) of the National Platform for Natural Hazard (PLANAT). Climate change adaptation is explicitly considered in the further development and improvement of the strategy, which provides the basis for a shift in priorities in the future. The strategy of integrated risk management is consistently integrated in order to tackle and overcome the additional challenges resulting from climate change. The alpine strategy for adaptation to climate change in the field of natural hazards (Swiss Confederation and Alpine Convention 2012) is consistent with this approach.

The implementation of the integrated risk management presents a major challenge. Besides ongoing measures, new measures that reduce the potential of damage created by climate change are becoming increasingly important. Additional efforts are necessary primarily in the following areas:

1. Monitoring of natural hazard processes: New processes and their evolution as well as changes in known processes need to be recognized in due time and be closely monitored. Improved weather and discharge forecasts will provide useful data for early warning;

2. Comprehensive knowledge of hazards and risks: Systematic nationwide hazard and risk assessments need to be established on a regular basis. In order to do this, a comprehensive knowledge base needs to be developed. Key elements are updated hazard maps, the development of missing hazard fundamentals and the assessment of the damage potential as well hazards and risks on a national and cantonal level;
3. Protective structures designed to accommodate excess loads: Protective infrastructures need to be designed to accommodate excess loads. The overload case needs to be considered already in the planning phase. Risk based protection goals need to be defined and considered. Constant maintenance ensures the function of the protection infrastructure. In addition to protective infrastructures protection forests need to be constantly regenerated and climate related changes need to be considered and reflected in the selection of tree species;
4. Implementation of land use planning measures: The goals and principles of living with natural hazards have to be defined and implemented on all levels of land use planning. According to the Swiss natural hazards strategy (PLANAT 2004), the creation of new risks needs to be avoid and risk based considerations including climate change scenarios need to be applied in land use planning;
5. Successful response to natural disaster (FOCP 2013): Up to date emergency planning and emergency concepts need to be developed for all cantons and communities. They need to be regularly exercised and adapted to site specific conditions and climate induced changes. The coordination of all parties involved in the management of an emergency situation needs to be ensured. Timely early warnings allow that adequate measures are initiated in time in case of an emergency;
6. Awareness, education and research in the field of natural hazards is improved: House owners, architects, planners, intervention forces and the public need to be trained and educated in the field of natural hazards. The education of local natural hazards advisors ensures that local knowledge is available for the intervention teams in the case of an emergency. Intervention and emergency teams have to be adequately trained in emergency response measures;
7. Analyses of the main events and their response: Extreme events and the subsequent response activities need to be well documented and evaluated on all levels. A harmonized data collection will allow the comparison of the events and interventions in order to ensure a continuous improvement and, if needed, adaptation of the processes.

Weather hazard alerts

The Federal Office of Meteorology and Climatology (MeteoSwiss) is tasked through an established federal legal framework to warn federal agencies, authorities, police forces, civil protection forces and staff organization of the cantons (second organizational level in Switzerland) in case of dangerous weather conditions. The "single official voice" principle for natural hazard warnings, including the weather hazard warnings of MeteoSwiss, is now realized together with other federal agencies (e.g. FOEN). One of the key elements of this legislation is the possibility to issue warnings for a compulsory dissemination via the suitable media (e.g. TV, radio). These warnings are issued in a uniform design with consistent alert levels. Since the awareness of the public to such dissemination is very high, this instrument is used only in extreme and thus rare events.

Biodiversity

The Federal Council's adaptation strategy (Swiss Confederation 2012a) addresses issues on biodiversity in two ways. On the one hand, biodiversity is one of the natural resources such as water; soil and air that is directly affected by climate change (see Fig 95). Therefore, other sectors, e.g., health, agriculture and forestry will have to adapt to these climate induced changes. On the other hand, biodiversity management is one of the selected sectors in the strategy, that are considered particularly affected by climate change and thus, providing a sectoral sub-strategy. The fields of action identified in the sub-strategy on adaption to climate change in biodiversity management cover the whole range from the level of genes (populations) to ecosystems.

Climate-induced migration increases the need to connect habitats and make the landscape permeable. In addition to existing efforts to connect suitable habitats on the same altitudinal range, climate change in a topographically complex country like Switzerland adds the emphasis for improved vertical connectivity. Last but not least, the level of ecosystems, their functions and services are also affected by climate change. Human wellbeing depends significantly on a large number of ecosystem services. In the context of climate change and biodiversity management, priority is given to the regulating ecosystem services that are under pressure as a result of climate change. These include e.g. carbon storage in peat soils and protection against landslides and debris flows by vegetation (root structures, water retention).

Apart from these direct impacts of climate change, adaptation measures proposed by other sectors may imply biodiversity impacts and thus, are at least equally important as the direct impacts of climate change and therefore, need to be considered when these measures shall be implemented.

In parallel to the strategy regarding the adaptation to climate change, a national biodiversity strategy has been elaborated, joined by an action plan. The measures from the action plan of the biodiversity strategy may also improve the adaptation capacity of the biodiversity to a change in climate of a weak scenario. With regard to more pronounced warming scenario, additional measures are being elaborated in the action plan of the adaptation strategy. These measures include the risk assessment of the most sensitive species with regard to climate change. They target the most affected ecosystems, such as aquatic habitats and alpine areas, but also habitat connectivity especially on vertical axes. They also tackle adaptation measures proposed by other sectors, in order to assess and minimize their potential negative impacts on biodiversity.

Forests and forestry

In Switzerland, forests are managed to provide a wide range of goods like high-value timber, and services such as catchment protection, biodiversity conservation, production of clean drinking water and recreation. By storing carbon in living and dead biomass, Swiss forests also contribute considerably to the mitigation of climate change.

The forest ecosystems and the goods and services they provide may be affected considerably by climate change by means of storms, dryness, forest fires or biotic calamities like bark beetle infestations. Compared to the slow processes that take place in forests (forest growth, seed distribution, genetic adaptation etc.), climate change threatens to occur at a rate that overwhelms natural adaptation processes. Important forest products and services such as timber production and protection from natural hazards could be reduced or disappear. This also has an impact on the Swiss forestry and the timber industry which currently employs nearly 80'000 people.

The Federal Council's adaptation strategy (Swiss Confederation 2012a) as well as the Forest Policy 2020 (FOEN 2013f) focus on three forest categories which are considered to be at high risks due to climate change. These fields of action are protection forests in which there is a combination of insufficient regeneration and reduced stability (covering approximately 68'000 ha, Brändli 2010), conifer-rich forests in low-lying areas which are sensitive to wind throw, drought and bark beetle infestations (covering approximately 50'000 ha, Brändli 2010), and climate-sensitive forest sites in the Central Alps and other parts of Switzerland which are drought prone sites or sites with large amounts of dry wood in areas at risk from forest fires (e.g. Ticino, Valais, Grisons) (covering approximately 50'000 ha, Brändli 2010). A further field of action aims at improving the knowledge base. The Swiss government launched the research program "forest and climate change" in 2009 with the objective of giving guidance, to reduce uncertainty in forestry and to develop scientifically based recommendations for adaptive forest management. This program, which is now in its second phase, does have a budget of CHF 8.5 million until 2015. Particular emphasis is laid on the influence of climate change on forest ecosystem services. High importance is attributed to knowledge transfer of the findings on adaptive measures into existing forest management practice.

Adaptation measures are to reduce existing risks, increase the adaptive capacity through carefully planned regeneration and reduce future risks. They aim at the prevention of major outbreaks of bark beetles and other harmful organisms. In addition, the adaptation measures target an appropriate and sufficient regeneration of forests to increase their adaptability and stability, and the conversion of forests to robust mixed forests by introducing an appropriate proportion of adaptable tree species.

Agriculture

Climate change offers agriculture – at least in the medium term – both opportunities and risks. Through pro-active adaptation, agricultural production and other agriculture-related services that serve the public interest should also be guaranteed in the future.

To achieve good production results, crops and animals must be optimally adapted to local climate. Accordingly, this needs to be taken into account when selecting and breeding. How climate change affects pest infestation and control, for example, must be clarified, as well as how the extension of the growing season can be optimally used for crop production. With an increase of hot days, animal farming also requires solutions that enable animal welfare and high performance.

Droughts increase the need for water and restrict the soil's ability to absorb water. Conversely, heavy rains erode arable land. Which management measures (such as adapted tillage, crop rotation or variety selection) can counteract such developments thus must be examined. More frequent periods of water scarcity require careful handling of available water. Water-sparing production systems should therefore be encouraged and new forms of water storage and irrigation developed and propagated.

Which kind of agricultural production is best suited for climatic influences in each location must be more carefully considered in the future. Currently existing data and information sources need to be adapted to create, for example, soil moisture and pest infestation forecasts and regionally differentiated cultivation. The many open questions about the impact of climate change on agriculture as well as existing adaptation options should be addressed in the next few years within the framework of a research and extension campaign. This can raise awareness among all stakeholders.

In the medium term, whether existing insurance policies against weather-related yield losses will be sufficient in the future needs to be clarified. A foundation should be laid for increased use of risk management possibilities (inter-farm collaboration, production planning, storage, diversification, etc.) and for improved availability of information on supply, demand and inventories of agricultural goods.

Energy

Energy supply and demand in Switzerland is affected by climate change in multiple ways. The Swiss Adaptation Strategy (Swiss Confederation 2012a) therefore includes the energy sector as an important area to be taken into consideration. The four main fields of action that have been identified as the most relevant for climate change adaptation in the energy sector are:

- Energy demand for air conditioning and cooling of buildings;
- Generation of electricity from hydropower;
- Generation of electricity from thermal power plants;
- Maintenance and safety of transport infrastructure.

Within these fields of action, several concrete adaptation measures have already been implemented or are being planned on a national level. Among these are:

- Studies and informational campaigns about how buildings can keep pleasant temperatures in a warmer climate while at the same time reducing energy needs for cooling;

- Taking the changing climate into account in supervision and licensing processes for hydroelectric dams and reservoirs as well as for transmission and distribution networks for gas and electricity;
- Examining the need to adjust regulation on the temperature of cooling water released back into rivers.

In terms of hydropower production, recent studies (SGHL and CHy 2011) have examined the expected medium and long-term impacts of climate change for different catchment areas and power plants. These analyses are to be updated and elaborated on a regular basis as more refined climate modeling results become available. Besides taking into consideration the risks that changing hydrological patterns present, the opportunities, such as the hydroelectric potential of newly forming glacial lakes, are also being examined.

In general, the following climate change adaptation goals have been defined for the generation of electricity from hydropower:

- Securing the contribution of hydropower to maintaining the security of electricity supply;
- Making optimal use of hydropower potential under changing hydrological and water management conditions;
- Where necessary, establishing federal-level safety monitoring of new climate-related risks (e.g. due to thawing of the permafrost).

Health

Climate change poses similar risks to human and animal health and requires similar measures to minimize these risks. That is why the Swiss adaptation strategy deals with the impacts of climate change on both, humans and animals. The focus is put on three fields of action requiring adaptation to climate change:

- Vector-borne diseases (humans and animals): Climate change fosters the emergence of new pathogens as well as their hosts and carriers (vectors). This increases the risk of new infectious diseases in humans and animals, which can spread rapidly and are sometimes difficult to treat;
- Effects of heat (humans and animals): Heatwaves can lead to cardiovascular conditions, dehydration, overheating and impaired performance. Summer heat increases ozone levels, which causes respiratory ailments and impairs lung function;
- Food- and water-borne diseases (humans): Infectious germs in water and food, in particular in dairy and meat products, thrive at higher temperatures.

The former two fields of action are addressed with the following adaptation measures:

- Updating the recommendations to the health care services and the public on adapted behavior during heat waves on the basis of new scientific results;
- Providing a guideline to cantonal and local health care services on how to deal with long lasting heat waves;
- Improving and coordinating monitoring systems for vector borne diseases, potential vectors, and infectious animal diseases.

No additional measures will be implemented for food- and water borne diseases. The existing measures, i.e., water treatment and food control, are expected to be effective in dealing with a potential increase in food- and water borne diseases due to climate change.

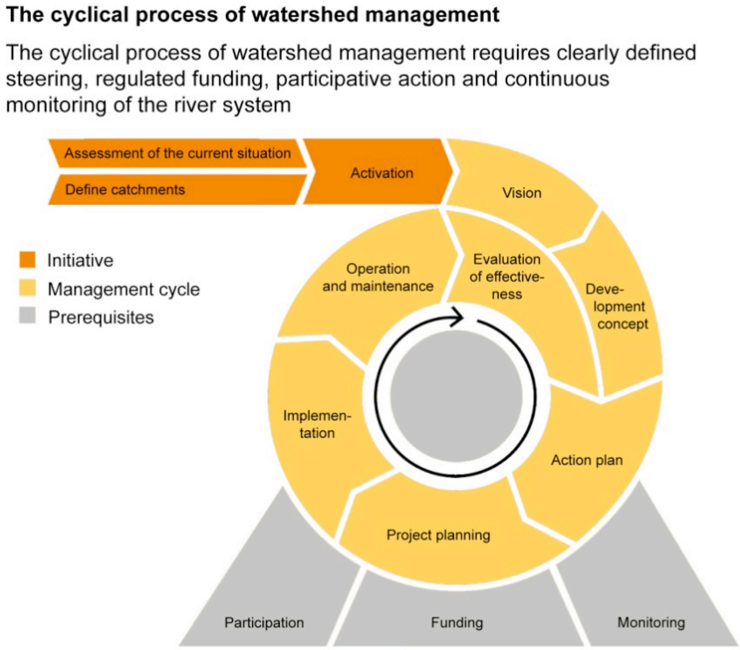
Water Resources Management

Due to the fact that Switzerland actually abstracts only about 5% of its annual precipitation for all water use purposes, water quantity is not the limiting factor for the adaptation strategy in the water management sector, even if the changes may turn out to be more severe than today's projections suggest. It is the change in the hydrological regimes, the rise in water temperature combined with water quality aspects and the increase of extreme events that need attention. Thus, with the support of expert judgment eight primary and (another) six secondary fields of action were identified (Swiss Confederation 2012a). The measures of these fields of action contribute to cope with the most important cross-sectoral challenges provided by climate change, such as increasing levels of summer drought, increasing risk of flooding, the rising snow-line and impacts on the water quality (6.3.1). The measures aim at

1. providing adequate space for rivers as well as to restore rivers in order to attenuate flood situations and to improve the ecological status of rivers;
2. developing new concepts for the storage and distribution of water in order to adjust to the changing hydrological regimes and to fulfill the needs of the society, the economy and the ecology;
3. bringing forward regional collaboration of water supply and waste water treatment in order to avoid shortage and water quality deterioration during low flow conditions;
4. developing new technologies for cooling water use (e.g. for thermal power plants) in order to be prepared for an additional rise in temperature in the river networks;
5. checking and if necessary adapting the legislative basis in the field of water in order to meet the future challenges; and finally
6. enforcing the implementation of transboundary water management in order to avoid interest conflicts in international river basins downstream Switzerland.

From a water management point of view drought situations which are projected to expand both on a spatial and temporal scale need most attention. Recently the Federal Council has agreed on a report which defines a strategy to handle droughts in Switzerland (FOEN 2012c). This strategy recommends the cantons in a first step to identify regions with a risk for droughts. In these regions the cantons can then either introduce a strategic planning process (considering the availability and the use of the water resources) or implement a river basin management as it is defined in the Guiding Principles for Integrated Management of Water in Switzerland (Water Agenda 21 2011). Management is understood here as a cyclical process of planning, implementation and monitoring processes based on long-term goals (see Fig. 96). With regards to extreme events, prevention and emergency planning is essential especially for water suppliers. Therefore the usefulness of an early warning system for droughts is examined and an improved availability of soil information is aimed at. What concerns water demand, the efficient use of water in all sectors, e.g. for irrigation purposes, must be promoted.

Fig. 96: Cyclical process of watershed management.



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Further scientific findings and recommendations to practitioners are expected as an outcome from the National Research Program No 61 "Sustainable Water Management" (NRP 61), which will be published in 2014 (*www.nfp61.ch*). Since the program started in 2010, this program has developed scientific foundations and methods for sustainable management of water resources, which are under increasing pressure. NRP 61 determined the effects of climate and social changes on these resources and identified the risks and future conflicts associated with their use. Those research projects covering the most important sectors of water management have developed strategies for ensuring sustainable and integrated water resources management in the future.

On January 2011 the revised Waters Protection Act (Swiss Confederation 2012b) came into effect. Beside new regulations to restore negative impacts of the hydropower production, the revised Act aims at rehabilitating the water bodies and at stipulating the spatial requirements for surface waters in order to safeguard the natural functions of the waters, flood protection and waters use. It was decided that 25% of the water courses (4'000 km) currently in a bad ecological status are to be rehabilitated. The new legislation can be seen as an important contribution towards adapting to climate change in the field of flood risk management.

Tourism

Adapting to climate change is one of the most important challenges for Switzerland as a tourist destination (The Swiss Federal Concil 2010). Tourism involves many aspects of life and the economy, which is why climate change has such a wide range of direct and indirect impacts on the tourism sector. Three central fields of action requiring adaptation to climate change have been identified (Swiss Confederation 2012a) based on the most important impacts of climate change on Swiss tourism (Universität Bern 2011). These fields of action are the development of tourism supply, hazard minimization, and communication. The identified adaptation measures within the fields of action, refer to the repositioning of summer tourism as well as safeguard and development of winter sports. In addition, they correspond to information and knowledge gaps related to climate change adaptation and tourism which are to be identified and addressed, among others by means of an online knowledge platform on climate change adaptation and tourism. These adaptation efforts aiming at the development of tourism supply, minimization of hazards and communication should help Switzerland to remain an attractive and successful tourist destination and to exploit its exceptional potential as a travel destination in the long term.

The 2012-2015 implementation programme on growth strategy for Switzerland as a tourism destination will focus on adapting tourism to climate change. This will include clarifying the roles of the various private and public stakeholders. The tourism sector itself will have a key role in adapting to climate change. The options of the federal government are based on the newly designed tourism policy, tourism policy goals and the relevant legal bases for tourism policy.

6.3.3 Support of the implementation of the adaptation strategy

The FOEN promotes and supports the implementation of the Federal Council's adaptation strategy (Swiss Confederation 2012a) with - among others - an information platform and a pilot program to initiate adaptation on the local and regional levels.

Information platform on adaptation to climate change

After the adoption of the Federal Council's adaptation strategy in March 2012, an internet based information platform on adaptation to climate change in Switzerland has been launched. The platform, which is operated by FOEN and integrated into the FOEN website as a separate sub-page (www.bafu.admin.ch/klimaanpassung), shall

- summarize and provide relevant information on climate change adaptation in Switzerland oriented towards end user needs;
- sensitize target groups for climate change impacts, vulnerability and adaptation requirements;
- inform decision making and capacitate stakeholders for sustainable adaptation measures in line with the goals and principles laid down in the National Adaptation Strategy; and
- enable and foster exchange of information and experiences, networking and cooperation across horizontal and vertical governance levels.

The platform addresses primarily responsible policy makers and administrative bodies from national to local level. Further target groups are associations, networks and experts that are engaged in adaptation activities. With this focus, the platform complements existing Swiss web portals on climate change (9.3) such as *www.proclim.ch* («Forum for Climate and Global Change», aiming at the scientific community) and *www.climate-change.ch* («Klimaportal», aiming at the public, teaching staff, students and media).

Detailed information is provided on the Federal Council's adaptation strategy, approaches of the cantons, specific adaptation activities (research programs, projects, practical measures), relevant publications and administrative responsibilities within. The sectors covered are, corresponding to the national strategy, water management, natural hazards management, agriculture, forestry, energy, tourism, biodiversity management, health and spatial management. Contents are updated and extended periodically.

In addition to the web based approach, knowledge transfer and networking is also accomplished increasingly in the frame of workshops and conferences with various stakeholders, concerning either particular sectoral issues or geographic regions. Furthermore, tailor made information products are under construction and planned respectively (e.g. fact sheets, guidelines, tools).

Pilot program Adaptation to climate change

As climate change adaptation is still a relatively new issue, practical activities and experiences on regional and local level are widely lacking. Therefore, the «Pilot program adaptation to climate change» was set up by several Federal Offices under the leadership of FOEN as a national funding initiative to support cantons, regions and municipalities in tackling climate change related challenges. The program's goals are

- to contribute to putting the National Adaptation Strategy into practice;
- to raise awareness for climate change adaptation in cantons, regions and municipalities;
- to trigger and implement innovative, cross-sector pilot projects;
- to capitalize climate change related opportunities, minimize risks, and increase adaptive capacity in the pilot areas; and
- to enhance vertical and horizontal cooperation, as well as to initiate and foster exchange between cantons, regions and municipalities.

After a one and a half year preparation phase, a call for projects was opened in March 2013. In a two-stage application phase, cantons, regions and municipalities as well as research institutions, associations and private enterprises can submit project ideas for five clusters:

- management of local water scarcity;
- management of natural hazards;
- management of ecosystem and land use changes;
- resilient urban development; and
- knowledge transfer and governance.

Eligible project types are analyses and planning, development of strategies, concepts and tools, applied research as well as information, communication and formation activities. It is assumed that with the financial resources available (budgets of the participating Federal Offices), approximately 25 projects can be approved. Project start is scheduled for 2014, termination until end of 2016. The pilot program concludes in 2017 with a synthesis and dissemination phase.

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7 Financial resources and transfer of technology

The Swiss Federal Constitution stipulates that Switzerland is committed to the long term preservation of natural resources and to a just and peaceful international order. Furthermore, it states that Switzerland shall in particular promote sustainable development and protect the natural resource base in view of alleviating poverty in the world. Support for international climate action – through a variety of channels and instruments, such as dedicated multilateral climate funds, specific multilateral and bilateral climate programs, as well as integrating low carbon development and climate resilience into Switzerland's development assistance – has thus been a corner stone of Switzerland's international policy since the early 1990s. Regarding international climate financing, three government entities - the Swiss Agency for Development and Cooperation (SDC), the State Secretariat for Economic Affairs (SECO), and the Federal Office for the Environment (FOEN) – have specific roles and dedicated budgets. They cooperate closely to assure the overall effectiveness and coherence of Swiss support for climate change adaptation and mitigation activities in developing countries and countries in transition. Since 2012, the three Swiss agencies coordinate their acitivities within the new joint platform PLAFICO, which associates other federal government offices as needed. Through a mandate by the Swiss Federal Council, all matters related to international environment finance and development cooperation are coordinated in this new platform, whose coordination rotates annually among the three offices. All three institutions have made structural adjustments and reorganizations to better respond to the increasing challenges related to climate change. Cooperation and coordination within the government and non-government stakeholders was considerably strengthened in recent years.

Building on decades of climate-relevant operational experiences in developing countries in energy efficiency, renewable energy, agriculture and forestry, land-use planning, disaster risk management and technology transfer, Switzerland has been playing an active role since the beginning of international climate policy. In its contributions in international climate change negotiations, process and funds, Switzerland emphasizes fair and equitable burden sharing and the creation of conducive and binding political framework conditions for low carbon and climate-compatible development. Through its multilateral and bilateral cooperation and its membership in the governing bodies of multilateral institutions (such as MDBs, GEF, GCF, AF, UN agencies, etc.) Switzerland aims for increased coherence in the design and implementation of climate-relevant policies, strategies and actions to promote synergies and multiple environment and development benefits. It operates through multiple partnerships at the multilateral, national and local levels. Withing its bilateral development cooperation Switzerland supports activities in mitigation and adaptation in a number of focal countries/ regions (refer to sections 7.2, 7.3 and 7.4 for further details).

SDC contributes to climate-compatible development by supporting innovative actions, policy development, knowledge generation and sharing and climate-relevant disaster risk management. Established in 2009, SDC's Global Program Climate Change – GPCC - is an important driver for these themes. GPCC promotes the integration of low-carbon and climate-compatible development throughout and beyond SDC's focal countries. It maintains an agency-wide network for this purpose, whose membership also includes external stakeholders. Furthermore, within their multilateral program GPCC contributes to some specialized international climate funds such as the Adaptation Fund, and the GFDRR. SDC manages approximately 57 % of the Swiss international climate change specific funds[15] from ODA.

SECO's Economic Development Cooperation operates through four branches: Macro-economic support, private sector development, trade promotion and infrastructure financing. Since 1992, SECO has been pioneering innovative modalities of technology transfer. To this end, SECO has partnered with the World Bank, multilateral development banks, UNIDO, UNCTAD, ITC, ITTO and other specialized organizations, including from the Swiss private sector. SECO's programs benefit from the rich experience of Swiss re-

[15] A proportion of Switzerland's core contributions to multilateral organizations may be allocated to climate change specific activities. The exact amount can not be reliably assessed. Therefore the hereby calculated share in public climate change specific funds does not include the Swiss core contributions to multilateral organizations.

search institutions and technology suppliers regarding environmentally sound technologies. SECO is continuing its engagement as built up in the last decade, including its support to the development of REDD+ (Reducing Emissions from Deforestation and Forest Degradation). SECO manages approximately 31 % of the Swiss international climate change specific funds from ODA.

FOEN is in charge of national and international climate change policies and measures – including the policy development on international climate finance and the multilateral climate change negotiations in UNFCCC (including climate finance, related committees and processes). In international climate finance FOEN is particularly engaged in policies related to the overall cimate finance architecture, innovative sources of funding, the overall resource mobilization strategy and MRV[16] systems of support. In addition, FOEN is responsible for the Swiss contribution to the GEF, including its climate change subfunds LDCF and SCCF. In this role it aims to assure that the GEF is responding to the guidance received by the COP. FOEN manages approximately 12 % of the Swiss international climate change specific funds from ODA.

In February 2011, the Swiss Parliament decided to increase the level of ODA to 0.5% of GNI by 2015. This decision took into consideration the need for Switzerland to honor its UNFCCC Fast-Star-Finance commitment. New and additional resources were provided to SDC to expand its climate-related technical cooperation and financial assistance for developing countries, and to SECO to expand its support for economic, investment, and trade policy measures in the context of climate change and development cooperation. Against the international trend, Switzerland was able to significantly increase its ODA in 2011 and 2012. It rose from 2'400 million Swiss francs in 2010 (0.39% of GNI) to 2'700 million Swiss francs in 2011 and to 2`800 million Swiss Francs (0.45% of GNI) in 2012.

All financial resources reported in this chapter (see chapter 7.5) relate exclusively to financing from public sources attributable to ODA and they have all been provided in the form of grants (no loans). The current Swiss public investments for climate change adaptation and mitigation measures can be found in Tab. 40 and Tab. 41. The Cancun decision of the UNFCCC refers to a variety of sources including the private sector[17]. As a leading clean technology export nation, Switzerland is certain to also have very significant levels of climate finance from private sources. Efforts are currently underway to quantify potentially eligible private climate finance flows for future reporting purposes. Initiatial studies point to very large potential amounts, while highlighting the definitional difficulties (Stadelmann and Michaelowa 2013).[18]

7.1 Multilateral activities

Switzerland has made financial contributions to the UNFCCC Secretariat, to multilateral institutions such as the Global Environment Facility (GEF) and to international financial institutions (IFIs) that fund climate change adaptation, mitigation, disaster risk management and technology cooperation programs in developing countries, such as the World Bank and other MDBs. Among the IFIs, the largest contributions goes to IDA, a substantial share of which is allocated to finance climate change action. Moreover, many international organizations, such as UNDP and CGIA, whose operations are co-funded by Swiss core contributions are increasingly generating important climate benefits.

Tab. 40 indicates Switzerland's contributions to these multilateral institutions, organizations and associated programs. Switzerland also cooperates with a number of multilateral institutions as implementing agencies of bilateral and regional programs and projects. The funds invested in those specific programs are included in Tab. 41.

[16] Measureable, reportable, verifiable
[17] See also SCD/SECO/FOEN: Final Report Swiss Fast-Start Finance, Bern, May 2013. http://unfccc.int/files/cooperation_support/financial_mechanism/fast_start_finance/application/pdf/swiss_fsf_final_report_2013.pdf
[18] Stadelmann and Michaelowa: Contribution of the private sector to Climate Change Long-Term-Finance: An assessment of private climate finance mobilized by Switzerland. Final report commissioned by the Swiss Federal Office for the Environment (FOEN), Bern, March 2013

Global Environment Facility

The Global Environment Facility (GEF) addresses global environmental issues while supporting national sustainable development initiatives. The GEF provides support – mostly in form of grants – for projects related to climate change, biodiversity, land degradation, forests, the ozone layer, persistent organic pollutants and international waters. Switzerland has been contributing to the fund since its inception 1991. To the GEF's fifth replenishment (2010-2014) Switzerland contributed 124.8 million Swiss francs. Besides the 32% of funds allocated for the climate change focal area in GEF-5, including mitigation and adaptation measures, capacity building and technology transfer, the GEF incorporates climate change into broader programs, which address the cross-cutting challenges of land degradation, biodiversity, chemicals management and international waters.

Least Developed Country Fund and Special Climate Change Fund

The GEF also features two dedicated climate change funds under the UNFCCC:i.e. the Least Developed Country Fund (LDCF) and the Special Climate Change Fund (SCCF).

The LDCF was established to address the special needs of the Least Developed Countries under the Climate Convention. The LDCs identified adaptation as their top priority, which is why the LDCF is so far the only existing fund whose mandate is to finance National Adaptation Programs of Action (NAMAs). The SCCF was established to support adaptation and technology transfer in all developing country parties to the UNFCCC. Switzerland committed itself to payments to the Special Climate Change Fund (SCCF) and the Least Developed Country Fund (LDCF) on the basis of an emissions-based burden sharing formula. Between 2009 and 2012, Switzerland contributed a total of 6.65 million Swiss francs to the LDCF and the SCCF.

Adaptation Fund

The AF was established to finance concrete adaptation projects and programs in developing countries that are parties to the Kyoto Protocol and are particularly vulnerable to the adverse effects of climate change. Financing for the Adaptation Fund comes mainly from a 2% levy on certified emission reductions of the Clean Development Mechanism defined in the Kyoto Protocol and other market-based mechanisms of the convention. In addition the fund receives voluntary contributions from governments, the private sector and individuals. Between 2009 and 2012 Switzerland provided supplemental contributions of 3.4 million Swiss francs to the Adaptation Fund.

Climate Investment Funds

The Climate Investment Funds (CIFs) support transformational, scaled-up climate action that leverages additional finance from the private sector and multilateral development banks to achieve significant climate and development outcomes. The CIFs support mitigation, adaptation, and technology transfer activities and are composed of the Clean Technology Fund and the strategic Climate Fund with its three programs: the Forest Investment Program, the Pilot Program for Climate Resilience and the Scaling Up Renewable Energy in Low Income Countries Program.

From 2010 to 2012 Switzerland contributed 23.46 million Swiss francs to the Scaling-Up Renewable Energy Program (SREP) for Low Income Countries. The SREP focuses on climate change mitigation and currently supports eight pilot countries (Ethiopia, Honduras, Kenya, Liberia, Maldives, Mali, Nepal and Tanzania).

Global Facility for Disaster Reduction and Recovery

GFDRR is a growing partnership among contributing and recipient countries and several international organizations hosted by the World Bank since 2006, with the mission to mainstream disaster risk management and climate adaptation into development strategies. About 40% of GFDRR funds are allocated to Sub-Saharan Africa. The facility carries out a range of activities to support countries to build resilience, structured around five pillars of action: (1) risk identification; (2) risk reduction; (3) preparedness; (4) financial protection; and (5) resilient recovery. Working as a grant-making facility, GFDRR supports countries to develop capacity, generate new knowledge, and apply it to policy reforms and investments for disaster risk management (DRM). From 2009 to 2012, Switzerland has contributed 2.5 million Swiss francs to the GFDRR.

7.2 Bilateral and regional activities

Next to the important multilateral engagement, the direct bilateral programs with selected focal countries and regions build a key element of Swiss Development Cooperation. Switzerland works closely with bilateral partners to deliver effective global responses to climate change. All programs and projects are implemented by one of the two Swiss development agencies, SDC and SECO, in close cooperation with government institutions, non-governmental organizations, private sector entities and research institutions. In its bilateral program Switzerland aims at generating new and relevant knowledge, leveraging successful experiences and supporting the policy processes in the partner countries and their engagement in the multilateral dialogue.

The climate change activities of SDC focus on four key intervention areas: (1) forest and land use, (2) energy, (3) vulnerability and adaptation, and (4) mitigation of greenhouse-gas emissions. In total SDC spent from 2009 to 2012 268.6 million Swiss francs for bilateral and regional programs in climate change. Additional 23.7 million Swiss francs were provided for humanitarian aid interventions as direct adaptation response measures to natural disasters. Further details are shown in Tab. 41.

Through SECO, Switzerland is helping to combat the causes of climate change and is fostering climate-friendly growth in its partner countries by promoting modern technologies and approaches as well as new market and financing mechanisms. The various projects and programs of SECO focus on the three business lines: (1) energy efficiency and renewable energy sources, (2) sustainable management of natural resources, (3) framework conditions and new market and financing mechanisms. SECO provided 158.64 million Swiss francs between 2009 and 2012 for its global, regional and bilateral programs and projects to foster climate-friendly growth[19].

7.3 Adaptation

Switzerland has undertaken a broad range of activities to promote climate resilient development especially in the most vulnerable developing countries. It seeks to create awareness on adaptation at different levels, such as at international and national policy level, sector level and at local level. Switzerland's overall goal in adaptation is to support developing countries in reducing their vulnerability to unavoidable climate change and minimizing the social and economic costs by:

- Maintaining or increasing productive capital of land (forest, agriculture) at local level;

[19] This amount includes 2.52 million Swiss francs spent on climate-related projects in the new EU member states through its enlargement contribution.

- Reducing vulnerability to natural hazards in highly endangered areas at the local / regional level;
- Support countries in defining their national and sub-national adaptation strategies and plans;
- Increasing technology transfer and innovation in the field of adaptation in developing and middle income countries.

Likewise, countries with important leverage potential are supported in their strategic approach to Climate Change Adaptation, to draft their policies, and to enter into South-South learning processes.

Climate Change represents a major global challenge and a potential threat to human welfare, economic and social development and to the fight against poverty. Management of natural resources is not only at the heart of the fight against poverty (agricultural and forest production, soil moisture regime, bio-mass for energy) but also helps to prevent climatic risks (droughts, extreme weather events, loss of life and infrastructure) and foster climate resilient and low carbon growth. Emphasis is given to linking climate change adaptation activities with efforts on prevention and disaster risk reduction. Switzerland has been active for many years in disaster risk reduction and has developed methods and tools to better integrate disaster risk reduction into project planning and project management[20]. In total Switzerland provided 205.9 million Swiss francs between 2009 and 2012 specifically for adaptation, including support to multilateral funds, as well as regional and bilateral projects.

Through its bilateral, regional and multilateral development cooperation Switzerland supported multiple climate change adaptation related projects, such as the Climate Change Adaptation Program Peru (Tab. 37) and:

- Adapting to Climate Change in China (ACCC): ACCC is focusing on linking climate change research with policy making and development. ACCC started in June 2009 as a collaboration between UK, China and Switzerland; the purpose of the project is to develop Climate Science in China, Assessing Impacts, Risks and Vulnerability in three different provinces, understanding Risk in Development Planning, Awareness and Capacity Building, and sharing knowledge and experience with other countries. The project, until 2013, was tackling the sectors Agriculture, Grasslands, Health, Disaster Risk and Water. The ACCC project laid the groundwork allowing for the formulation, and recent approval, of the National Adaptation Strategy of the People's Republic of China.
- CLIMANDES (Servicios CLIMáticos con énfasis en los ANdes en apoyo a las DEcisioneS): With a newly established training centre, CLIMANDES is strengthening climate services in Peru for professionals and students trained in meteorology and climatology. High-quality weather and climate information will provide government agencies with a strongly improved basis for decision-making. International exchange is taking place through the WMO, and regional outreach supported by the collaboration with neighbouring National Meteorology Services.
- Bank study "Economics of Adaptation to Climate Change": The overall objective is to help decision makers in developing countries better understand and assess the risks posed by climate change and to better design strategies to adapt to climate change. This USD 8 million study is being financed by the Governments of the UK, the Netherlands and Switzerland and consists of a 'global track' and a set of seven country studies.
- Commodity Risk Management Group (CRMG) of the World Bank: It co-funds pilot projects on weather insurance for farmers. Those insurance products are developed according to pre-disaster analysis and index development that is the reference or baseline when weather fluctuations occur (drought, floods). Payments to farmers are triggered by specific patterns of the index, not by actual yields. Therefore weather indexed risk management products are considered as a new alternative to traditional crops insurance programs. It reduces the occurrence of moral hazard and adverse selection.
- Technical assistance for Disaster Risk Financing and Insurance (DRFI): The program implemented by the World Bank aims at reducing the financial vulnerability of states to natural disasters by improving

[20] For further information see:
http://www.sdc.admin.ch/en/Home/Themes/Disaster_risk_reduction_emergency_relief_and_reconstruction/Disaster_Risk_Reduction

their financial response capacities in the aftermath of natural disasters while protecting their long term fiscal balances.

Tab. 37 > Climate Change Adaptation Programme Peru

Project / programme title: Climate Change Adaptation Programme Peru (PACC)			
Goal: Support Adaptation to Climate Change in the Peruvian Andes.			
Recipient country	Sector	Total funding	Years in operation
Peru	Adaptation	CHF 10.5 thereof fast-start financing: 1.88Mio	2009-2016
Description: The programme consists of the following four components: (1) Government entities scale-up adaptive responses through evidence-based public policy, generating inputs for the global dialogue (2). Regional and Local Governments of Apurímac and Cusco implement adaptation strategies effectively and in an articulated manner (3) Rural Andean populations in prioritized areas, strengthen innovative and adaptive responses, providing evidence that is useful for decision-making on public policy (4) The universities of Cusco and Apurímac generate applied research and train professionals that meet regional demands for managing climate change adaptation.			
Expected added value of the programme: • Alignment with the National Climate Change Strategy. • Linking operational level with policy level: Research results and best practices generated are shared with the authorities in order to stimulate policy dialogue and promote policy framework setting; • Demonstration of best practices related to Adaptation in mountain regions; • Establishment of partnerships between Peruvian and Swiss Research Institutes; • Dissemination of best practices			
Technology transferred: Switzerland contributes to the reduction of climate change vulnerabilities of the disadvantaged population in rural highland areas, by capitalising on available local knowledge, and by providing an instrument that enables the transfer of relevant Swiss expertise useful for this purpose.			
Impact on Government Targets: The Ministry of Environment (MINAM) has proposed a new National Climate Change Strategy which aims at mainstreaming adaptive action into various sectors and develops actors´ capacities at different levels. The implementation of these policies and programs requires basing on solid evidence that can demonstrate the relationship between action and its impact on poverty reduction. PACC contributes with concrete actions to the implementation, and further improvement of the strategy, on the other hand, public policies provide a favourable environment for the scaling-up effective adaptive practices nationally and in other sectors as subsistence agriculture and spheres as public investment.			
SDC			

7.4 Mitigation and transfer of technology

Under the Swiss foreign policy on energy of 2008 (renewed in 2012) the Swiss Federal Council has mandated the relevant ministries (1) to increase their engagement regarding promotion of renewable energy and energy efficiency in the programs of development cooperation; (2) to foster public private partnerships for sustainable energy projects; and (3) to increase relevant contributions to multilateral development banks.

In line with this decision, Swiss development cooperation work on climate change mitigation is a cross-cutting issue. The focus is on access to modern energy infrastructure, including renewable energies, rural electrification, energy efficiency in the industry and in the buildings/construction sector, and reducing deforestation. In addition, the activities within the Swiss development cooperation focusing on the reduction of greenhouse gas emissions also tackle clean air policies and the mitigation of black carbon emissions. Overall Switzerland provided 245.0 million Swiss francs between 2009 and 2012 for climate change mitigation activities.

Switzerland has deepened its inter-ministerial coordination through a number of institutional arrangements. One is the interdepartmental platform Renewable Energy and Energy Efficiency Promotion in International

Cooperation[21]. Besides enhancing knowledge and coherence, REPIC offers seed money and technical advice for promising climate change initiatives, during the pre-competitive phases of project development, for technology and market testing. In Ethiopia for example, REPIC funded the testing of 500 innovative solar home systems which provide sustainable energy supply in remote villages.

Mitigation in developing and emerging countries

Promotion of renewable energy, energy efficiency, sustainable land management and forestry has been a priority for Swiss development cooperation since 1992. With its new Global Program Climate Change, Switzerland is intensifying its efforts in these areas, under a dual objective of poverty alleviation and climate change mitigation, while integrating issues such as clean air and sustainable forestry into the strategic priorities.

The overall goal of Switzerland's Global Program Climate Change in mitigation is to support developing and threshold countries in following a sustainable development path with low greenhouse gas emissions and therefore becoming less dependent on fossil fuels. This shall be achieved by focusing on:

- Policy dialogue with authorities and investors in the field of energy efficiency, air pollution control and climate change mitigation;
- Increasing technology transfer and innovation in developing and threshold countries in the field of mitigation;
- Facilitating and consolidating long-term energy supply in rural areas with a focus on locally available renewable potentials (mainly biomass and small hydro);
- Promotion of fuel-switching and energy savings through efficiency measures in selected small scale industries, including through targeted South-South know-how-transfer;
- Reducing emissions in general, and from deforestation and land degradation at the local level in particular.

Technology transfer is recognized as an important means to provide adequate modern energy services for economic development and poverty alleviation without creating adverse environmental effects.

As far as energy efficiency in buildings is concerned, Switzerland has developed leading technological and scientific expertise. A transfer of this knowledge to developing and emerging countries makes it possible to save large amounts of energy thereby reducing considerably the amount of emissions in this sector, while yielding important economic savings to energy users.

Through its bilateral and regional development cooperation Switzerland supported multiple climate change mitigation related projects, such as the South Africa Energy Efficient Building Programme (Tab. 38), the Green Building Code Colombia (Tab. 39) and the following:

- Minergy in India: SDC supports, since 2011 a building efficiency programme in India in partnership with the Indian Ministry of Power. The programme has supported the development of building material testing capacities for energy efficiency. The programme supports the development of standards on residential buildings regarding energy efficiency in collaboration with the Swiss label Minergie. The Minergie label is in the process to be adapted to the Indian context. The interventions are estimated to lead to energy savings of up to 40% per building.
- Diesel Particle Filters to reduce Black Carbon Emissions: The clean air project in Santiago de Chile supported retrofitting urban public transport buses with diesel particle filters. The project leads to a reduction in black carbon emissions of 27 tons per year in 2010 and contributed to the elaboration of clean air legislation in Chile. The estimated black carbon emission reduction of the intervention by 2018, when legislation is fully implemented, is 85 tons per year, corresponding to roughly 1.8 million tons CO_2

[21] For further information see: *www.repic.ch*

equivalents over 20 years. The experience from Santiago will now be replicated through SDC's new Climate and Clean Air in Latin American Cities Programme that will contribute to the implementation of an ambitious public transport retrofitting program in Bogota. The creation of a city alliance comprising interested metropolises on the continent offers the possibility to further roll out experience in the future. Experiences in Latin America are also supporting a similar action in China.

Tab. 38 > Energy Efficient Building Programme South Africa

Project / programme title: Energy Efficient Building Programme South Africa			
Goal: To contribute to the reduction of CO_2 emissions and the alleviation of energy poverty in South Africa. Purpose: To contribute to a significant reduction of energy consumption in the building sector through enhanced energy efficiency in the full building life cycle.			
Recipient country	Sector	Total funding	Years in operation
South Africa	Building	CHF 16 million	2008 - 2013
Description: The programme consists of the following three components: Setting, enforcement and monitoring of the policy framework (strategies, regulations, standards, fiscal tools); Building capacities and develop skills of builders, architects, engineers, labs, institutions, municipalities and others in the area of energy efficient buildings; Implementation of projects to demonstrate energy efficiency a) in the production of building material (bricks), b) by the design and the construction of the building and c) by the use of energy efficient basic equipments and behaviour during the rest of the building lifecycle. Strategic partners at the national level are the Department of Minerals and Energy, the Department of Housing, and the Department of Environment and Tourism. The programme also closely works with training and research institutions and the private sector.			
Expected added value of the programme: Alignment with the National Energy Efficiency Strategy; Linking operational level with policy level: Research results and best practices generated under component two and three are shared with the authorities in order to stimulate policy dialogue and promote policy framework setting; Demonstration of best practices in the production of building material and use of energy efficient equipment; Promotion of South-South Know-how and Technology Transfer; Establishment of partnerships between South-African and Swiss Research Institutes; Dissemination of best practices developed in South Africa to other South African countries (outreach).			
Technology transferred: Introduction of energy efficient technology of the brick sector (Vertical Shaft Brick Kiln) developed in India and Nepal to South Africa; Transfer of Know-how regarding the production and use of energy efficient materials and technology in the construction of buildings through establishment of partnerships among South-African and Swiss Research Institutes; Capacity and skills Development of workers of the building sectors.			
Impact on greenhouse gas emissions/sinks: The programme will contribute to reach the government's target of a final energy demand reduction of 10% for the residential sector and of 15% for the commercial and public building sector by 2015.			
SDC			

Tab. 39 > Green Building Code Colombia

Project / programme title: Green Building Code Colombia			
Goal: To contribute to the reduction of CO_2 emissions and the conservation of natural resources in Colombia. Purpose: To promote energy efficiency and water conservation during the use of buildings in a cost-effective way			
Recipient country	Sector	Total funding	Years in operation
Colombia	Building	USD 1.6 million	2011 - 2015
Description: The programme consists of the following three components: I) the design of a national Green Building Code that will establish sustainable standards to be applied by developers and municipalities nationwide; (II) capacity building within the construction related public and private sector, and (III) an adequate national communication strategy so as to build knowledge on the supply side (construction material companies and builders) and demand side (real-estate owners and tenants). Strategic partners at the national level are the Ministry of Environment, Housing and Territorial Development and the construction sector.			
Expected added value of the programme: - Introduction of a Green Building Code in the national regulatory framework - Strengthen implementation capacities of national stakeholders - Strenghten awareness raising on green building isses			
Technology transferred: not applicable			
Impact on greenhouse gas emissions/sinks: Reduction of GHG emission will only be measurable after the implementation of the code, which is currently in the process of being approved.			
SECO			

Multiple Benefits of Forestry

Switzerland's activities in the field of sustainable management of soil or forests do not focus exclusively on emission reductions effects, but tend to yield multiple environmental, economic and social benefits. Better management of natural resources is not only a vector for mitigation but is at the heart of the fight against poverty. At a global scale, deforestation is responsible for up to 20 percent of global annual green house gas emissions. Tropical forests are of eminent importance in the fight against climate change, in particular mitigation, but also adaptation to climate change. Carbon capture, water regulation, soil conservation, the prevention against natural disasters and preservation of biodiversity are among the most pressing issues. Next to their criticical role for climate change mitigation and adaptation, forests also bring multiple social benefits, such as food and shelter and access to economic resources for the surrounding communities.

Through its bilateral, regional and multilateral development cooperation Switzerland supported multiple sustainable forest management and climate change related projects, such as:

- Forest Carbon Partnership Facility (FCPF): Through the FCPF at the World Bank, Switzerland supports for instance the development of REDD+ and thus preparations for a results-based payment scheme to sustainably manage and protect forests as important carbon stocks and sinks. Likewise, Switzerland is involved in initiatives seeking to establish sustainability standards for renewable resources (e.g. soy, cotton, biofuels), some of which are important drivers of deforestation.
- Indigenous People and Climate Change: In countries like Laos and Vietnam, the recognition of the rights and interests of ethnic groups is a complex matter. Indigenous people are often excluded from consultative processes on sustainable forest management. Building the capacities and modalities for a partnership between indigenous communities, civil society organizations, government agencies, and donors will pave the way for inclusive development and implementation of rights-based, equitable and pro-poor forestry strategies. The aim of the project is that national strategies take into account long-term forest conservation goals and the rights and concerns of indigenous peoples/ethnic minorities.
- Regional Forests and Climate Change: The program aims to reduce the vulnerability to Climate Change of Andean forest ecosystems and of people that depend on them, by strengthening the linkages between Adaptation and Mitigation, within the framework of sustainable ecosystem management. With the un-

derlying aim to improve livelihoods of communities depending on Andean forests, the programmes' objective is to address the existing gap of knowledge and know-how to integrate Andean forests biomes to help to adapt to Climate Change and to mitigate GHG emissions in an integral way.

Mitigation for sustainable growth through technology transfer

Through its technology transfer activities in developing and threshold countries Switzerland seeks to integrate partner countries into the global economy and promote their sustainable economic growth, which also supports the lowering of poverty rates. The role of the Swiss development agencies is to gauge the economic consequences of climate change and support the implementation of suitable measures in partner countries in a manner that also makes economic sense by focusing on mitigating emissions of greenhouse gases.

To foster sustainable and climate-friendly growth Switzerland gives particular importance to the promotion of energy efficiency and renewable energy sources. The diversification of energy production to include renewable sources has a positive impact on the environment and climate and mitigates the adverse effects of fluctuating prices for fossil fuels. Switzerland promotes attractive framework conditions, financial incentives, technology transfer and projects with a demonstration effect. This helps make modern technologies such as hydropower, solar energy and biogas utilization, more easily available to the world's less developed countries.

In its climate change mitigation and technology transfer activities, Switzerland works closely with various international partners such as the multilateral development banks and international organizations such as UNIDO, UNCTAD and ITTO.

Resource Efficiency

Since the 1990s, Switzerland has been engaged in the field of resource efficiency and has been supporting different elements of a successful technology transfer by fostering and developing the following initiatives and instruments: Support and build-up of a network of Cleaner Production Centers (CPC) together with UNIDO, green credit lines, participation in venture capital funds, fostering of energy sector reforms and more. Currently Switzerland is one of the main partners of the joint UNIDO-UNEP program on Resource Efficient and Cleaner Production (RECP) that applies and disseminates cleaner production methods in order to support developing and transitional countries on their way toward green growth. Part of the Swiss engagement includes also the support of the build-up of the RECP net.

7.5 Provision of financial resources (incl. under Art. 11 KP)

From 2009 to 2012, Switzerland's official development assistance (ODA) amounted to 10.442 billion Swiss francs (between 2.4 and CHF 2.83 billion Swiss francs per year), whereof approximately 25% have been provided through multilateral assistance (core contributions and programs) and 75% through bilateral or regional assistance projects. The climate component within Switzerland's development cooperation has steadily increased over the last years. Tab. 40 and Tab. 41 give an overview on multilateral and bilateral climate related contributions.

Tab. 40 > Switzerland's financial contributions to multilateral institutions and programs 2009-2012

Multilateral climate change funds	2009		2010		2011		2012		Status [3]	Source	Financial instrument	Type of Support [3]	Sector [3]
	Core [2]	CC-specific	Core [2]	CC-specific	Core [2]	CC-specific	Core [2]	CC-specific					
	CHF												
1. GEF [1]		9'735'000		9'735'000		9'636'000		9'834'000	P.	ODA	Grant	C.C.	C.C.
2. LDCF		1'000'000		1'000'000		1'000'000		1'000'000	P.	ODA	Grant	A.	C.C.
3. SCCF		575'000		575'000		750'000		750'000	P.	ODA	Grant	C.C.	C.C.
4. AF		200'000				3'200'013			P.	ODA	Grant	A.	C.C.
5. GCF/Transitional Committee						143'426		131'000	P.	ODA	Grant	C.C.	C.C.
6. UNFCCC	0	686'594	0	470'655	0	973'911	0	761'495	P.	ODA	Grant	C.C.	C.C.
6.1 UNFCCC contribution		341'594		410'655		330'485		341'495	P.	ODA	Grant	C.C.	C.C.
6.2 UNFCCC Trust Fund for Supplementary Activities and other voluntary contributions		345'000		60'000		643'426		420'000	P.	ODA	Grant	C.C.	C.C.
7. Other	0	0	0	0	0	0	0	0					
Subtotal	0	12'196'594	0	11'780'655	0	15'703'350	0	12'476'495					

Multilateral financial Instituions including regional development banks	2009		2010		2011		2012		Status [3]	Source	Financial instrument	Type of Support [3]	Sector [3]
	Core	CC-specific	Core	CC-specific	Core	CC-specific	Core	CC-specific					
	CHF												
1. World Bank (IDA)	192'225'531	0	209'338'713	11'759'744	237'663'286	20'773'750	259'045'044	5'076'350	P.	ODA	Grant	C.C.	C.C.
1.1 CIF / SREP (Scaling up Rewable Energy Program)				10'285'000		9'350'000		3'825'000	P.	ODA	Grant	M.	C.C.
1.2 Forest Carbon Partnership Facility						4'071'250		87'124	P.	ODA	Grant	M.	C.C.
1.3 Carbon Finance Assist Trust Fund				1'474'744		1'402'500		1'164'226	P.	ODA	Grant	M.	C.C.
1.4 Partnership for Market Readiness						5'950'000			P.	ODA	Grant	M.	C.C.
2. IFC													
3. African Development Fund	88'066'334		83'159'880		58'249'914		59'849'852		P.	ODA	Grant	C.C.	C.C.
4. Asia Development Fund	13'600'000		5'658'300		13'353'000		13'533'000		P.	ODA	Grant	C.C.	C.C.
5. European Bank for Reconstruction and Development													
6. Inter-American Development Fund	0		0		2'599'441		0		P.	ODA	Grant	C.C.	C.C.
7. Other													
Subtotal	293'891'865	0	298'156'893	11'759'744	311'865'641	20'773'750	332'427'896	5'076'350					

Specialized United Nations bodies	2009		2010		2011		2012		Status [3]	Source	Financial instrument	Type of Support [3]	Sector [3]
	Core	CC-specific	Core	CC-specific	Core	CC-specific	Core	CC-specific					
	CHF												
1. UNDP	54'000'000		54'000'000		54'000'000		54'000'000		P.	ODA	Grant	C.C.	C.C.
2. UNEP	6'500'000		6'500'000		6'500'000		7'400'000		P.	ODA	Grant	C.C.	C.C.
2.1 UNEP core contribution	4'500'000		4'500'000		4'500'000		4'900'000		P.	ODA	Grant	C.C.	C.C.
2.2 UNEP Ozone Fund	2'000'000		2'000'000		2'000'000		2'500'000		P.	ODA	Grant	C.C.	C.C.
3. Other	6'546'800	2'507'061	15'377'703	2'668'954	15'010'950	4'875'513	9'178'020	3'472'315					
3.1 UNCCD	525'000		677'703		410'950		978'020		P.	ODA	Grant	C.C.	C.C.
3.2 IFAD	5'271'800		14'000'000		14'100'000		7'200'000		P.	ODA	Grant	C.C.	Agri
3.3 UNITAR (climate change, environmental law)		300'000		300'000		300'000		300'000	P.	ODA	Grant	C.C.	C.C.
3.4 UNIDO (Cleaner Production Center / Ressource Efficient Cleaner Production Program)		287'061		448'954		2'690'513		1'980'315	P.	ODA	Grant	M.	C.C.
3.5 UNISDR	750'000		700'000		500'000		1'000'000		P.	ODA	Grant	A.	C.C.
3.6 IPCC		1'920'000		1'920'000		1'885'000		1'192'000	P.	ODA	Grant	C.C.	C.C.
Subtotal	67'046'800	2'507'061	75'877'703	2'668'954	75'510'950	4'875'513	70'578'020	3'472'315					

Other	2009		2010		2011		2012		Status [3]	Source	Financial instrument	Type of Support [3]	Sector [3]
	Core	CC-specific	Core	CC-specific	Core	CC-specific	Core	CC-specific					
	CHF												
GFDRR	0		0		1'500'000		1'000'000		P.	ODA	Grant	A.	C.C.
OECD	580'531		500'265		1'163'468		552'457		P.	ODA	Grant	C.C.	C.C.
OECD Climate Change Research Collaborative						50'000		135'000	P.	ODA	Grant	C.C.	C.C.
IUCN	2'125'000		2'125'000		2'125'000		3'125'000		P.	ODA	Grant	C.C.	C.C.
CGIAR	12'550'000		13'500'000		14'000'000		14'000'000		P.	ODA	Grant	C.C.	Agri
GEO GEOSs		50'000		70'000		100'000		50'000	P.	ODA	Grant	C.C.	C.C.
WCC-3		521'794		155'497		0		150'000	P.	ODA	Grant	C.C.	C.C.
Geneva Ministerial Dialogue on Climate Finance				246'561					P.	ODA	Grant	C.C.	C.C.
Climate Vulnerable Forum Costa Rica								67'888	P.	ODA	Grant	C.C.	C.C.
REDD-Summit Indigenous People Amazone Basin				307'500					P.	ODA	Grant	C.C.	REDD
Ministerial Consultations Pretoria						241'534			P.	ODA	Grant	C.C.	C.C.
Subtotal	15'255'531	571'794	16'125'265	779'558	18'788'468	391'534	18'677'457	402'888					
Total	**376'194'196**	**15'275'449**	**390'159'861**	**26'988'911**	**406'165'059**	**41'744'147**	**421'683'373**	**21'428'048**					

Multilateral Organizations BUR

*1. According to the evaluation report of GEF-5 32% of the core funding were invested in climate change activities.

*2. A proportion of Switzerland's core contributions to multilateral organisations may be allocated to climate change activities, the exact amount of which cannot be assessed reliably.

*3. Abbreviations: P. means Provided, C.C. means Cross-Cutting, A. means Adaptation, M. means Mitigation, Agri means Agriculture

General comment: Switzerland provides funding to a number of multilateral organisations as implementing partners for regional and bilateral activities.
This funding is reported in the Bilaterald and Multi-Bilateral Funding table.

Tab. 41 > Switzerland's provision of financial support: Contribution through bilateral and multi-bilateral channels.

Donor Funding *: Africa	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
SDC Africa Regional Programs and Projects (Adaptation)	384'000	210'000	834'922	1'633'613	P.	ODA	Grant	A.	C.C.	Africa Regional
SDC Africa Regional Programs and Projects (Mitigation)	0	210'000	460'910	304'083	P.	ODA	Grant	M.	C.C.	Africa Regional
SDC E&S Africa Adaptation	2'745'071	4'991'999	5'678'820	9'233'141	P.	ODA	Grant	A.	C.C.	East and Southern Afric
SDC E&S Africa Mitigation	1'035'539	2'253'918	2'338'508	4'999'719	P.	ODA	Grant	M.	C.C.	East and Southern Afric
SDC West Africa Adaptation	1'144'123	1'632'769	1'722'196	4'399'139	P.	ODA	Grant	A.	C.C.	West Africa
SDC West Africa Mitigation	489'953	220'000	299'751	561'623	P.	ODA	Grant	M.	C.C.	West Africa
Subtotal Africa	5'798'686	9'518'686	11'335'107	21'131'318						

Donor Funding *: Asia	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
SDC Asia Regional Programs and Projects (Adaptation)	0	0	250'000	574'000	P.	ODA	Grant	A.	C.C.	Asia Regional
SDC East Asia Adaptation	6'172'544	9'057'522	12'573'323	12'094'674	P.	ODA	Grant	A.	C.C.	East Asia
SDC East Asia Mitigation	2'467'436	2'690'150	5'495'963	4'223'305	P.	ODA	Grant	M.	C.C.	East Asia
SDC South Asia Adaptation	4'568'129	7'395'700	11'000'619	10'026'540	P.	ODA	Grant	A.	C.C.	South Asia
SDC South Asia Mitigation	6'151'507	4'342'047	4'269'088	4'022'895	P.	ODA	Grant	M.	C.C.	South Asia
Subtotal Asia	19'359'616	23'485'419	33'588'993	30'941'414						

Donor Funding *: Europe and CIS	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
SDC CIS Adaptation Programs and Projects	2'858'122	3'686'013	3'685'387	2'854'062	P.	ODA	Grant	A.	C.C.	CIS
SDC CIS Mitigation Programs and Projects	711'955	338'317	275'553	297'533	P.	ODA	Grant	M.	C.C.	CIS
SDC Adaptation Projects in New EU Member States	0	0	0	48'547	P.	ODA	Grant	A.	C.C.	New EU Member States
SDC Mitigation Projects in New EU Member States	0	0	0	26'564	P.	ODA	Grant	M.	C.C.	New EU Member States
SECO Programs and Projects in New EU Member States	0	0	90'777	2'430'000	P.	ODA	Grant	M.	C.C.	New EU Member States
SDC West Balkans Adaptation	75'848	112'710	125'787	162'602	P.	ODA	Grant	A.	C.C.	West Balkans
SDC West Balkans Mitigation	25'340	86'703	141'471	155'655	P.	ODA	Grant	M.	C.C.	West Balkans
Subtotal Europe and CIS	3'671'265	4'223'743	4'318'975	5'974'963						

Donor Funding *: Latin America	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
SDC Latin American Adaptation Programs and Projects	7'144'404	8'143'891	10'778'176	14'016'073	P.	ODA	Grant	A.	C.C.	Latin America
SDC Latin American Mitigation Programs and Projects	4'398'006	7'334'077	6'791'833	10'038'344	P.	ODA	Grant	M.	C.C.	Latin America
Subtotal Latin America	11'542'410	15'477'968	17'570'009	24'054'417						

Donor Funding *: Middle East and North Africa	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
SDC Middle East and North Africa Adaptation Programs and Projects	40'000	29'317	276'970	170'379	P.	ODA	Grant	A.	C.C.	Middle East and North Africa
SDC Middle East and North Africa Mitigation Programs and Projects	196'512	39'254	178'000	0	P.	ODA	Grant	M.	C.C.	Middle East and North Africa
Subtotal Middle East and North Africa	236'512	68'571	454'970	170'379						

Donor Funding *: Global	2009	2010	2011	2012	Status *1	Source	Financial instrument	Type of Support *1	Sector *1	Recipient Country / Region
	CC-specific	CC-specific	CC-specific	CC-specific						
	CHF									
Humanitarian Aid	5'559'806	5'668'189	5'671'074	6'848'530	P.	ODA	Grant	A.	C.C.	Global
SDC Global Adaptation Programs and Projects	2'891'092	3'998'759	5'088'283	4'862'854	P.	ODA	Grant	A.	C.C.	Global
SDC Global Mitiagation Programs and Projects	1'967'370	2'479'699	3'099'647	3'785'366	P.	ODA	Grant	M.	C.C.	Global
Climate Change Adaptation relevant ODA bi- and multi-bilateral programming of SECO	551'250	495'000	1'379'125	405'011	P.	ODA	Grant	A.	C.C.	Global
Climate Change Mitigation relevant ODA bi- and multi-bilateral programming of SECO	18'948'632	23'149'231	23'376'269	44'795'056	P.	ODA	Grant	M.	C.C.	Global
Subtotal Global	29'918'150	35'790'878	38'614'398	60'696'817						
Total Provision of Financial Support through bilateral and multibilateral channels	**70'526'639**	**88'565'265**	**105'882'452**	**142'969'308**						

Bilateral Contributions BUR

Footnote *

The climate change relevant part of all SDC funded projects was calculated as follows:
The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 1-50%, principal: 51-100%)

The climate change relevant part of all SECO funded projects was calculated as follows:
The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 50%, principal: 85%)

*1. Abbreviations: P. means Provided, C.C. means Cross-Cutting, A. means Adaptation, M. means Mitigation

References[22]

Swiss Agency for Development and Cooperation SDC; Swiss State Secretariat for Economic Affairs SECO; Swiss Federal Office for the Environment FOEN: Climate Change: Swiss Fast Start Financing from Public Sources (ODA), Final Report to UNFCCC, May 2013, Bern (*http://www3.unfccc.int/pls/apex/wwv_flow_file_mgr.get_file?p_security_group_id=1090408772142046&p_flow_id=116&p_fname=Swiss FSF Final Report 2013.pdf*)

Stadelmann and Michaelowa 2013: Contribution of the private sector to Climate Change Long-Term-Finance: An assessment of private climate finance mobilized by Switzerland. Final report commissioned by the Swiss Federal Office for the Environment (FOEN), Bern (*http://www.bafu.admin.ch/international/04692/04786/index.html?lang=de*).

[22] Where available, references are provided online at www. climatereporting.ch

8 Research and systematic observation

Research has made significant progress in understanding the climate system, its current changes and their impacts on humans and the environment. This improved scientific understanding results to a considerable extent from substantial improvements in the available data sets. Switzerland's research efforts and its systematic observation of various Essential Climate Variables (ECV) is a valuable contribution to both the national and the international scientific community.

8.1 General policy on research and systematic observation

8.1.1 Research structures and funding

According to the Federal Research Act (SR420.1), it is the responsibility of the Swiss Confederation to support and promote scientific research. The federal departments can commission research in areas of public interest, and parts of the federal administration host fully fledged research institutions. Research that is directly funded by government institutions falls into one of the federal research programmes. These programmes provide the conceptual framework and set research priorities in eleven policy areas[23]. They are used to coordinate research activities and promote collaboration between research institutions. With regard to climate, four programmes are particularly relevant: Environment, energy, spatial development and mobility, and sustainable transport.

In the following paragraphs data are based on the information system of ProClim-, the Forum for Climate and Global Change of the Swiss Academy of Sciences, where data on research activities, publications and a list of experts in climate research is held up to date. The database is publicly available at *http://www.proclim.ch.*

Climate research in Switzerland can be divided into several categories:

- National Centres of Competence in Research (NCCR);
- Individual research projects (funded by the National Science Foundation (NFS) or government institutions);
- Energy and transport research (mainly funded by the government);
- Participation in international research programmes (EU, COST, WCRP, IHDP, IGBP) by researchers at various universities, the federal institutes of technology (ETHZ and EPFL), universities of applied sciences (Fachhochschulen) and private and public research organizations;
- Collaborations with international research centres and organizations (ECMWF, EUMETSAT, WMO, IPCC).

National Centres of Competence in Research

Two National Centres of Competence in Research (NCCR) are or have been, respectively concerned with climate change issues – the NCCR „Climate“ and the NCCR „North-South“.

NCCR Climate

The NCCR Climate (*http://www.nccr-climate.unibe.ch/*) was created in April 2001 with an intended duration of 12 years. The official closing event took place in October 2012. In 2013 activities will be reduced and many of them will be continued by other organisations (universities, federal research institutes, academies, etc.). The NCCR Climate brought together experts from a wide range of universities and research institutes. It addressed broad issues of natural climate variability and predictability by combining the

[23] http://www.ressortforschung.admin.ch/html/dokumentation/publikationen_de.html

contributors from relevant disciplines into an integrated network of competence. This network included expertise from the physical, chemical, biological, economic and sociological disciplines and addresses research questions in various fields. It operated on three levels:

- First, disciplinary research in individual research groups, ensuring continuous cutting-edge research, facilitating access to and sharing of latest results and methods through international co-operation (e.g. EU projects);
- Second, thematic research within the topical modules of NCCR Climate, coordinating and integrating the results in the wider context;
- Third, establishment of a university-based, long-term Swiss centre of competence on issues of climate variability, extreme events, climate projections, and the assessment of ecological and economic consequences and associated risks.

The overall goals of the NCCR Climate were to:

- Acquire a better understanding of climate system processes, variability and predictability and the complex inter-relationships between climate, economic and societal drivers;
- Adapt and refine scientific tools and knowledge for Switzerland, considering specific characteristics in physical, chemical, biological, geographical, economic and societal factors;
- Transfer and apply the knowledge to assess the risks and future cost of projected climate change, and to provide a basis for adaptation strategies;
- Educate young scientists of all disciplines with an emphasis on interdisciplinarity. NCCR Climate has established a series of thematic summer schools and developed forms of participatory learning;
- Investigate new financial and economic tools to hedge against the increased probability of extreme events.

Oeschger Centre for Climate Change Research, University of Bern

In October 2007, the University of Bern – the leading house of the NCCR Climate – has inaugurated the Oeschger Centre for Climate Change Research, OCCR with the aim to bring together and promote the various fields of climate research within the University of Bern. The 200 members of Oeschger Centre engaged in joint research projects, started new interdisciplinary research initiatives, developed a common infrastructure and are offering outstanding education through aspecialized master programme and a graduate school in climate sciences.

The OCCR's focus is on the climate system and its interactions with society and the economy. The research is comprised of four closely linked core areas:

- the long-term development and dynamics of the climate system;
- the present and future climate;
- consequences of climate change for important land ecosystems;
- consequences of climate change for the economy and society as well as the adaptive and legal strategies that are derived from them.

Centre for Climate Systems Modelling (C2SM), ETH Zürich

In November 2008, the ETH Zürich has inaugurated the Centre for Climate Systems Modelling, C2SM, a joint venture involving NCCR Climate researchers from the ETH and from partner institutions including MeteoSwiss, Empa, and ART. The Centre's overarching and integrating theme is "multi-scale interactions within the climate system". The C2SM receives funding from the ETH-Foundation, ETH Zürich, MeteoSwiss, Empa, and ART.

The Center is active in several ways including research, user support, scientific animation, teaching, and outreach activities. The main objectives are:

- To maintain, improve, and make available state-of-the-art climate and climate-related models;
- To utilize climate models by conducting comprehensive simulations and diagnostics;
- To exploit and disseminate key national and international data sets;
- To prepare for and exploit the next generation of high-performance computers;
- To foster the collaboration between research groups.

NCCR North-South, University of Bern

The NCCR North-South (*http://www.north-south.unibe.ch/*) focuses on international research cooperation and promotes high-quality disciplinary, interdisciplinary and transdisciplinary research with the aim of contributing to an improved understanding of the status of different syndromes of global change, of the pressures these syndromes and their causes exert on different resources (human, natural, economic), and of the responses of different social groups and society as a whole.

By identifying the potential of social systems to mitigate syndromes, by considering their dynamics, and by adopting existing innovative solutions, the NCCR North-South primarily aims to help design ways to mitigate syndromes. The NCCR North-South enables Swiss research institutions to enhance partnerships with institutions in developing and transition countries, thereby building up competence and capacity on both sides to develop socially robust knowledge for mitigation action.

Individual projects are focused on one of the following themes.

- IP1: Conceptual Framework and Methodologies;
- IP2: Natural Resources and Ecology;
- IP3: Environmental Sanitation;
- IP4: Health and Well-being;
- IP5: Social practices and empowerment in urban societies;
- IP6: Institutional Change and Livelihood Strategies;
- IP7: Conflict Transformation;
- IP8: Governance, Human Development and Environment.

Activities in international research programmes and assessments

Switzerland participates in international research programmes (e.g. World Climate Research Programme WCRP) through individual research projects, research conducted at federal institutes and within co-ordinated programmes (NCCRs, Climate Research Centers), the operation of monitoring stations and networks, as well as maintaining calibration and data centres (for monitoring see section 8.2 and 8.3). It also plays a leading role in several regional climate research programmes.

Switzerland also contributes significantly to the International Geosphere Biosphere Programme (IGBP). The international project office for the IGBP Past Global Changes (PAGES) project is located in Bern and is jointly funded by Switzerland through the Swiss National Science Foundation and the US. Swiss scientists are involved in the PAGES and Global Change and Terrestrial Ecosystems (GCTE) projects, the DIVERSITAS programme and most other core projects. Switzerland has also contributed significantly to the International Human Dimensions Programme (IHDP) on Global Environmental Change. Swiss researchers are active in fields relevant to the IHDP and have also made important contributions to the United Nations University over the years.

Switzerland is also hosting and funding the Mountain Research Initiative (MRI), a multidisciplinary scientific organization that addresses global change issues in mountain regions around the world. The MRI strives to support the design of integrated research strategies and programmes that further our understanding of the impacts of Global Change in mountain areas and that lead to tangible results for stakeholders and policy-makers. MRI is a joint project of IHDP and IGBP and is funded by the Swiss National Science Foundation.

A number of Swiss researchers are involved (some of them in leading positions) in the preparation of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and other IPCC reports. Prof. Thomas Stocker of Switzerland is co-chair of the Working Group I (WGI) of IPCC on the Physical Science Basis of climate change. The WG I Technical Support Unit, which manages the organizational and administrative activities of WG I, is hosted by the University of Bern, Switzerland, and funded by the Swiss Federal Office for the Environment.

Funding

Swiss research is mainly funded by the National Science Foundation (programme research and individual projects), by the EU (EU research projects) and COST (projects in the framework of COST actions). In 2011 the ProClim- Information system listed 290 ongoing research projects of relevance to climate and global change. The National Science Foundation provided funds for about 160 of these projects (including NCCR) with a total budget per year of about CHF 23 million. This number includes also projects, which were funded during part of the year only. The average funding per project is about CHF 140'000 per year. The funding provided for 46 EU projects was about CHF 28 million and for the 6 COST projects was about CHF 300'000.

Individual research projects

The majority of research projects are individual projects funded by the Swiss National Science Foundation or by government agencies such as FOEN. The distribution of the funding between different disciplines is shown in Tab. 42.

Tab. 42 > 160 projects receive CHF 23 millions from the Swiss National Science Foundation

Some projects are assigned to more than one group

Natural sciences:	109 projects	15.2 million CHF/y
Biological and medical sciences (incl. biodiversity):	45 projects	8.3 million CHF/y
Technical (energy technology not included):	17 projects	1.9 million CHF/y
Social, political, legal and economical	19 projects	6.0 million CHF/y
NCCR programmes	3 programmes	5.0 million CHF/y

Research in EU projects

In 2003 Switzerland and the EU signed a research agreement, giving Switzerland the status of an "associate country" in the 6^{th} EU research framework programme from 1.1.2004. Rather than participating in EU research on a "project by project" basis, Switzerland now contributes to the overall EU research budget. Thus, Swiss projects are financed directly by the EU research institutions. At the same time, Swiss researchers can now take on a leading role in any EU project. All the former restrictions on project activities have been suspended. This agreement has been extended to the 7^{th} EU research framework programme

(FP7), comprising the funding period 2007-2013. Swiss participation in the new framework programme Horizon 2020 (period 2014-2020) is currently issue of negotiations.

In 2011, the 46 EU projects were pursued in the field of climate and global change including mitigation and adaptation. The distribution of EU-funded Swiss projects in the different fields is shown in Tab. 43. A further 82 projects in climate and global change were funded by other sources (COST, universities, etc.)

Tab. 43 > EU-funded research projects

Environment	31 projects	24.9 million CHF/y
Energy and Transport related Programs	15 projects	3.0 million CHF/y

State Secretariate for Education, Research and Innovation SERI

Energy research

Switzerland's energy research and development (R&D) policy aims to contribute to a secure and sustainable energy supply; continue the strong position of Switzerland as a market place for energy technology and ensure the high quality of its energy research. The long-term goal is to reduce annual energy needs per person to 2'000 W or 1 tonne CO_2 if the equivalent energy is produced from renewables. International co-operation and efficient implementation of research findings have a high priority. Within the federal administration, the support of energy research is organised by the State Secretariat for Education, Research and Innovation (SERI), the Swiss Federal Office of Energy (SFOE) and the Commission for Technology and Innovation (CTI). Energy R&D policy is laid down in the Federal Energy Research Masterplan developed every four years by the Federal Energy Research Commission (CORE), a high-level advisory body to the federal government, consisting of 15 members from industry, academia and politics.

An action plan on «Coordinated Energy Research Switzerland» was created as a consequence of the Swiss decision to phase out nuclear energy. It aims at building up capacities in energy research and strengthening thematic focal points in seven clearly defined fields of action. The federal parliament decided to fund the action plan with an amount of CHF 202 million (EUR 155 million) over the period 2013–2016. While the main part of the funding is dedicated to building up research teams and new professorships within the ETH domain, the universities and the universities of applied sciences, a part of the budget is reserved for competitive research projects (CTI). Additionally, two new National Research Programs «Transforming Energy» and «Options for Controlling Final Energy Consumption» will run over five years, starting in 2014. Furthermore the SFOE supports pilot and demonstration projects and ordinary research projects.

Transport research

Swiss transport research is mainly carried out by the federal administration, the federal institutes of technology in Zürich (ETHZ) and Lausanne (EPFL), and regionally by the cantonal universities. Outside government, private research institutions such as consulting and engineering offices also conduct extensive research. Much of this research is coordinated by the association of Swiss road and traffic engineers (VSS). The federal offices conduct, support, coordinate, monitor and fund strategic research. National priorities of transport research are within the fields of external costs of transport, sustainable transport and road infrastructure construction.

Agricultural research

Research in the agriculture sector is coordinated by the Federal Office for Agriculture and to a large extent funded through the government framework research programme agriculture (Agroscope 2007), supplemented by funding from NSF and EU Framework Programmes. Its main goals are to improve agricultural practice in the context of the political and economic framework, and in particular, in view of achieving sustainability in farming. Amongst other objectives, this includes research into farming practices that contribute to climate change mitigation or to improved practices to cope with potential future climate conditions. Individual research projects are carried out at the federal research stations Agroscope, ETH Zürich and various Swiss universities as well as the Research Institute of Organic Agriculture. Some of the projects are embedded in the framework of the SNSF-funded NCCR Climate, while others are commissioned by the government.

Forest research

Forest research in Switzerland is mainly carried out by ETHZ and EPFL, the Swiss Federal Institute for Forest Snow and Landscape Research (WSL) which is part of the ETH domain and universities. More in applied research engaged are third-level technical high schools and also private institutions mainly mandated by the federal or cantonal administrations. The research is focused on sustainable forest management, protection against natural hazards, ecology and biodiversity. A new focus is set on impact of climate change and adaptation measures (see section 8.2.5).

8.1.2 Systematic observation

The Global Climate Observing System (GCOS) is designed to ensure that the observations and information needed to address climate-related issues are obtained systematically and made available to all potential users, in accordance with the requirements of the UN Framework Convention on Climate Change (UNFCCC). At the global level, GCOS is coordinated by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the UN Environment Programme (UNEP), and the International Council of Science (ICSU).

Switzerland's contribution to GCOS has been reported to UNFCCC in the third, fourth and fifth national communication (SAEFL 2001, SAEFL 2005, FOEN 2009). A progress report on the GCOS implementation in Switzerland was submitted to the UNFCCC in September 2008 in response to a request[24] of the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) in 2005 (MeteoSwiss 2008).

National GCOS coordination

In Switzerland, the Swiss GCOS Office at the Federal Office of Meteorology and Climatology MeteoSwiss is responsible for coordinating all climate relevant measurements conducted by federal offices, research institutes and universities. The Swiss GCOS Office also serves as the contact point for the international GCOS Secretariat at the WMO, as well as for national GCOS coordinators worldwide.

In 2013, the 10th edition of the so-called "Swiss GCOS Roundtable" gathered nearly 60 representatives from different partner institutions involved in systematic climate observation in Switzerland. The Swiss GCOS Roundtable is organized annually and provides a platform to exchange information between partner institutions. The national coordination mechanism aims at securing a continuous operation of representative observation networks as well as international data and calibration centers. Financial and technological support is provided for selected observations abroad through international capacity building projects.

[24] SBSTA Conclusion L.14 (COP 13, Bali 2007): http://unfccc.int/resource/docs/2007/sbsta/eng/l14.pdf

The national inventory report "National Climate Observing System (GCOS Switzerland)" describes Switzerland's most important long-term climate measurement series and international data centers (Seiz and Foppa 2007) and has been continuously updated since its release. The long-term financial contribution to GCOS Switzerland entered into force in 2010. It was agreed upon by the Swiss Federal Council in 2008 following the publication of the national GCOS report. This contribution secures the continuation of several long-term climate measurement series and international data centers in Switzerland which had been identified to be at risk. As a result, several agreements were signed between MeteoSwiss and partner institutions. These agreements now secure the continuation of measuring atmospheric and terrestrial ECVs, eg. permafrost, and guarantee a sustainable operation of international data centers, eg. the World Glacier Monitoring Service (WGMS).

The Swiss GCOS Office's outreach efforts encompass a variety of activities. A Swiss GCOS Office website *(www.gcos.ch)* links to activities and international projects, as well as to the digital version of the national GCOS report. In 2013, on the occasion of the 10th edition of the GCOS Roundtable, a new GCOS Switzerland short film "Local observations - for global understanding" was released, highlighting the efforts of monitoring activities in Switzerland (available at the Swiss GCOS Office website).

The national coordination mechanism for systematic climate observation in Switzerland also has the potential to facilitate the national implementation of delivery strategies for climate services as part of the ermerging WMO-led Global Framework for Climate Services (GFCS).

8.2 Research

8.2.1 Climate and global change research

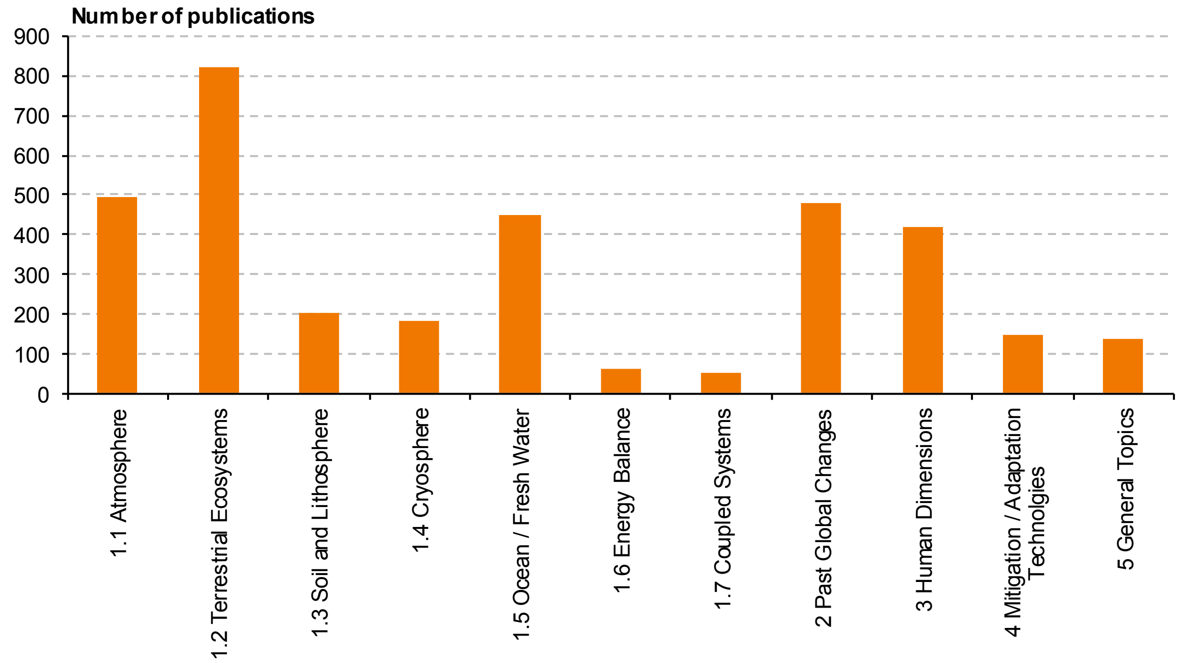
In 2011, about 290 research projects on climate and global change and on related human aspects were in progress. The distribution of research projects into different disciplines funded by the National Science Foundation (about 160) and EU-funded projects (about 50) is presented in section 8.1.1.

Swiss climate and global change research results

Fig. 97 presents an overview on the activities and fields of Swiss research by listing the number of peer-reviewed publications with Swiss (co-)authors and its distribution on different fields during the years 2009-2012. Publications related to natural sciences dominate, partly because peer-reviewed publications play a more important role in natural sciences than in other disciplines, and partly because the natural sciences research community is much larger.

Fig. 97 > **Publications of Swiss researchers**

Number of peer-reviewed publications with Swiss (co-)authors and distribution on different topics over 2009-2012.



There is a long-standing tradition of terrestrial ecosystem research that covers applied research (e.g. at the WSL) and pure research in various climate-related areas (e.g. at the universities of Basel, Bern, ETHZ). For example, forest ecosystem observations at the WSL date back many decades, and several current research projects investigate tree growth and forest dynamics in view of climate change.

A strong atmospheric research community in Switzerland looks into climate and climate-change related issues. The research groups are scattered across many universities and other research institutions (e.g. at the universities of Basel, Bern, Fribourg, Geneva, Zürich, ETH Lausanne and Zürich and MeteoSwiss), but they collaborate regularly in joint research projects and also contribute to international efforts. An example is the recent PRUDENCE and ENSEMBLES project that delivered regional climate model scenarios for Europe. Other research topics include global climate modelling, climate change, aerosols and clouds as well as atmospheric dynamics, variability and extreme events and their effects both globally and on the Alpine region.

Research into past global changes is also well established in Switzerland. The research approach for climate reconstruction and analysis is very broad, including historical documents and data, lake and marine sediments, tree rings, cave deposits and ice cores. For example, Swiss researchers contributed significantly to the reconstruction of past GHG concentrations from ice cores that covers the past 800'000 years.

Research highlights from NCCR Climate, period 2009–2012

Swiss researchers collaborate in NCCR Climate and contribute substantially in various fields of climate change research, particularly in the fields of reconstructing past climate, analysis of the present climate, modelling of future climate where long-standing expertise exists. But also the study of ecological impacts of climate change and possible economic, social and political mitigation and adaptation measures make part of the Swiss research portfolio. Some research highlights of the last few years are listed below (further details regarding the achievements of NCCR Climate can be found on *www.nccr-climate.unibe.ch*):

- New reconstruction methods for past climate were developed and climate reconstructions were deduced. Utilising the simulations performed during the entire NCCR Climate research period (2001-2012), we could test the robustness of proxy reconstructions;
- New proxy data were produced which fill large gaps in the global proxy network, e.g., in the Mediterranean – a hotspot of future climate change;
- New climate change scenarios for Switzerland have been developed. These scenarios employed the newest available set of global and regional climate simulations and were derived using new and improved statistical methods to enable a better quantification of uncertainties in climate projections;
- Improved land-surface schemes in Regional Climate Models (RCM) foster the understanding of land-climate feedbacks, which is relevant, for instance, for better seasonal forecasting of dry spells;
- New index-based options for hedging weather-related climate risks such as droughts were evaluated; if properly structured, these offer possibilities to farmers to better deal with more variable climatic conditions, specifically with more frequent risks of crop losses due to drought;
- A new method to spatially assess climate suitability for major crops may support adaptation to climate change in Swiss agriculture;
- The issue of setting incentives for participation and compliance in climate change mitigation has been evaluated since it has not been possible to establish an international agreement succeeding the Kyoto Protocol. This includes the discussion of economic aspects of funding adaptation as well as North-to-South technological transfers, but also legal aspects of border adjustment measures in case of unilateral climate policies. The results allow to identify possible challenges and obstacles from both an economic and legal viewpoint and to derive policy measures that can be invoked into a post-2012 policy regime.

Research highlights from NCCR North-South, period 2009–2012

In the framework of the National Competence Center North-South, which focuses on international research cooperation, especially with developing countries, a number of projects included research related to climate change. Some important outcomes of the activities are:

- **Adapting to climate change through sustainable land management (SLM):** More than 100 examples of SLM practices have been documented and analysed how far they can prevent and halt land degradation and rehabilitate already degraded land. A questionnaire has been elaborated to evaluate and monitor their climate sensitivity in order to support effective climate change adaptation. Furthermore, workshop guidelines were developed and tested in the region to support integrated and participatory planning at the village level;
- **Food security and drought management training course, Kenya:** An annual course has been developed that offers education in assessing food security conditions, analysing the impacts of droughts on livelihoods and food security and in assessing the coping and adaptation options combined with fieldwork in local communities;
- **Adaptation to climate change in smallholder farming systems**: A number of projects focused on how to increase the resilience of smallholder production to climate change impacts in Kenya and Tanzania, for example through improving communication of seasonal forecasts to farmers and mainstreaming climate change into government activities. Current results show that conservation agriculture increases yields compared to conventional agriculture, also under drought conditions.

8.2.2 Energy research

The **Federal Energy Research Masterplan** is a vision shared within the Swiss research community and a planning tool for federal funding bodies. It is also intended as a guide for cantonal and communal authorities who are familiar with implementing energy policy requirements or have their own funding tools for energy research. The masterplan defines four focus areas listed below which essentially cover all aspects of energy research. They reflect everyday life and our everyday energy requirements.

- **Living and Working in the future** involves energy-efficient buildings and near emissions-free housing stock: This focus area includes technologies and models for energy requirements and energy conversion in buildings. It also involves the distributed generation of renewable energy in the buildings sector.
- **Mobility of the future** aims at reducing fuel consumption by increasing efficiency of means of transport and improving engines: Mobility of the future looks at efficiency, environment and energy supply in transport systems. This includes the availability and use of fuel in private, public and freight transport.
- **Energy systems of the future** should be intelligently networked to ensure that our energy supply is secure and sustainable: This focus area involves research and development of technologies for energy supply through to the end-user.

Besides technical measures there is also the need to know how acceptable new technologies are and how to create incentives so that they can soon become widespread on the market. This involves investigating the economic, sociological, psychological and political aspects of energy conversion, distribution and use.

Energy Science Center ETH Zurich

The Energy Science Center (ESC) was founded at the beginning of 2005 in order to facilitate intense cross-departmental collaboration, exploit synergies between complementary kinds of energy-related expertise, and strengthen research co-operation among industrial and academic partners in the energy field. In accordance with the overarching strategy of the ETH domain in energy science and technology, the ESC provides an umbrella for ETHZ activities in both research and teaching. It also serves as a platform for large-scale interactions with important stakeholders (industry, government, opinion leaders, and society in general) and provides them with needed services.

The ESC synergistically combines key expertise in various disciplines to address large-scale problems successfully and to form so-called “light-house” projects. Such large, highly visible projects are centred on three large thematic areas, namely:

- Electric power generation and energy distribution;
- Energy for personal and freight transport systems;
- Energy for heating and cooling in domestic and industrial applications.

Energy Center EPF Lausanne

The Energy Center and the associated EPFL's Energy Systems Management Chair intend to foster multi-disciplinary research projects and networks to develop sustainable energy production, storage, transportation, distribution and end-use systems and technologies. The main aims are:

- Facilitating and implementing strong interactions between the EPFL scientific community (laboratories and institutes) and the private sector (companies, etc.);
- Positioning the Center as a catalyst and partner in important R&D projects in Switzerland and abroad;
- Promoting high-quality teaching in areas related to energy issues (undergraduate and postgraduate studies, further education);
- Taking an active part in building and implementing energy-related strategies and policies in Switzerland and abroad;
- Implementing communication/information projects regarding energy issues for specific audiences;
- Disseminating energy-related information for the media.

8.2.3 Transport research

In the framework of transport research, the following research activities are relevant for climate policy:

- External costs: Switzerland is undertaking a major review of the methods applied for estimating external costs of transportation and on this basis updating its figures for external costs (and benefits) for the first time for all major transport modes. A special focus is given to climate costs as well as up- and downstream costs;
- Many research activities have analysed the interrelation between transport and spatial development. On the basis of these studies, strategies for steering spatial organization (also based on market instruments) have been elaborated;
- Leisure traffic: In 2009, the Swiss government has adopted a leisure transport strategy proposing measures and instruments to shift the ever-increasing leisure traffic onto a more sustainable path and allowing for curbing growth rates. Various research activities focusing on the shifting potential of leisure traffic to more climate neutral transport modes have been approved;
- Non-motorized traffic (pedestrians, biking, hiking, etc.): The Swiss transport policy strives to promote non-motorized traffic as the most energy-efficient form of mobility contributing to bring down CO_2 emissions as well as pollution of air and noise. Different research projects have been carried out delivering schooling material for higher education courses on non-motorized traffic, base material for producing a handbook on planning comprehensive networks for pedestrians, and conceptual and practical guidelines for offering bike parking in public spaces;
- Aircraft emission trends: The FOCA calculates aircraft emissions at the highest possible degree of accuracy (tier 3a and 3b methods) in order to monitor technology developments and detailed emission trends. On the basis of these results, strategies and future environmental action plans are developed.

Since 2012, a new legal framework in Switzerland allows to use revenues from current taxes on kerosene in domestic aviation to finance environmental protection measures related to aviation. Approved research projects with respect to reduction of the aviation climate impact so far included:

- Development and validation of sensors for turbine blade tip clearance to further improve aircraft gas turbine efficiency;
- Research to support the development of a new aircraft engine PM standard with a prospect for very low soot emissions from large aircraft gas turbines;
- Investigation of impact of airplanes on local air quality at Zurich Airport.

8.2.4 Agricultural research

With regard to mitigation, current research addresses options to reduce methane and nitrous oxide emissions from Swiss animal husbandry and fertilizer management, quantification of carbon pools, sources and sinks in agricultural soils in relation to climate and management, quantification of gaseous N-exchange in fertilized grasslands, structural and energetic optimisation of animal houses and of plants for renewable energy.

In the area of adaptation, research focuses on using downscaled high-resolution climate scenarios to estimate changes in productivity and land suitability, implications of changes in weather variability for the production and quality of forage and arable crops and options for improved risk management, irrigation requirements and adaptation of water-use, effects of farming on natural hazards and preventive measures, forecasting and monitoring of pests in horticultural crops, conservation tillage to protect soils and to conserve soil water, as well as the farmers' perception and response to climate change.

8.2.5 Forest research

The climate projections for Switzerland suggest that the average summer will become warmer and drier in the coming decades, with great regional deviations and potentially more frequent extreme weather events like storms and heat waves. As a consequence, more pests and diseases, and insect calamities are expected. This will affect forests, although the details of the anticipated changes remain unclear. Forest management under uncertainty is the future challenge for silviculture.

To reduce uncertainty and to develop scientifically based recommendations for adaptive forest management, the Swiss government launched the "forest and climate change" research programme in 2009. This programme, which is now in its second phase, has a budget of CHF 8.5 million until 2015. It is a common undertaking of the FOEN and the WSL. The first phase deals with questions of highest priority for the development of forest adaptation measures: Particular emphasis lays on scenario analysis of forests and trees under a changing climate, and on the influence of climate change on forest ecosystem services. Knowledge transfer of new findings on adaptive measures into the forest management practice is part of the overall objectives of the programme.

Climate change is only one factor altering the environment for plants, interacting with other potentially damaging factors like excess nitrogen input or elevated ozone levels. Therefore, the EU COST action "Climate Change and Forest Mitigation and Adaptation in a Polluted Environment" was launched in 2009. In Switzerland the FOEN and the WSL are engaged in this European action, which creates a platform of experts from different fields of climate and environmental research. The main objectives are to increase the understanding of the state and the potential of forest mitigation and adaptation to climate change in a polluted environment and to combine process-oriented research and long-term monitoring.

Since 2009, the climatological and physiological causes of the natural dispersal ranges of European tree species are studied at the University of Basel. The project is funded by the European Research Council (ERC) within the 7th framework programme of the EU.

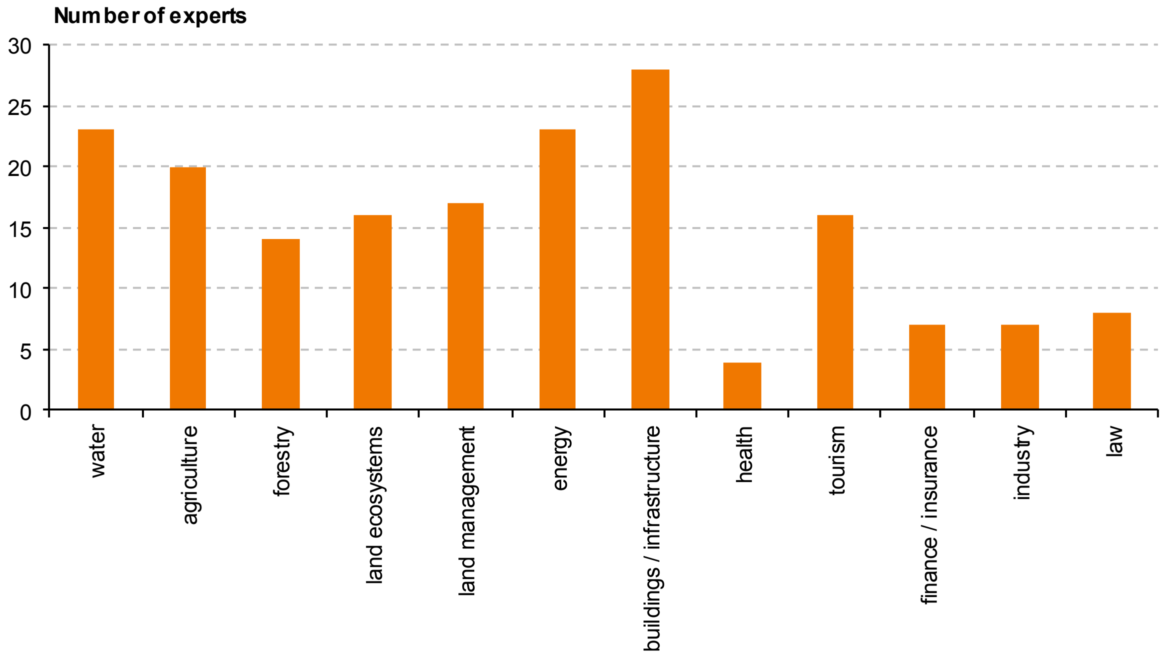
8.2.6 Adaptation research

Currently, adaptation research is not coordinated centrally. Specific questions related to the vulnerability and adaptation of ecosystems to climate change have been addressed in the third phase of the NCCR Climate (8.2.1). Furthermore, adaptation to climate change is part of applied research, e.g. in the agriculture sector (8.2.4), in the area of water resource management (Project CCHydro, (6.1.4) or for tourism (Research Institute for Leisure and Tourism, University of Berne). An effort to integrate adaptation into an integrated economic assessment model has been undertaken in a joint project of the EPFL and FOEN in 2010-2011. The results show that activities of the private actors are not able to absorb the whole effect of climate change and therefore policy measures to support adaptation are necessary. This is especially true after 2050 when climate change gets stronger.

A survey in 2010 showed that adaptation research in Switzerland is performed in all sectors that are influenced by climate change. It is most common in the sectors water and land ecosystems where climate impacts seem most obvious. Key expertise is found in research on buildings and infrastructure, agriculture and forestry and water management, followed by energy and land use research (Fig. 98). In general the survey exhibited that the importance of adaptation has only been little acknowledged by the research community until now and corresponding research should be further encouraged and supported.

Fig. 98 Experts in adaptation research

Number of experts per sector that declared activities in adaptation research in a Swiss survey in 2010.



ProClim (2013)

8.3 Systematic observation

Switzerland has a long tradition of climate observation, with temperature and precipitation series ranging back more than 150 years, the world's longest total ozone series, glacier measurements dating back to the end of the 19th century, and including important international calibration and data centers. The Swiss GCOS Office at MeteoSwiss is responsible for coordinating all climate relevant measurements in Switzerland. New measurement techniques, such as Earth observation satellites, have thereby become increasingly important within GCOS Switzerland, complementing conventional measurement networks.

Resulting from the Swiss Federal Council's decision in June 2008, several GCOS Switzerland agreements were signed between MeteoSwiss and partner institutions concerning the observation of atmospheric (eg. CO_2) and terrestrial climate variables (eg. snow water equivalent, permafrost) and the operation of international data centers (eg. WGMS). Establishing these agreements was a crucial step forward in securing long-term systematic climate observation in Switzerland.

8.3.1 Atmospheric observations

Atmospheric observations are classified into three domains, namely surface, upper air and atmospheric composition (Tab. 44). MeteoSwiss is responsible for the operation and maintenance of the meteorological and climatological network in Switzerland guaranteeing regular measurements over the entire country. Within the second phase of the project "SwissMetNet" (completed in 2013), MeteoSwiss renewed its ground-based standardized stations to 130 state of the art automatic weather stations. Another 27 stations will be added in the third phase (until 2015). SwissMetNet replaces previously existing networks measuring a large set of meteorological parameters over the Swiss territory.

The Swiss National Basic Climatological Network (NBCN) is the core of the climatological observation network and consists of 29 stations of greatest climatological importance for surface-based atmospheric observations (Fig. 99). Eight Regional Basic Climatological Network (RBCN) stations (Begert et al. 2007) including the two GCOS Surface Network (GSN) stations Säntis and Grand St. Bernard belong to the NBCN. To adequately represent the climatology of precipitation in Switzerland, 46 additional stations for precipitation, the so called NBCN-P stations, complement the NBCN network (Begert 2008). The operation of all NBCN stations follows the GCOS Climate Monitoring Principles (WMO 2004).

Since 1992, an extensive set of surface-based radiation parameters has been measured at the Payerne aerological station of MeteoSwiss as part of the Baseline Surface Radiation Network (BSRN). The BSRN network consists of around 60 stations worldwide and represents the surface radiation observation section of GCOS. In addition, high quality radiation measurements as part of the Swiss Alpine Climate Radiation Monitoring network (SACRaM) are conducted in Payerne, Locarno-Monti, Davos and on the Jungfraujoch.

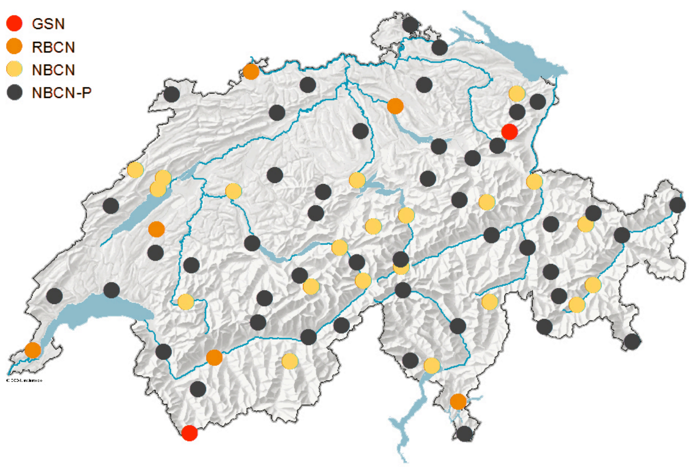
Tab. 44 > Switzerland's atmospheric observation networks

Domain	Variable	Number of stations and observation networks
Surface	Air temperature, Precipitation	2 GSN, 8 RBCN, 29 NBCN, 46 NBCN-P
	Radiation	1 BSRN, 4 SACRaM
Upper air	Upper air temperature, Wind speed and direction, Water vapour	1 GUAN / GRUAN
Composition	Ozone, Carbon dioxide, Methane, other GHGs, Air Pollutants, Aerosols	1 GAW global station 2 Ozone (total column, profile) 1 Carbon dioxide, 1 Methane, 1 Other GHGs 16 Air pollutants (NABEL) 5 Aerosols (optical depth, properties)
	Pollen	14 NAPOL sites

MeteoSwiss

Fig. 99 > Overview of the Swiss National Basic Climatological Network (NBCN)

The Swiss National Basic Climatological Network (NBCN) consists of 29 stations for atmospheric observations near the surface (red, orange, and yellow). Eight Regional Basic Climatological Network (RBCN; orange) stations including the two GCOS Surface Network (GSN; red) stations are part of NBCN. For precipitation, the 29 NBCN stations are supported by additional 46 NBCN-P stations (black).



Begert et al. (2007), Begert (2008), swiss map: VECTOR200 © swisstopo (DV053906)

At MeteoSwiss Payerne, measurements of the atmospheric profile of temperature, air pressure, and wind have been performed for more than 50 years using radiosondes. Since 2008, upper air observations carried out at Payerne belong to the GCOS Upper Air Network (GUAN). Upon invitation from WMO, Payerne became part of the GCOS Reference Upper Air Network (GRUAN) in 2010. GRUAN forms a set of selected stations worldwide that provide long-term, high-quality upper-air observing data.

Several measurement stations in Switzerland continue to contribute to the WMO Global Atmosphere Watch (GAW) programme. The Swiss GAW Programme (GAW-CH) is coordinated by the GAW-CH Office at MeteoSwiss. Measurements include long-term observations of total ozone and estimates of the ozone profile at the Light Climatic Observatory (LKO) in Arosa (since the beginning of last century) and ozone profiles at Payerne up to an altitude of more than 30 km by radiosondes since 1968.

The continuation of the carbon dioxide measurements at the High Altitude Research Station Jungfraujoch was not guaranteed post-2008, as reported in the national inventory (Seiz and Foppa 2007). On the basis of the Federal Council's decision in 2008, measurements were secured through an agreement between MeteoSwiss and the University of Bern in 2010. Starting in 2013, these measurements are continued in the framework of the Integrated Carbon Observing System (ICOS). Jungfraujoch is one out of 29 stations belonging to the network of GAW global stations (Fig. 100).

Measurements of air pollutants are conducted at 16 stations in the National Air Pollution Monitoring Network (NABEL). It is operated by the Swiss Federal Laboratories for Materials Science and Technology (Empa) under the supervision of the Federal Office for the Environment (FOEN). Measurements of aerosol optical depth are carried out at five sites in Switzerland. At Jungfraujoch, measurements of aerosol concentrations and properties as well as of atmospheric concentrations of greenhouse gases (GHGs) such as carbon dioxide, methane, and a series of additional climate relevant trace gases (eg. nitrous oxide, halogenated GHGs and ozone-depleting substances) are performed.

MeteoSwiss is also responsible for operating the national pollen monitoring network (NAPOL). It comprises a total of 14 stations that are equipped with volumetric pollen traps. It covers Switzerland's main climate and vegetation regions and is operated during the vegetation period (January-September).

Fig. 100 > High Altitude Research Station Jungfraujoch

The High Altitude Research Station Jungfraujoch is an important atmospheric observation site in Switzerland and part of the GAW network (global station).

Photo: Empa

8.3.2 Oceanic observations

Switzerland does not maintain measurements in the oceanic domain.

8.3.3 Terrestrial observations

Climate observations in the terrestrial domain are subdivided into the hydrosphere (river discharge, lakes, water use, isotopes, groundwater, and soil moisture), the cryosphere (snow cover, glaciers, and permafrost), and the biosphere (land use, forest ecosystem, forest fires, and phenology) (Tab. 45). Isotopes and phenology are not listed as ECVs in the GCOS Implementation Plan (WMO 2010), however, since their measurements have a long tradition in Switzerland, their series are an important part of the National Climate Observing System (GCOS Switzerland).

Tab. 45 > Switzerland's terrestrial observation networks

Domain	Variable	Number of stations and observation networks
Hydrosphere	River discharge	232 Federal sites (48 contributing to GTN-R)
	Lake levels	34 (3 contributing to GTN-L)
	Isotopes	25 ISOT sites (15 precipitation, 10 surface water)
	Groundwater	> 600 NAQUA sites
	Soil moisture	17 sites (SwissSMEX, SwissSMEX-Veg)
Cryosphere	Snow cover	71 NBCN-S (including 17 potential Swiss GCOS snow stations)
	Glacier mass balance and length	25 mass balance and/or volume changes, about 100 length changes
	Permafrost	29 locations (26 temperature boreholes, 5 changes in ice content, ca. 200 surface temperature, 14 rock glaciers with creep velocities)
Biosphere	Biomass, growth rate, ecosystem and microclimatological variables	50 study sites 19 monitoring sites (LWF)
	Phenology	12 (most important observation sites)

MeteoSwiss

The FOEN operates various hydrological monitoring networks and provides monitoring information on discharge, water levels, and water flows. Water quality for rivers, lakes, and groundwater bodies are monitored by FOEN in cooperation with the cantons, the Swiss Federal Institute of Aquatic Science and Technology (Eawag) and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). Daily river discharge data from 48 stations are submitted to the Global Runoff Data Center (GRDC), in support of the Global Terrestrial Network for River Discharge (GTN-R).

Swiss lakes are monitored at 34 sites in the basic hydrological monitoring network operated by FOEN, including three lakes that directly contribute to the Global Terrestrial Network for Lakes (GTN-L). In the framework of a GCOS Switzerland agreement with the University of Bern, a long term satellite-based data set of Lake Water Surface Temperatures (LWST) was generated for 15 Swiss lakes to complement existing measurement networks. A comprehensive archive of Advanced Very High Resolution Radiometer (AVHRR) data over Switzerland post-1989 served as the basis. To enhance the quality of satellite-derived long-term climate data records over Switzerland, geolocation accuracy of data sets such as of LWST is currently being analyzed by ETH Zurich.

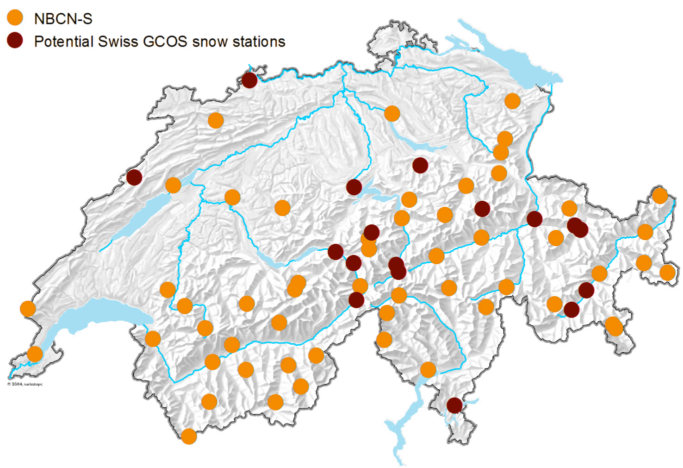
The national groundwater monitoring (NAQUA) is based on more than 600 stations including modules for long-term assessments of groundwater quality and quantity. The module for isotopes in the water cycle (ISOT) currently comprises 25 sites distributed throughout Switzerland and is operated by FOEN. Isotope data is being submitted to the Water Isotope System for Data Analysis, Visualization, and Electronic Retrieval (WISER) center. Lake level, groundwater data, and isotope analyses are partly submitted to designated international data centers as a contribution to the Global Terrestrial Network for Hydrology (GTN-H).

Soil moisture is an important parameter influencing land-atmosphere interactions, and hence climate. As a consequence, soil moisture is one of the climate variables that was recently added to the list of ECVs in the update of the GCOS Implementation Plan (WMO 2010). In a collaboration between ETH Zurich, Agroscope ART, WSL, and MeteoSwiss, soil moisture has been monitored in Switzerland on a project basis, both in the framework of the Swiss Soil Moisture Experiment (SwissSMEX) project since 2008, and in the SwissSMEX-Veg project since 2010. Measurements are performed at 17 sites, including grassland, arable land, and forests, to investigate soil moisture evolution for different land cover types.

Records of snow cover (snow depth, snow water equivalent), with some series dating back more than 100 years, are available from measurement networks operated by MeteoSwiss, the WSL, and other cantonal and private institutions. In 2010, the so-called National Basic Climatological Network for Snow (NBCN-S) was defined based on the analysis of 160 historical snow measurement series (Wüthrich et al. 2010). A subset of 17 NBCN-S stations was selected as potential Swiss GCOS snow stations representing main climatological regimes in Switzerland (Fig. 101). The continuation of long-term snow water equivalent measurements at the Wägital site by Meteodat GmbH was secured in 2010 based on the Federal Council's decision. Joint efforts of MeteoSwiss and WSL are targeted towards establishing a framework for systematic snow observations in Switzerland.

Fig. 101 > Overview of the Snow Monitoring Network

The National Basic Climatological Network for Snow (NBCN-S) consists of 71 snow stations (orange, brown). A subset of 17 NBCN-S stations was selected as potential Swiss GCOS snow stations (brown).



Wüthrich et al. (2010), swiss map: VECTOR200 © swisstopo (DV053906)

Switzerland has one of the world's most extensive monitoring networks for glacier length changes, comprising more than 100 glaciers. For about 25 glaciers, long-term observations exist enabling investigations of changes in glacier volume. In addition, long-term measurements of mass balance are continued for some glaciers. Glaciological studies are further supported through a new high-resolution Digital Elevation Model (DEM) above 2000 m a.s.l. for the entire area of Switzerland. The DEM was generated by the Federal Office of Topography swisstopo (completed in 2012) and partly supported through a GCOS Switzerland agreement.

The Swiss Permafrost Monitoring Network (PERMOS) provides a systematic long-term documentation of state and changes of mountain permafrost in the Swiss Alps. It is coordinated by the PERMOS Office at the University of Zurich and run in collaboration with a number of university-based partner institutes. PERMOS is co-funded on a sustained level from 2011 onwards by MeteoSwiss, FOEN, and the Swiss Academy of Science (SCNAT). The monitoring predominantly relies on measurements of borehole temperatures complemented by near-surface temperatures, geodetic surveys and photogrammetry (PERMOS 2010). PERMOS contributes to the Global Terrestrial Network for Permafrost (GTN-P).

Monitoring activities of the biosphere are conducted in the National Forest Inventory (NFI) surveys that register the current state and changes of the Swiss forests. After completion of the third survey period (2004-2006) (Speich et al. 2010), the fourth survey is being carried out in a collaboration between WSL and FOEN (2009-2017). Land use statistics are generated every twelve years by the Federal Statistical Office (SFSO) based on aerial photographs (latest observation period 2004-2009).

Documentation of long-term tree health (since 1985) is guaranteed at approximately 50 sites through the Sanasilva inventory. Under the Federal Long-term Forest Ecosystem Research Programme (LWF), more intensive and wide-ranging studies at 19 sites are being pursued as part of an integrated approach to forest monitoring. A database containing information and statistics on forest fires, for some areas dating back to the 19th century, is centrally managed at WSL.

Observations of annual vegetation phenology are obtained through the national phenological monitoring network. The network has been operational since 1951, is managed by MeteoSwiss and now comprises approximately 160 stations. A subset of twelve sites covering a variety of regions and elevations represents the most important phenological observations in Switzerland.

8.3.4 International activities

Switzerland actively contributes to the GCOS Cooperation Mechanism (GCM) to enhance the quality of climate-related observations globally, in particular in developing and emerging countries. In the context of the GCM, the project CATCOS (Capacity Building and Twinning for Climate Observing Systems) aims to improve the capacity to measure ECVs from the atmospheric and terrestrial domains in seven countries in Africa, South-East Asia, South America, and Central Asia (Tab. 41). CATCOS ensures the transfer of newly measured aerosol and GHG data, as well as glacier data to the designated GCOS international data centers. CATCOS is coordinated by the Swiss GCOS Office at MeteoSwiss and financed by the Swiss Agency for Development and Cooperation (SDC).

International data centers

The Swiss GCOS Office recently published a report that provides information on the availability of Swiss GCOS data in designated international data centers (MeteoSwiss 2011). For each ECV listed in the national GCOS report (Seiz and Foppa 2007), the document reports on the flow of data and the respective responsibilities. It further identifies areas of action and therefore provides the basis for future improvements regarding the availability of Swiss GCOS data at designated international data centers. Switzerland is host to a number of important international data and calibration centers that make a vital contribution to data quality and the global standardization of observations, both in the atmospheric and terrestrial domains.

The World Radiation Center (WRC) run by the Physical Meteorological Observatory (PMOD) in Davos serves as an international center for the calibration of radiation and also hosts the World Optical Depth Research and Calibration Center (WORCC). In addition, building upon the Regional Calibration Centre for UV, the World UV Calibration Center (WUVCC) became operational in 2013, managed by PMOD/WRC. Empa is the hosting institution for both the GAW Quality Assurance/Scientific Activity Center (QA/SAC Switzerland) for surface ozone, carbon monoxide, methane (since 2000), and carbon dioxide (since 2010), and the World Calibration Center (WCC) for surface ozone, carbon monoxide and methane (WCC-Empa) since 1996, and carbon dioxide since 2010.

The World Glacier Monitoring Service (WGMS) at the University of Zurich collects standardized observations on changes in mass, volume, area, and length of glaciers as well as statistical information on the spatial distribution of perennial surface ice. Through a GCOS Switzerland agreement between MeteoSwiss and the University of Zurich, sustained operation of the WGMS has been secured since 2010. In collaboration with other international institutions, the WGMS jointly runs the Global Terrestrial Network for Glaciers (GTN-G). MeteoSwiss serves as the Swiss Focal Point for the Global Cryosphere Watch (GCW) Programme of WMO.

Historical documentary data provides important information for studies on climate change and is a vital component of long-term systematic climate observation in Switzerland. Euro-Climhist is a database developed and operated by the University of Bern, currently containing more than 120'000 historical documentary records for the period 1550-1864. Until 2015, the database will be expanded to cover the entire previous millennium. It includes early instrumental measurements, daily to seasonal weather reports, observations of lake and river freezing, snow cover, phenology, and the impacts of natural disasters as well as reports on perceptions of weather in Switzerland and Europe. In a public workshop at the University of Bern in 2012, an updated version of Euro-Climhist was released. Sustained operation of Euro-Climhist is secured through a long-term GCOS Switzerland agreement between MeteoSwiss and the University of Bern (since 2010).

Role of satellites

Earth observation satellites are essential to obtain information on climate variables, in particular at the global scale (WMO 2011). Within GCOS Switzerland, satellite-based observations of ECVs have gained in importance (Seiz et al. 2011) and complement conventional observation techniques, eg. for cloud cover (Fontana et al. 2013), snow (Foppa and Seiz 2012), and glaciers (Paul et al. 2011). Switzerland is a member of the European Space Agency (ESA) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). Both ESA and EUMETSAT have strengthened their activities in the field of climate monitoring of atmospheric and terrestrial ECVs over the last four years.

Swiss institutions are involved in a number of international initiatives relying on satellite data, eg. the ESA Climate Change Initiative (CCI) projects on GHG (Empa), Aerosols (Paul Scherrer Institute), Ozone (MeteoSwiss), Clouds (MeteoSwiss, ETH Zurich), Soil Moisture (ETH Zurich), and Glaciers (University of Zurich). Swiss institutions are involved in the ESA Data User Element Project GlobSnow-2 aiming at enhancing retrieval methodologies for snow extent and snow water equivalent based on Earth observation satellites. Since 2004, MeteoSwiss has been a partner of the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF). MeteoSwiss develops and validates algorithms for CM SAF with a focus on complex terrain and snow covered surfaces and contributes with climate data records of global radiation, cloud cover, and land surface temperature from Meteosat First and Second Generation satellites.

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9 Education, training and public awareness

Switzerland has a long-standing tradition on raising public awareness for environmental issues. To some extent, this may be related to the (alpine) landscape and its natural hazards which coined the notion that precautionary measures and risk management represent the only viable strategy to maintain the high standard of living in terms of safety in Switzerland in the long run.

The "traditional" natural hazards (such as e.g. landslides or flooding) still exist, however, some have been (or are projected to be) exacerbated by climate change. Furthermore, relatively rare hazards (such as heat waves and droughts) are expected to occur more often according to regional climate model forecasts. Recurrent severe weather events over the past decades that might potentially be related to a changing climate have reinforced the public perception of climate change.

The sustained attention climate change has received from the public is reflected on the one hand by the way these topics are addressed by politicians: Not only the Green and left-wing parties, which traditionally covered these grounds, but increasingly also parties further to the right include aspects of climate policy in their agenda. Thereby, the importance of climate change issues has gained. On the other hand, also certain fields of business make use of climate related topics, either as a marketing tool or as an element of corporate image and culture.

As outlined in chapter 2.2, unemployment, foreigners and retirement provisions were the top three concerns of Swiss citizens in Switzerland in 2012 (GfS 2012). However, awareness of environmental issues (18%) is continuously increasing (+2% compared to the 2011 survey), a score still far below the 56 % recorded between 1988 and 1995 (Longchamp et al. 2003). According to a study on the public perception and knowledge with regard to environmental issues (Diekmann et al. 2008), climate change was listed as the second most important concern, outweighed by air pollution and exhaust fumes. The results of the survey 2007 were compared to a similar study dating back to 1994. While the ranking of environmental concerns remained the same over the years, the percentage of people assigning a high or very high risk to climate change has increased from 54% in 1994 to 82% in 2007 (Fig. 102). In line with the increased concern about climate change, the knowledge about the main cause for global warming has increased significantly (see Fig. 103).

Fig. 102 > Public perception of risk of climate change

Risk of climate change and global warming to society and the environment as perceived by the Swiss population in 1994 and 2007.

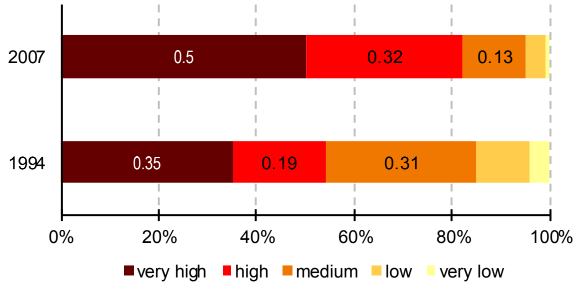
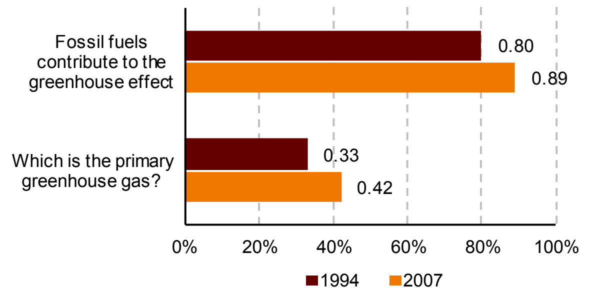


Fig. 103 > Knowledge about greenhouse effect

Comparison of percentage of correct answers to questions regarding greenhouse effect between 1994 and 2007.



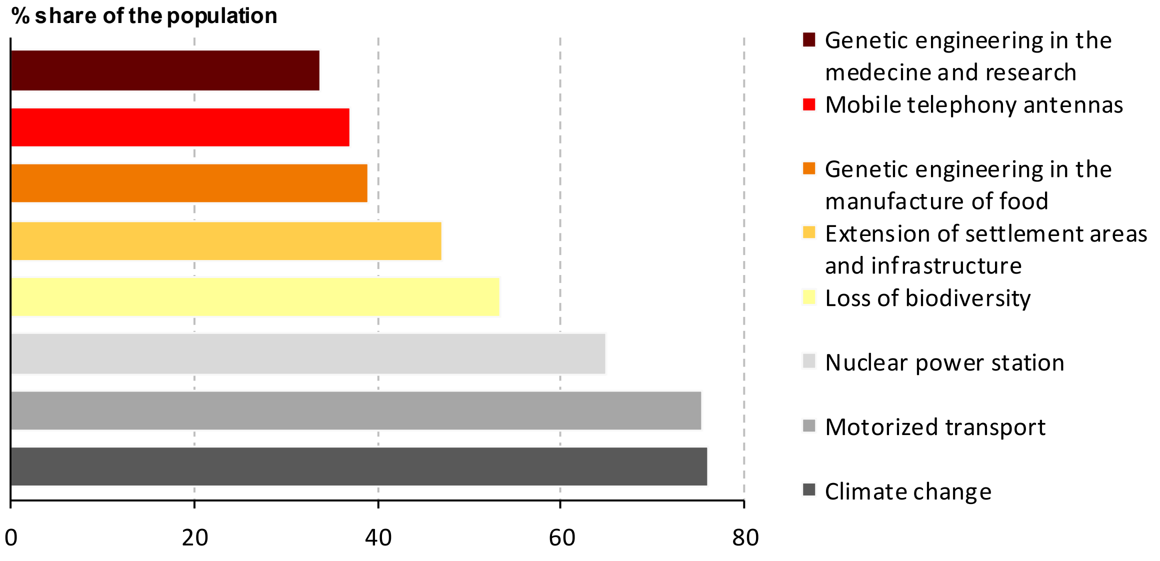
Diekmann et al.(2008)

The increased knowledge may be related to the concerted effort of leading (Swiss) climate researchers in communicating the results of climate and climate-impact research and the cooperation between scientists and the media. The Swiss National Centre of Competence in Research on Climate (NCCR Climate), a nationwide research network funded by the Swiss National Science Foundation in 2001, has facilitated the cooperation between Swiss climate researchers and provided some sort of a national equivalent to international organizations. The fact that some of the leading Swiss scientists actively (and successfully) sought to communicate the results of their research combined with the establishment of independent scientific advisory bodies (OcCC, ProClim) certainly promoted the build-up of knowledge among journalists, politicians and the general public alike. The objectives and activities established by the NCCR Climate did not stop with the conclusion of programm in January 2013, but are pursued in some ways by the Oeschger Centre of the University of Bern and the Center for Climate Systems Modeling (C2SM) at the Swiss Federal Institute of Technology in zürich (ETHZ). The two permanent centres promote the education of young researchers, encourage exchanges between researchers and took the lead in organizing the Swiss Climate Summer School, in replacement of the NCCR Summer School (see section 8.1.1).

Efforts of various players to broadly disseminate knowledge about climate change via the education system also seem to bear fruit, as younger people tend to be more knowledgeable with regard to the scientific basis of climate change compared to older people (Diekmann et al. 2008). The Omnibus survey 2011 (SFSO 2012b) carried out by the Swiss Federal Statistical Office (SFSO) on a sample of Swiss people aged between 15 and 74 years revealed that 39% informed itself at least one time a week about environmental problems and that over 75% pretended to be particularly well informed about climate change and traffic issues (Fig. 104). Myriads of different ways and channels to spread information on climate change are explored by institutions at federal, cantonal and local level. Significant efforts are also made by the scientific community and various non-profit organizations.

Fig. 104 > Information level on environmental issues

Share of the population which pretend to be extremely well or well informed in 2011.



SFSO (2012b)

However, the increased knowledge still contrasts with behaviour, in particular in some areas. While, for example, waste handling and recycling show very high cooperation and compliance, measures involving bigger efforts or which are perceived as limiting individual freedom are not implemented (e.g. individual transport, leisure travel/activities) (SFSO 2013). According to Diekmann et al. (2008), knowledge about environmental issues has only a limited impact on behaviour. A far stronger influence is observed from the consciousness of environmental issues, which itself is partly driven by the exposure to environmental impacts in the personal surroundings. Taking these results at face value means that sustained efforts to raise public awareness and illustrating impacts of climate change to a wide community does contribute to individuals taking action. A few examples of such activities are given in the following sections.

9.1 Climate-related activities by federal, state and local authorities

Many climate-related activities are jointly supported by federal, cantonal, communal and private sector agencies. It is sometimes very difficult to quantify the contribution of each partner in an objective way and to put weights to financial, personal or infrastructure contributions. In the following section, such multi-party initiatives have been assigned to one single subsection. However, this doesn't mean, that the contribution from other institutions was necessarily smaller or less important.

9.1.1 Federal level

Climate change is a complex phenomenon that people find quite often hard to relate to due to the large spatial and temporal dimension it encompasses. The understanding of the scientific basis can be perceived as rather academic, which – on its own – may hinder emotional identification with the problem. While the awareness of the large-scale context is a necessary prerequisite, the relation to the individual's daily life is crucial for a personal commitment. Therefore, education and outreach activities need to address various different levels, ranging from the general understanding of the climate system and its drivers over to practical advice in areas of every-day life. Several federal agencies collaborate in covering these topics.

The Swiss Federal Office for the Environment (FOEN), the Federal Office of Meteorology and Climatology MeteoSwiss, and the Swiss Federal Office of Energy (SFOE) maintain comprehensive websites that cover aspects of climate change, climate politics and energy politics. The Federal Office of Meteorology and Climatology MeteoSwiss provides climatological services and information including regular updates on the current state of the Swiss climate and climate change, climate predictions on seasonal to multi-decadal time scales and a number of fact sheets covering a variety of climate topics (*www.meteoswiss.admin.ch*). MeteoSwiss co-founded and supports the Centre for Climate Systems Modelling (C2SM), a joint initiative of different authorities and institutes to improve the understanding of the Earth's climate system. Education, training, and rising of public awareness are important components of the emerging WMO-led Global Framework for Climate Services (GFCS). Based on this international framework, MeteoSwiss – in collaboration with several federal authorities and institutes – is in the process of establishing a Swiss National Framework for Climate Services. ProClim, MeteoSwiss, OcCC and FOEN jointly support the web portal *www.climate-change.ch*. The Federal Office for Spatial Development coordinates all efforts within the framework of Agenda 21 for the implementation of sustainable development in Switzerland and the Federal Office for Civil Aviation maintains a website with fact sheets about aircraft emissions and climate impact from aviation.

The Federal Office of the Environment and the Federal Office of Meteorology and Climatology MeteoSwiss also respond to climate-related enquiries from the general public. The FOEN provides access to the official documents submitted by the Swiss Confederation under the UNFCCC and the Kyoto Protocol (*www.climatereporting.ch*) and to the latest emission statistics.

These information channels are supplemented with a wide spectrum of magazines, reports and newsletters published by federal agencies (e.g. FOEN 2008; FOEN 2011; FOEN 2013b; Perroud and Bader 2013; Seiz and Foppa 2007; Taverna et al. 2007), media releases, as well as talks and public appearances at exhibitions and meetings by representatives of the federal administration.

9.1.2 State (canton) level

The cantonal environmental authorities have set up and maintain websites where information and links related to climate change as well as practical guidance for environmentally friendly actions are found. The conference of the directors of the cantonal offices for the environment (*www.kvu.ch*) helps to exchange experiences, coordinate activities and promote best practices between the cantons. Activities related to education and outreach are very diverse, addressing a wide audience that ranges from school children, house-owners to professionals in specific sectors. The following list gives a few selected examples to illustrate the breadth and inventiveness of the cantonal authorities:

- The cantons of Basel City and Geneva as well as the city of Zürich have committed themselves to the goal of the "2000-Watt Society". These pilot regions prepared wide scale actions plans at the cantonal level and outside, launched communication campaigns and could demonstrate that the objectives can be realized. Six pioneer cities (Buchs, Erstfeld, Illnau-Effretikon, Planken FL, Vevey und Zürich) got involved in the process and took engagements to reduce energy consumption;
- "Education trails on themes related to Climate": Various cantons (e.g. Berne, Lucerne, Grisons, Valais) have added information panels along hiking trails that show particularly strong evidence of climate change. The information panels represent snippets of information, provide more philosophical considerations, and give practical advice for actions;
- "Energy-Apéros": Informal meetings open to the general public that provide a platform for information exchange, networking and promotion of innovation in the area of energy efficiency (http://www.energie-cluster.ch/events/veranstaltungen/energie-aperos-2013);
- Various activities focusing on sustainable development in the framework of Agenda 21. Initiatives are also realized at a local level;http://www.are.admin.ch/themen/nachhaltig/agenda21/index.html?lang=fr
- "Energy detectives": Initiative of the canton of Basel Stadt that invites school children to investigate energy usage and search for energy-saving measures in their daily life. A newsletter provides information on a particular topic, makes suggestions for activities, and invites children to special events (www.energiedetektive.ch);
- "The challenge of climate change": General information brochure published by the canton of Berne that illustrates impacts of climate change with respect to the local conditions, i.e. how the glaciers in the Bernese Alps retreat, how the snowline may rise in the future, or what the projected changes in precipitation pattern mean for the local hydrological balance (AUE 2006);
- "Minergie-Prize": Minergie ® is a label awarded to energy-efficient buildings. The canton of Berne has established a competition amongst its municipalities, rating the status, the development and the efforts in terms of energy efficiency in the building stock sector (www.minergierating.ch). Three municipalities were awarded in 2011.

9.1.3 Local level

Activities at the local level are often aimed at raising awareness for the general issue of climate change, combined with practical advice on how to make a difference in its own environment. Many towns and cities have joined the association "Climate Alliance" that is loosely linked to the European association of cities. A few creative examples are given to illustrate some of these activities:

- "ECORegion": Climate Alliance encourages cities and towns committed to climate protection and aiming to reduce greenhouse gas emissions to establish regular emission inventories to fix objectives and assess effectiveness of measures taken in the energy and environmental sector. Martigny and Lausanne tested and produced a municipal GHG emssions inventory in 2009 already;
- Various regions and communities make improvement in the energy sector. This is presented in section 9.2;
- "Covenant of Mayors": A number of Swiss cities signed the "Covenant of Mayors", a European movement which aims at improving energy efficiency and promoting the use of renewable energy at a region-

al level. Covenor signatories voluntarily commited to reduce their CO2 emissions by more than 20% by 2020 compared to the base year 1990;
- "Municipalities friends of ancient forests": 600 municipalities have joined in the action for a sustainable procurement of wood and paper-based products supported by FUPS, the organisation to promote environmentally compatible paper products and office ecology;
- "Kids on the move": An international initiative joined by the city of Zurich, providing an incentive for school children to walk to school and reflect their own and their parents' mobility habits (http://klimabuendnis.ch/de/Info/Aktivitaten/Kindermeilen-Kampagne);
- "Climat Local" : People over 50 years are offered the possibility to get involved in climate protection project by organizing cultural events in their municipality, taking actively part to awareness campaigns and discussing current issues with the younger generation. The first group is formed in the city of Dietikon in 2012;
- Various initiatives offer voluntary GHG compensation activities for companies (https://www.myclimate.org/en/offsetting.html, http://www.swissclimate.ch/e/);
- Various cities offer voluntary compensation activities. By doing so, the issue of climate change remains on the political agenda and funds for mitigation and adaptation measures can be raised;
- NewRide: Initiative aimed at increasing the use of electric bikes and scooters as an alternative to less efficient individual transport (www.newride.ch/).

9.2 Selected government-supported activities in the energy sector

The promotion of education, training and public awareness is one of the main priorities of the SwissEnergy programme. In order to establish innovations, specialists have to be familiar with new materials and technological developments. To accelerate the transfer of knowledge, SwissEnergy launches an educational campaign in line with the Energy Strategy 2050.

To ensure the acceptance of energy innovations in practice, the knowledge of experts has to be updated constantly, including all steps from planning to construction to the operation of buildings. In close coordination with industry associations, professional organizations and the providers of education and training courses, SwissEnergy wants to involve all relevant target groups in an educational campaign. The new training courses cater to planners, civil engineers and craftsmen as well as experts from industry, trade and services.

The educational campaign is based on the following six main objectives:

- Accelerate knowledge transfer and enhance the quality of offers: With hands-on training offers, the competence of professionals in the field of buildings and facilities is to be quickly improved;
- Renewal of educational documents: The comprehensive training offer requires qualitatively advanced and technically up-to-date training material;
- Initiate passage programs ("Passerelle"): Offerings for newcomers with a different educational background can recruit additional experts - in particular for vocational fields with a lack of trainees. The programs are based on pilot projects implemented in 2011 as part of the third stabilization program;
- Include energy issues in vocational education systematically: The issues of energy efficiency and renewable energy have to be quickly incorporated into the basic vocational education;
- Ensure expertise for the enforcement: Selective training is needed to implement cantonal regulations and measures concerning the energy strategy 2050 effectively;
- Raising awareness in elementary schools: Even students should be sensitized to the careful handling of energy;
- For the implementation of the educational initiative, funds for education and training were increased from previously CHF 2.5 million to CHF 7 million per year, starting from 2014.

SwissEnergy, the platform for all voluntary measures and the networking of actors

Information about all these issues can be found on the new information portal of SwissEnergy, www.energieschweiz.ch which was launched autumn 2011. In addition to extensive information on energy efficiency and renewable energy, the newly developed website offers individual queries, for example, on energy subsidies in a particular municipality.

To make sure that measures promoting energy efficient technologies and renewable energies are well understood and accepted, SwissEnergy bolsters the competent consulting of investors, buyers and operators of facilities, appliances and buildings regarding the profitability of innovations. Therefore, SwissEnergy aims to include manufacturers and sellers of appliances and facilities increasingly in the communication efforts. For that matter, future-oriented energy applications should be announced as well, such as new lighting technologies or chances in electric mobility.

Central communication hub is the website www.energieschweiz.ch. In addition, various means of communication are used:

- TV commercials, advertisements and brochures, appearances at trade fairs and exhibitions, used to inform and sensitize the general public;
- Education and training: motivation campaigns in the energy field for technical professions and for teachers at the elementary school;
- Information materials such as website, brochures, leaflets, consulting and training;
- Advertorials: These articles in industry publications provide background knowledge, responding to the specific needs of the particular professional audience;
- Special newsletter for homeowners, giving tips and instructions regarding the energy efficiency of buildings;
- "energyday»: This event aligned to a broad public is organized in close cooperation with partners from the industry of domestic appliances and electronics.

In the framework of the program "SwissEnergy for communities", the SFOE promotes the program "Energy Region," supporting regions which want to become advanced regions in terms of energy autarky. The program enables regions to improve local energy provision in accordance with their needs. The participating municipalities can promote synergies among each other and aim at intercommunal solutions. With the free of charge tool "energy-region" regions can establish local and regional energy and CO_2 balances in a simple way. This can be used by professionals for consultation or by private persons for deepening their knowledge. Furthermore, regions have the possibility to involve specially trained "energy region" consultants.

The program "Energy City" aims to promote renewable energies, a sustainable mobility and an efficient use of resources in Swiss cities. The Swiss label "Energy City" which acted as the model for the European Energy Award, is a reference for communities exemplifying and implementing a sustainable local energy policy. Communities with this label pass through an extensive process leading to sustainable energy, transport and environmental policies and authorities, entrepreneurs and people working together.

Under the umbrella of "SwissEnergy for Communities", the programs "energy region" and "Energy City" along with the programs "sustainable neighbourhoods", "2000 Watt Society" and "smart cities" build a broad basis for effective development of the Swiss municipalities. The interaction of these programs enables decision-makers and experts to analyze the situation and take specific steps towards a sustainable future under the point of view of environment, society and economy.

9.3 Further activities with government support

Scientific advisory bodies

The scientific advisory bodies ProClim- and OcCC are the most prominent organizations that regularly publish the latest information on climate change research.

Initiated in 1988, ProClim- is an independent organization of the Swiss Academy of Sciences. Its mission includes the promotion of interdisciplinary scientific collaboration and the distribution and exchange of information on global change science within Switzerland. It aims at providing a holistic view on climate change, including the physical climate system, biogeochemical processes and the human dimensions of global change. ProClim- seeks to further nationwide networking amongst people and institutions involved. An important tool in this respect is the climate change information system, which provides easy access to information on ongoing research activities and expertise. Additionally, ProClim- organizes the annual "Swiss Global Change Day", where the Swiss climate change community meets and discusses the latest results in climate change research.

The Advisory Body on Climate Change (OcCC) was appointed in 1996 by the Federal Department of Home Affairs (FDHA) and the Federal Department of the Environment, Transport, Energy and Communication (DETEC). Its role is to formulate recommendations on questions regarding climate and global change for politicians and the federal administration. The mandate to create this body was given to the Swiss Academy of Sciences (scnat), which selected approximately 30 people from research, the private sector and the federal administration to participate in this body. The FOEN provides federal representation.

ProClim- and OcCC maintain websites where a wealth of information, contact details of various experts as well as links to related institutions in Switzerland and abroad can be found (*www.climate-change.ch*, *www.proclim.ch/*, *www.occc.ch*). They are involved in translating and distributing the summaries of the IPCC reports. Various brochures and reports aimed at the general public have been published recently. They discuss the latest IPCC results from a Swiss point of view (OcCC 2008) and deal with longer term objectives of the Swiss climate policies, as in terms of CO_2 emissions reduction (OcCC 2012).

A further scientific advisory body, created in 1997 with governmental support, is the National Platform for Natural Hazards, PLANAT. It is specialised for coordinating concepts in the field of prevention against natural hazards.

Further activities

Apart from these two well-established institutions, various other initiatives are supported by federal agencies. As climate change becomes particularly visible in the Alpine regions of Switzerland, several tourist destinations have set up hiking trails along which information about the climate system, its past and future changes and the main drivers of climate change are explained. Most of these information panels were developed in collaboration with a research group of one of the leading Swiss universities in climate research. The ETHZ has gone one step further and developed a freely available e-learning environment based on the hiking trail in the Engadine (*www.klimaweg.ethz.ch*) As well, in collaboration with the ETHZ and the Swiss Alpine-Club, Myclimate also set up audio climate trails in various location of Switzerland (*myclimate-audio-adventure.ch*).

The Swiss Academies of Arts and Sciences have been mandated to support the foundation "Science et Cité", which is aimed at a dialogue between science and society on various topics. Climate change is among the themes that are regularly present on the agenda of Science et Cité.

The FOEN is also involved in shaping the area of education and training in the environment sector. While education is controlled at the cantonal level, FOEN provides input on priorities and financial support to specific projects. Mostly, FOEN is delegating the implementation to partner organization, such as the education branch of WWF Switzerland, or éducation21. The foundation éducation21 coordinates and promotes Education for Sustainable Development (ESD) in Switzerland. This newly national competence centre (January 2013) also acts on behalf of the Swiss Conference of Cantonal Ministers of Education (EDK), the Swiss Agency for Development and Cooperation and the Federal Office of Public Health and covers, in addition to global and environmental education, health education (other themes being soon integrated).

9.4 Private sector initiatives

There exists a myriad of ongoing private sector initiatives related to climate change in Switzerland. Their focus range from fostering individual actions (e.g. environmentally conscious consumption or environmentally friendly renovations and constructions etc.), improving information and education about climate change (e.g. in schools) and raising public awareness and involvement, to climate protection initiatives in Swiss companies, cities and regions. Additionally, Swiss companies and foundations are also very active in supporting climate change events, projects, campaigns and funds etc. outside Switzerland.

In Switzerland, there is a long standing tradition of voluntary climate protection measures by companies (see section 4.3.3). Climate change is not only perceived as a challenge by Swiss companies, but also as a chance for new business opportunities, improving sustainable development and competitiveness.

Voluntary compensation of CO_2 emissions

Many Swiss companies are undertaking voluntary efforts to minimize their climate impacting emissions and making their contribution to climate protection. Some have even decided to voluntarily compensate their (unavoidable) CO_2 emissions, mainly by using carbon offset projects.

- Examples of climate-neutral services: The first fully climate neutral hotel chain in the world is located in Switzerland. Beside the effort to reduce their emissions by energy efficiency and other climate-friendly measures, the hotel chain offsets its remaining emissions. Also Swiss youth hostels offer guests the option of a climate neutral overnight stay. Examples of other climate-neutral services are flights, printing, sending of letters and packets, heating, driving or car sharing etc.
- -Examples of climate-neutral products: There are several companies offering climate-neutral products, such as food and drinks, T-Shirts, flower bouquets, vegetable gardening etc.

Climate Labels

Several Swiss companies and organisations provide climate labels (Swiss Climate, myclimate, WWF Climate Group, Axpo, ClimatePartner, fair recycling, c0mpensate ect.). Some climate labels distinguishe organisations that offset their CO_2 emissions in carbon offset projects. Other climate labels demand that companies not only offset their greenhouse gas emissions, but also make efforts to avoid and reduce climate-relevant emissions. Climate labels are not only intended for entire companies, but also individual company divisions, products or events.

Energy Agency for the Economy

The agency assists companies to reduce CO_2 emissions, increase energy efficiency and tap the potential of cost-efficient and climate-friendly measures in the Swiss industry, trade and service sector (see section 4). The Energy Agency for the Economy mainly coordinates, evaluates and imparts knowledge and information about possible measures and instruments in the different companies and sectors.

Research and development

In 2010 the Commission for Technology and Innovation CTI launched an initiative to promote research and development in the Cleantech sector broadly defined as resource efficiency and renewable energies. One of the measures was the 'Cleantech innovation cheque', which enabled SMEs to obtain research and development services from public research institutions to the value of up to CHF 7'500 per cheque. 115 joint projects were successfully carried out mainly by small firms (under 10 employees), 80% of these in collaboration with universities of applied sciences. The total amount spent by CTI was CHF 1 million.

Additionally, in 2012 CTI funded 65 collaborative projects with a focus on Cleantech i.e. resource protection, resources management, sustainable mobility, efficient energy systems, and renewable energies. The funds allocated amounted to CHF 22 million matched by nearly CHF 30 million from private sector businesses. This represents roughly 15% of all projects and funds allocated by CTI.

Information

Swiss companies and associations organize an increasing number of activities and events, aimed at increasing public awareness and consciousness towards climate change, its challenges and potential measures for mitigation or adaptation.

- **Information for consumers:** Several environmental and governmental organization, companies, consumer and other associations provide information on ecological behaviour, sustainable consumption and individual climate protection measures through media, such as internet, brochures, lists of particularly environmentally friendly products etc. Tools, such as CO_2-calculators, climate checks, labelling and certifications assist individuals, consumers and homeowners to adopt more environmentally friendly decisions and behaviours.
- **Swiss Association for Environmentally Conscious Management**: The Swiss Association for Environmentally Conscious Management (ÖBU) encompasses 330 Swiss companies of all sizes and from all economic sectors. One of its top priorities is climate change. The activity of ÖBU is based on different instruments, such as exchange of experiences (workshops, conferences, strategies, working groups etc.), a website for companies with different tools such as a presentation of good practice examples, publications, a questionnaire to estimate the potential of sustainable economic activity (*www.proofit.ch*) and improvement of framework conditions, namely by fostering the dialogue between policy and economy.
- **WWF and Greenpeace Switzerland:** WWF and Greenpeace Switzerland have long track records on energy and climate issues and have launched – among many other initiatives in Switzerland – several information and education campaigns to increase public awareness in Switzerland.
- **Swiss Transport and Environment Association:** The Swiss Transport and Environment Association (VCS) is continuously promoting human-oriented and environmentally sound mobility since 1979. As Switzerland's second-largest transport association, it lobbies for a sustainable transport policy. Each year, as part of its commitment to climate policy, the association publishes the VCS environmental guide for car buyers (German: *www.autoumweltliste.ch*; French: *www.ecomobiliste.ch*), which rates various models by CO_2, pollutant and noise emissions. As well as an environmental assessment of over 500 models and best-buy lists, the publication provides a wide range of advice and information for prospective buyers.

9.5 International cooperation

Switzerland is cooperating in various international efforts, e.g. in the framework of Agenda21. Recent examples of Swiss contributions to international education and outreach activities are listed below.

World Climate Conference WCC-3

Switzerland hosted the WCC-3 of the WMO in September 2009. This international conference is partly a scientific conference, where latest results are discussed, and partly a forum for policy makers to define a common strategy. During the conference, Switzerland and Denmark organized a ministerial meeting on adaptation with the aim of underlining the importance of the science-based climate predictions and risk assessments as discussed at WCC-3 for planning of adequate adaptation measures.

World Wide Views on Global Warming

Switzerland is part of the world-wide initiative that gives citizens all over the world the opportunity to communicate their positions on issues related to the international climate policy.

Francophonie (CB activities during CH presidency - sommet de la Francophonie)

During its presidency of the Organization of La Francophonie (77 French-speaking countries), 2010 to 2012, Switzerland has sought to promote fruitful exchanges on climate matters among OIF countries. It has done so repeatedly not only at all meetings of the Francophonie, but also during conferences of State parties to the United Nations Framework Convention on Climate Change. Although this presidency has now been passed on to the Democratic Republic of Congo, Switzerland continues its commitment to foster regular exchanges on important climate-related matters among French-speaking countries and subregions.

CC:Learn (pilot-phase 2011-2013)

CC:Learn is a collaborative initiative with the goal to foster country-driven, results-oriented and sustainable learning to address climate change in Member States. The pilot implementing phase, 2011-2013, in five countries (Benin, Dominican Republic, Indonesia, Malawi and Uganda) has been funded by the Swiss Agency for Development and Cooperation (SDC).

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[26] Where available, references are provided online at www. climatereporting.ch

Annex 1: Summary of reporting of the supplementary information under Art. 7, para. 2 of the Kyoto Protocol

Tab. 46 > Supplementary information under the Kyoto Protocol

Information reported under Article 7, paragraph 2	Section
National systems in accordance with Article 5, paragraph 1	3.4
National registry	3.5
Supplementarity relating to the mechanisms pursuant to Articles 6, 12 and 17	4.4.2 and 5.3
Policies and measures in accordance with Article 2	4
Domestic and regional programmes and/or legislative arrangements and enforcement and administrative procedures	4.2
Information under Article 10 Art 10a Art 10b Art 10c Art 10d Art 10e	 3.4 4.3 and 6.3 7.4 8 9
Financial resources (Annex II only)	7

Annex 2: Biennial Report

A.1. Information on greenhouse gas emissions and trends.

According to the most recent annual inventory submission (September 2013), Switzerland emitted 50.163 million t CO_2 eq (excluding LULUCF and international bunkers) in 2011. With a share of 84%, the largest contributor gas was CO_2, 41.978.64 million t, and the most important source was the energy sector with 39.989.66 million t CO_2 eq. **Tables 1s1, 1s2, 1s3** show emissions by gas and sector in Switzerland over the period 1990 – 2011.

In order to understand the variations in the sectors, the trends for all major source and sink categories have been considered **(Tables 1(a)s1 - 1(d)s3).**

Emissions from the energy sector, the most relevant sector for Switzerland GHG emissions, remained at relatively constant level since 1990, despite differing trends for the sub-sectors. In the sector 2 Industrial Processes, emissions increased steadily between 1998 and 2011, but tend to stabilize since 2005. The decreasing trend in emissions of sector 3 Solvent and other product use and sector 6 Waste is less pronounced since 2004 and 2000, respectively. Emissions of sector 4 Agriculture remained relatively stable since 2004.

Excerpt from the Swiss 2013 GHG inventory submission to the UNFCCC secretariat (FOEN 2013) is reported in NC6, section 3. It provides more information on greenhouse gas emissions and emissions trends and details the national inventory arrangements. Note that the GHG emissions presented in the summary tables of this biennial report deviate slightly from the values reported in the NC6. The NC6 is based on the submission of April 2013, whereas the biennial report on the submission of September 2013. The bias of 153kt CO_2 eq in the total emissions corresponds to an underestimation of the Swiss GHG emissions of 0.3%. This small difference does not affect the conclusions of chapter 3.

Table 1 CHE_BR1_v0.3

Emission trends: summary (1) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 1 of 3)

GREENHOUSE GAS EMISSIONS	Base year[a] *Base year* [a]	1991	1992	1993	1994	1995	1996	1997	1998
	(kt CO_2eq)[(3)]kt	*kt CO_2 eq*	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
CO_2 emissions including net CO_2 from LULUCF	41,497.79	43,110.26	43,273.14	39,519.16	39,901.68	39,783.24	39,512.41	38,050.52	39,636.35
CO_2 emissions excluding net CO_2 from LULUCF	44,671.97	46,404.17	46,302.16	43,765.88	43,026.01	43,685.12	44,345.36	43,526.75	44,831.53
CH_4 emissions including CH_4 from LULUCF	4,684.05	4,647.64	4,512.41	4,377.28	4,285.56	4,272.43	4,197.01	4,099.44	4,046.42
CH_4 emissions excluding CH_4 from LULUCF	4,675.86	4,646.54	4,512.03	4,376.97	4,283.38	4,269.17	4,195.28	4,088.21	4,044.57
N_2O emissions including N_2O from LULUCF	3,468.17	3,466.58	3,443.55	3,364.55	3,324.24	3,330.12	3,332.93	3,226.75	3,216.70
N_2O emissions excluding N_2O from LULUCF	3,457.81	3,460.36	3,437.77	3,358.82	3,317.48	3,322.84	3,326.63	3,215.05	3,210.59
HFCs	0.02	0.25	6.57	14.59	33.74	180.75	227.01	300.12	356.24
PFCs	100.21	84.70	69.26	29.69	17.66	14.69	17.20	20.04	22.83
SF_6	143.62	145.92	148.21	126.35	112.04	97.73	94.42	130.61	160.18
Total (including LULUCF)	49,893.86	51,455.34	51,453.15	47,431.62	47,674.92	47,678.96	47,380.98	45,827.48	47,438.73
Total (excluding LULUCF)	53,049.50	54,741.93	54,476.00	51,672.30	50,790.32	51,570.31	52,205.90	51,280.78	52,625.94

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a] *Base year* [a]	1991	1992	1993	1994	1995	1996	1997	1998
	(kt CO_2eq)[(3)]kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq	kt CO_2 eq
1. Energy	42,083.22	44,185.40	44,216.36	41,908.97	41,013.18	41,876.84	42,723.13	42,066.32	43,384.20
2. Industrial Processes	3,380.95	3,023.31	2,868.43	2,563.29	2,725.07	2,654.90	2,530.25	2,468.14	2,563.62
3. Solvent and Other Product Use	470.11	443.91	419.86	391.75	374.25	353.76	330.80	308.05	286.35
4. Agriculture	6,092.10	6,069.45	5,978.83	5,877.37	5,808.00	5,819.29	5,780.01	5,605.71	5,577.86
5. Land Use, Land-Use Change and Forestry[b]	-3,155.63	-3,286.59	-3,022.85	-4,240.68	-3,115.40	-3,891.36	-4,824.92	-5,453.31	-5,187.22
6. Waste	1,010.98	1,007.54	980.01	918.23	856.94	852.45	828.44	819.10	800.27
7. Other	12.13	12.33	12.52	12.69	12.89	13.08	13.27	13.46	13.65
Total (including LULUCF)	49,893.86	51,455.34	51,453.15	47,431.62	47,674.92	47,678.96	47,380.98	45,827.48	47,438.73

Note: All footnotes for this table are given on sheet 3.

The common tabular format will be revised, in accordance with relevant decisions of the Conference of the Parties and, where applicable, with decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto

Table 1 CHE_BR1_v0.3

Emission trends: summary (1) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 2 of 3)

GREENHOUSE GAS EMISSIONS	Base year[a] *1999* (kt CO_2eq)(3)kt	2000 *kt CO_2 eq*	2001 kt CO_2 eq	2002 kt CO_2 eq	2003 kt CO_2 eq	2004 kt CO_2 eq	2005 kt CO_2 eq	2006 kt CO_2 eq	2007 kt CO_2 eq	2008 kt CO_2 eq
CO_2 emissions including net CO_2 from LULUCF	41,400.75	42,800.77	45,224.85	43,625.33	42,133.93	41,182.34	42,185.02	43,121.22	41,258.02	43,956.18
CO_2 emissions excluding net CO_2 from LULUCF	44,953.84	44,033.03	44,989.10	43,942.72	45,129.68	45,758.68	46,387.04	46,018.68	44,048.47	45,576.73
CH_4 emissions including CH_4 from LULUCF	3,984.83	3,916.55	3,931.06	3,880.33	3,787.15	3,765.89	3,772.40	3,782.74	3,781.89	3,845.44
CH_4 emissions excluding CH_4 from LULUCF	3,984.76	3,916.28	3,930.79	3,877.28	3,782.95	3,765.74	3,772.05	3,781.99	3,780.15	3,845.05
N_2O emissions including N_2O from LULUCF	3,187.95	3,188.49	3,215.78	3,198.20	3,143.57	3,092.22	3,074.80	3,073.69	3,094.90	3,113.98
N_2O emissions excluding N_2O from LULUCF	3,183.02	3,183.56	3,210.98	3,191.91	3,136.72	3,087.85	3,070.37	3,069.08	3,089.77	3,109.74
HFCs	418.70	498.54	593.71	635.19	707.87	818.16	900.68	926.36	960.23	1,025.58
PFCs	35.88	69.09	45.22	40.29	57.01	52.53	32.88	32.36	28.86	39.06
SF_6	146.90	157.79	157.09	168.27	174.06	189.84	212.99	200.87	185.75	244.72
Total (including LULUCF)	49,175.01	50,631.23	53,167.72	51,547.62	50,003.59	49,100.97	50,178.77	51,137.24	49,309.65	52,224.97
Total (excluding LULUCF)	52,723.10	51,858.29	52,926.88	51,855.66	52,988.29	53,672.80	54,376.00	54,029.34	52,093.22	53,840.88

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a] *1999* (kt CO_2eq)(3)kt CO_2 eq	2000 *kt CO_2 eq*	2001 kt CO_2 eq	2002 kt CO_2 eq	2003 kt CO_2 eq	2004 kt CO_2 eq	2005 kt CO_2 eq	2006 kt CO_2 eq	2007 kt CO_2 eq	2008 kt CO_2 eq
1. Energy	43,484.34	42,403.64	43,339.89	42,313.12	43,520.13	43,955.07	44,475.51	44,136.44	42,131.62	43,683.76
2. Industrial Processes	2,667.83	2,938.03	3,043.64	3,043.22	3,092.16	3,362.96	3,538.35	3,517.62	3,541.02	3,667.03
3. Solvent and Other Product Use	273.07	258.55	245.01	233.31	224.46	211.32	210.80	205.16	204.31	201.04
4. Agriculture	5,511.20	5,495.70	5,560.99	5,535.79	5,460.86	5,447.40	5,474.18	5,494.09	5,555.69	5,648.46
5. Land Use, Land-Use Change and Forestry[b]	-3,548.09	-1,227.06	240.84	-308.04	-2,984.70	-4,571.83	-4,197.24	-2,892.10	-2,783.57	-1,615.91
6. Waste	772.80	748.31	723.27	716.12	676.56	681.92	663.02	661.87	646.41	626.41
7. Other	13.86	14.05	14.09	14.10	14.12	14.13	14.14	14.16	14.17	14.18
Total (including LULUCF)	49,175.01	50,631.23	53,167.72	51,547.62	50,003.59	49,100.97	50,178.77	51,137.24	49,309.65	52,224.97

Note: All footnotes for this table are given on sheet 3.

Table 1 CHE_BR1_v0.3

Emission trends: summary (1) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 3 of 3)

GREENHOUSE GAS EMISSIONS	*2009*	2010	2011	Change from base to latest reported year
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	(%)
CO_2 emissions including net CO_2 from LULUCF	42,264.77	43,632.41	38,562.09	-7.07
CO_2 emissions excluding net CO_2 from LULUCF	44,362.30	46,041.18	41,978.64	-6.03
CH_4 emissions including CH_4 from LULUCF	3,788.91	3,767.87	3,735.62	-20.25
CH_4 emissions excluding CH_4 from LULUCF	3,788.60	3,767.69	3,734.38	-20.13
N_2O emissions including N_2O from LULUCF	3,070.56	3,138.87	3,079.61	-11.2
N_2O emissions excluding N_2O from LULUCF	3,066.48	3,135.01	3,075.24	-11.06
HFCs	1,065.13	1,119.04	1,171.45	5,199,794.59
PFCs	35.17	36.71	39.36	-60.72
SF_6	187.12	154.77	164.37	14.45
Total (including LULUCF)	50,411.65	51,849.67	46,752.49	-6.3
Total (excluding LULUCF)	52,504.79	54,254.39	50,163.44	-5.44

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2009*	2010	2011	Change from base to latest reported year
	kt CO_2 eq	*kt CO_2 eq*	kt CO_2 eq	(%)
1. Energy	42,557.80	44,050.12	39,989.66	-4.97
2. Industrial Processes	3,531.45	3,748.40	3,769.60	11.5
3. Solvent and Other Product Use	200.1	197.56	199.43	-57.58
4. Agriculture	5,593.50	5,647.19	5,603.54	-8.02
5. Land Use, Land-Use Change and Forestry [b]	-2,093.14	-2,404.73	-3,410.94	8.09
6. Waste	607.74	596.92	586.99	-41.94
7. Other	14.2	14.21	14.22	17.22
Total (including LULUCF)	50,411.65	51,849.67	46,752.49	-6.3

Footnotes Table (1) summary

Notes :

(1) Further detailed information could be found in the common reporting format tables of the Party's greenhouse gas inventory, namely

(2) 2011 is the latest reported inventory year.

(3) 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Includes net CO_2, CH_4 and N_2O from LULUCF.

Table 1 (a) CHE_BR1_v0.3

Emission trends (CO_2) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*Base year* [a]	1991	1992	1993	1994	1995	1996	1997	1998
	(kt)kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	41,178.36	43,273.78	43,335.63	41,077.22	40,198.64	41,077.01	41,926.33	41,295.06	42,614.46
A. Fuel Combustion (Sectoral Approach)	41,087.00	43,167.36	43,233.46	40,979.58	40,116.56	41,000.67	41,844.06	41,216.47	42,540.71
1. Energy Industries	2,503.76	2,768.02	2,854.39	2,507.51	2,541.75	2,575.87	2,788.11	2,748.44	3,066.61
2. Manufacturing Industries and Construction	6,106.38	6,289.90	5,948.80	5,866.98	5,868.02	6,061.06	5,837.89	5,736.28	5,918.99
3. Transport	14,347.47	14,830.39	15,144.35	14,094.72	14,277.88	13,969.90	14,025.80	14,577.30	14,793.75
4. Other Sectors	17,925.81	19,092.82	19,107.95	18,340.72	17,264.82	18,247.13	19,056.37	18,008.72	18,616.63
5. Other	203.58	186.22	177.96	169.64	164.09	146.71	135.90	145.74	144.74
B. Fugitive Emissions from Fuels	91.36	106.42	102.17	97.65	82.08	76.34	82.27	78.59	73.76
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	91.36	106.42	102.17	97.65	82.08	76.34	82.27	78.59	73.76
2. Industrial Processes	3,059.34	2,721.11	2,581.20	2,332.29	2,492.76	2,294.20	2,126.09	1,958.35	1,962.29
A. Mineral Products	2,696.79	2,364.34	2,223.32	2,034.97	2,219.75	2,100.25	1,898.29	1,711.29	1,712.74
B. Chemical Industry	109.80	107.63	110.30	109.01	109.07	87.01	109.57	122.46	107.71
C. Metal Production	251.71	248.20	246.75	187.59	163.32	106.42	118.03	124.28	141.40
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	1.04	0.94	0.83	0.73	0.62	0.52	0.20	0.32	0.44
3. Solvent and Other Product Use	359.98	337.91	318.45	295.26	282.72	267.33	249.76	232.61	216.41
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry	-3,174.18	-3,293.91	-3,029.02	-4,246.72	-3,124.34	-3,901.89	-4,832.95	-5,476.23	-5,195.18
A. Forest Land	-4,228.88	-4,485.28	-4,034.10	-5,317.13	-4,828.49	-4,868.51	-5,723.39	-6,392.95	-6,563.79
B. Cropland	385.33	519.88	332.22	391.61	968.54	201.85	105.44	122.20	533.00
C. Grassland	164.06	164.41	165.13	176.98	219.77	230.31	257.43	264.72	300.64
D. Wetlands	18.54	18.89	18.99	20.67	26.42	29.88	28.36	29.44	30.13
E. Settlements	391.14	392.63	393.12	387.49	384.16	397.18	392.52	393.39	393.82
F. Other Land	95.63	95.56	95.63	93.68	105.26	107.40	106.69	106.98	111.01
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	63.33	60.21	55.53	49.58	40.18	34.68	31.09	28.45	25.89
A. Solid Waste Disposal on Land	9.24	10.70	10.66	9.66	5.79	5.12	4.46	4.33	4.28
B. Waste-water Handling									
C. Waste Incineration	54.10	49.51	44.87	39.92	34.39	29.56	26.63	24.12	21.61
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (as specified in the summary table in CRF)	10.96	11.15	11.34	11.52	11.71	11.90	12.09	12.28	12.47
Total CO2 emissions including net CO2 from LULUCF	41,497.79	43,110.26	43,273.14	39,519.16	39,901.68	39,783.24	39,512.41	38,050.52	39,636.35
Total CO2 emissions excluding net CO2 from LULUCF	44,671.97	46,404.17	46,302.16	43,765.88	43,026.01	43,685.12	44,345.36	43,526.75	44,831.53
Memo Items:									
International Bunkers	3,125.66	3,047.07	3,240.50	3,375.20	3,489.50	3,709.58	3,853.95	4,000.59	4,183.04
Aviation	3,065.92	2,991.86	3,184.16	3,319.07	3,428.71	3,654.00	3,804.56	3,951.57	4,143.03
Marine	59.74	55.21	56.34	56.13	60.79	55.58	49.39	49.02	40.01
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass	4,866.37	5,013.77	4,885.18	4,889.73	4,665.04	4,865.55	5,178.03	4,852.42	4,957.21

Note: All footnotes for this table are given on sheet 3.

Table 1 (a)
Emission trends (CO_2)
(Sheet 2 of 3)

CHE_BR1_v0.3
Source: Submission 2014 v2.1, SWITZERLAND

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	42,706.40	41,657.22	42,593.19	41,610.20	42,846.32	43,341.69	43,872.86	43,546.52	41,566.56	43,113.86
A. Fuel Combustion (Sectoral Approach)	42,640.32	41,594.28	42,527.69	41,548.10	42,787.32	43,278.60	43,813.53	43,481.21	41,509.69	43,053.76
1. Energy Industries	3,097.92	2,997.51	3,119.93	3,203.04	3,233.12	3,553.39	3,738.77	4,009.34	3,769.31	3,956.57
2. Manufacturing Industries and Construction	5,903.64	5,789.78	6,074.44	5,813.64	5,948.91	6,067.11	6,120.13	6,259.51	6,094.35	6,101.48
3. Transport	15,402.20	15,645.21	15,365.06	15,307.71	15,492.92	15,625.15	15,693.61	15,826.53	16,156.95	16,534.58
4. Other Sectors	18,105.89	17,026.79	17,836.09	17,085.53	17,988.57	17,920.41	18,138.79	17,259.87	15,370.45	16,347.81
5. Other	130.66	134.98	132.17	138.18	123.80	112.54	122.23	125.97	118.63	113.32
B. Fugitive Emissions from Fuels	66.08	62.94	65.51	62.11	59.00	63.09	59.33	65.30	56.87	60.10
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	66.08	62.94	65.51	62.11	59.00	63.09	59.33	65.30	56.87	60.10
2. Industrial Processes	2,003.62	2,144.37	2,176.14	2,125.83	2,086.49	2,232.24	2,330.96	2,290.16	2,299.41	2,282.00
A. Mineral Products	1,712.07	1,832.62	1,862.93	1,789.44	1,753.31	1,864.74	1,982.48	1,974.12	2,009.03	1,976.36
B. Chemical Industry	105.59	109.32	105.96	111.59	99.65	120.69	112.63	119.43	111.30	119.63
C. Metal Production	185.32	201.67	206.45	223.48	231.89	245.37	235.53	196.02	178.64	185.43
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	0.64	0.76	0.80	1.32	1.64	1.44	0.32	0.60	0.44	0.58
3. Solvent and Other Product Use	208.53	199.40	191.06	181.08	171.66	159.91	158.48	156.55	157.07	155.02
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry	-3,553.09	-1,232.25	235.76	-317.38	-2,995.75	-4,576.34	-4,202.02	-2,897.46	-2,790.45	-1,620.54
A. Forest Land	-5,208.16	-2,088.95	-1,364.10	-1,550.48	-4,473.60	-5,127.57	-5,340.56	-4,486.12	-3,335.40	-2,481.31
B. Cropland	820.99	19.74	765.68	399.64	646.46	-284.70	334.76	852.84	-108.36	351.60
C. Grassland	301.15	304.51	304.41	305.67	306.04	310.48	246.37	216.04	173.51	97.69
D. Wetlands	30.28	30.45	30.48	30.51	30.54	30.70	25.70	21.13	18.38	10.18
E. Settlements	390.89	389.52	386.22	383.63	380.58	379.82	425.19	398.53	370.91	330.21
F. Other Land	111.75	112.48	113.07	113.65	114.23	114.93	106.52	100.12	90.52	71.09
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	22.61	19.17	15.80	12.69	12.27	11.90	11.79	12.49	12.45	12.86
A. Solid Waste Disposal on Land	2.83	1.80	1.14	0.48	0.32	0.08	0.05	0.01	0.00	0.00
B. Waste-water Handling										
C. Waste Incineration	19.78	17.37	14.66	12.21	11.95	11.82	11.74	12.48	12.44	12.86
D. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (as specified in the summary table in CRF)	12.68	12.87	12.90	12.92	12.93	12.94	12.95	12.97	12.98	12.99
Total CO2 emissions including net CO2 from LULUCF	41,400.75	42,800.77	45,224.85	43,625.33	42,133.93	41,182.34	42,185.02	43,121.22	41,258.02	43,956.18
Total CO2 emissions excluding net CO2 from LULUCF	44,953.84	44,033.03	44,989.10	43,942.72	45,129.68	45,758.68	46,387.04	46,018.68	44,048.47	45,576.73
Memo Items:										
International Bunkers	4,492.12	4,700.46	4,430.46	4,085.99	3,673.70	3,464.10	3,526.17	3,701.81	3,954.22	4,266.46
Aviation	4,450.95	4,661.85	4,399.10	4,060.24	3,642.63	3,432.79	3,489.52	3,667.95	3,919.34	4,234.18
Marine	41.17	38.61	31.36	25.76	31.07	31.31	36.64	33.86	34.88	32.28
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass	5,075.91	5,085.80	5,405.98	5,406.47	5,558.89	5,630.35	5,804.63	6,103.82	5,965.02	6,296.69

Note: All footnotes for this table are given on sheet 3.

Table 1(a) CHE_BR1_v0.3

Emission trends (CO_2) e: Submission 2014 v2.1, SWITZERLAND

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2009	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	42,003.69	43,494.64	39,466.30	-4.16
A. Fuel Combustion (Sectoral Approach)	41,946.68	43,441.41	39,414.08	-4.07
1. Energy Industries	3,881.87	4,108.25	3,911.91	56.24
2. Manufacturing Industries and Construction	5,721.62	5,877.95	5,376.25	-11.96
3. Transport	16,347.93	16,256.01	16,082.65	12.09
4. Other Sectors	15,880.22	17,079.65	13,936.34	-22.26
5. Other	115.05	119.55	106.92	-47.48
B. Fugitive Emissions from Fuels	57.01	53.23	52.23	-42.84
1. Solid Fuels	NA, NO	NA, NO	NA, NO	0.00
2. Oil and Natural Gas	57.01	53.23	52.23	-42.84
2. Industrial Processes	2,178.11	2,369.23	2,331.68	-23.78
A. Mineral Products	1,946.36	2,073.46	2,033.34	-24.60
B. Chemical Industry	98.06	122.39	110.55	0.68
C. Metal Production	132.87	172.43	186.63	-25.85
D. Other Production	NA	NA	NA	0.00
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	0.83	0.96	1.15	10.92
3. Solvent and Other Product Use	155.36	151.77	155.28	-56.86
4. Agriculture				
A. Enteric Fermentation				
B. Manure Management				
C. Rice Cultivation				
D. Agricultural Soils				
E. Prescribed Burning of Savannas				
F. Field Burning of Agricultural Residues				
G. Other				
5. Land Use, Land-Use Change and Forestry	-2,097.53	-2,408.78	-3,416.55	7.64
A. Forest Land	-3,261.27	-3,948.22	-3,982.98	-5.81
B. Cropland	358.78	736.90	-239.68	-162.20
C. Grassland	321.78	321.68	325.85	98.62
D. Wetlands	28.94	28.98	29.09	56.94
E. Settlements	341.94	339.08	337.81	-13.64
F. Other Land	112.31	112.80	113.35	18.53
G. Other	NE	NE	NE	0.00
6. Waste	12.13	12.54	12.34	-80.51
A. Solid Waste Disposal on Land	NO	NO	NO	-100.00
B. Waste-water Handling				
C. Waste Incineration	12.13	12.54	12.34	-77.18
D. Other	NO	NO	NO	0.00
7. Other (as specified in the summary table in CRF)	13.00	13.02	13.03	18.86
Total CO2 emissions including net CO2 from LULUCF	42,264.77	43,632.41	38,562.09	-7.07
Total CO2 emissions excluding net CO2 from LULUCF	44,362.30	46,041.18	41,978.64	-6.03
Memo Items:				
International Bunkers	4,075.18	4,288.68	4,719.90	51.00
Aviation	4,043.40	4,254.21	4,689.16	52.94
Marine	31.78	34.47	30.74	-48.54
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass	6,267.34	6,588.73	6,184.25	27.08

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Fill in net emissions/removals as reported in CRF table Summary 1.A of the latest reported inventory year. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

Custom Footnotes

Table 1(b) CHE_BR1_v0.3

Emission trends (CH_4) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a] Base year [a]	1991	1992	1993	1994	1995	1996	1997	1998
	(kt)kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	29.60	28.83	26.51	24.34	22.99	21.71	20.66	19.06	18.57
A. Fuel Combustion (Sectoral Approach)	11.46	11.61	10.81	9.94	8.96	8.75	8.74	7.84	7.57
1. Energy Industries	0.07	0.08	0.09	0.08	0.08	0.09	0.10	0.09	0.10
2. Manufacturing Industries and Construction	0.37	0.39	0.38	0.39	0.38	0.39	0.40	0.37	0.38
3. Transport	4.92	4.66	4.37	3.73	3.38	3.03	2.88	2.78	2.60
4. Other Sectors	6.09	6.47	5.97	5.74	5.11	5.23	5.35	4.58	4.49
5. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	18.14	17.22	15.70	14.40	14.03	12.96	11.92	11.22	11.00
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	18.14	17.22	15.70	14.40	14.03	12.96	11.92	11.22	11.00
2. Industrial Processes	0.46	0.44	0.43	0.41	0.40	0.38	0.38	0.39	0.38
A. Mineral Products	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Chemical Industry	0.46	0.44	0.43	0.41	0.40	0.38	0.38	0.39	0.38
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production									
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use									
4. Agriculture	157.48	157.04	154.11	152.36	151.80	152.44	151.01	147.94	147.24
A. Enteric Fermentation	125.50	125.36	122.91	121.30	121.36	122.43	121.50	118.85	117.77
B. Manure Management	31.98	31.68	31.20	31.07	30.44	30.01	29.51	29.09	29.47
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Agricultural Soils	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	0.39	0.05	0.02	0.01	0.10	0.16	0.08	0.53	0.09
A. Forest Land	0.39	0.05	0.02	0.01	0.10	0.16	0.08	0.53	0.09
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	35.10	34.93	33.78	31.28	28.76	28.74	27.69	27.26	26.38
A. Solid Waste Disposal on Land	32.77	32.41	30.93	28.30	25.48	25.06	23.88	23.26	22.26
B. Waste-water Handling	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.26	0.26
C. Waste Incineration	0.68	0.67	0.67	0.66	0.65	0.64	0.63	0.63	0.63
D. Other	1.43	1.62	1.95	2.09	2.39	2.80	2.93	3.11	3.23
7. Other (as specified in the summary table in CRF)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total CH4 emissions including CH4 from LULUCF	223.05	221.32	214.88	208.44	204.07	203.45	199.86	195.21	192.69
Total CH4 emissions excluding CH4 from LULUCF	222.66	221.26	214.86	208.43	203.97	203.29	199.78	194.68	192.60
Memo Items:									
International Bunkers	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07
Aviation	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass									

Note: All footnotes for this table are given on sheet 3.

Table 1(b) CHE_BR1_v0.3

Emission trends (CH_4) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	18.59	17.08	17.18	15.47	14.48	14.17	13.92	13.44	12.91	13.09
A. Fuel Combustion (Sectoral Approach)	7.26	6.59	6.48	5.94	5.86	5.67	5.53	5.19	4.74	4.80
1. Energy Industries	0.10	0.09	0.09	0.09	0.10	0.10	0.11	0.10	0.09	0.11
2. Manufacturing Industries and Construction	0.36	0.35	0.37	0.35	0.36	0.36	0.36	0.37	0.37	0.37
3. Transport	2.51	2.34	2.14	1.96	1.82	1.70	1.58	1.43	1.37	1.29
4. Other Sectors	4.27	3.80	3.87	3.53	3.59	3.50	3.48	3.28	2.91	3.02
5. Other	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
B. Fugitive Emissions from Fuels	11.33	10.49	10.70	9.54	8.62	8.50	8.40	8.25	8.16	8.29
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	11.33	10.49	10.70	9.54	8.62	8.50	8.40	8.25	8.16	8.29
2. Industrial Processes	0.37	0.38	0.38	0.38	0.38	0.41	0.41	0.39	0.40	0.41
A. Mineral Products	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Chemical Industry	0.37	0.38	0.38	0.38	0.38	0.41	0.41	0.39	0.40	0.41
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production										
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	145.48	145.09	146.64	146.16	144.88	144.31	145.71	147.04	148.49	152.54
A. Enteric Fermentation	116.38	116.06	117.21	116.78	115.68	115.00	115.73	116.70	118.00	121.50
B. Manure Management	29.10	29.03	29.43	29.38	29.20	29.31	29.98	30.34	30.49	31.04
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Agricultural Soils	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	0.00	0.01	0.01	0.15	0.20	0.01	0.02	0.04	0.08	0.02
A. Forest Land	0.00	0.01	0.01	0.15	0.20	0.01	0.02	0.04	0.08	0.02
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	25.28	23.91	22.94	22.59	20.38	20.40	19.55	19.19	18.18	17.03
A. Solid Waste Disposal on Land	21.08	19.06	17.98	17.17	15.04	15.00	14.07	13.53	12.39	11.15
B. Waste-water Handling	0.26	0.27	0.27	0.27	0.28	0.28	0.29	0.33	0.34	0.38
C. Waste Incineration	0.63	0.63	0.63	0.63	0.62	0.62	0.61	0.62	0.62	0.62
D. Other	3.30	3.95	4.06	4.51	4.43	4.50	4.58	4.71	4.84	4.89
7. Other (as specified in the summary table in CRF)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Total CH4 emissions including CH4 from LULUCF	189.75	186.50	187.19	184.78	180.34	179.33	179.64	180.13	180.09	183.12
Total CH4 emissions excluding CH4 from LULUCF	189.75	186.49	187.18	184.63	180.14	179.32	179.62	180.09	180.01	183.10
Memo Items:										
International Bunkers	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07
Aviation	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.06	0.07	0.07
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass										

Note: All footnotes for this table are given on sheet 3.

Table 1(b) CHE_BR1_v0.3

Emission trends (CH_4) e: Submission 2014 v2.1, SWITZERLAND

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2009*	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	12.84	12.90	12.24	-58.65
A. Fuel Combustion (Sectoral Approach)	4.56	4.62	3.96	-65.48
1. Energy Industries	0.10	0.11	0.10	35.48
2. Manufacturing Industries and Construction	0.35	0.37	0.35	-6.95
3. Transport	1.21	1.14	1.07	-78.28
4. Other Sectors	2.89	3.00	2.44	-59.91
5. Other	0.01	0.01	0.01	-32.58
B. Fugitive Emissions from Fuels	8.29	8.28	8.28	-54.33
1. Solid Fuels	NA, NO	NA, NO	NA, NO	0.00
2. Oil and Natural Gas	8.29	8.28	8.28	-54.33
2. Industrial Processes	0.38	0.40	0.41	-10.51
A. Mineral Products	NA, NO	NA, NO	NA, NO	0.00
B. Chemical Industry	0.38	0.40	0.41	-10.51
C. Metal Production	NA, NO	NA, NO	NA, NO	0.00
D. Other Production				
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use				
4. Agriculture	151.18	150.81	150.43	-4.48
A. Enteric Fermentation	120.33	119.87	119.48	-4.79
B. Manure Management	30.85	30.94	30.94	-3.24
C. Rice Cultivation	NA, NO	NA, NO	NA, NO	0.00
D. Agricultural Soils	NO	NO	NO	0.00
E. Prescribed Burning of Savannas	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	0.00
G. Other	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	0.01	0.01	0.06	-84.85
A. Forest Land	0.01	0.01	0.06	-84.85
B. Cropland	NO	NO	NO	0.00
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NE, NO	NE, NO	NE, NO	0.00
E. Settlements	NE, NO	NE, NO	NE, NO	0.00
F. Other Land	NE, NO	NE, NO	NE, NO	0.00
G. Other	NE	NE	NE	0.00
6. Waste	15.98	15.28	14.72	-58.05
A. Solid Waste Disposal on Land	10.09	9.43	8.61	-73.74
B. Waste-water Handling	0.38	0.43	0.48	115.59
C. Waste Incineration	0.61	0.61	0.61	-10.78
D. Other	4.91	4.81	5.04	253.18
7. Other (as specified in the summary table in CRF)	0.03	0.03	0.03	3.88
Total CH4 emissions including CH4 from LULUCF	180.42	179.42	177.89	-20.25
Total CH4 emissions excluding CH4 from LULUCF	180.41	179.41	177.83	-20.13
Memo Items:				
International Bunkers	0.06	0.06	0.07	-21.82
Aviation	0.06	0.06	0.07	-21.67
Marine	0.00	0.00	0.00	-48.78
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass				

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change an

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Custom Footnotes

Table 1(c) CHE_BR1_v0.3
Emission trends (N_2O) Source: Submission 2014 v2.1, SWITZERLAND
(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a] *Base year[a]*	1991	1992	1993	1994	1995	1996	1997	1998
	(kt)kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	0.91	0.99	1.04	1.03	1.07	1.11	1.17	1.20	1.22
A. Fuel Combustion (Sectoral Approach)	0.91	0.99	1.04	1.03	1.07	1.11	1.17	1.19	1.22
1. Energy Industries	0.16	0.17	0.18	0.19	0.20	0.21	0.23	0.24	0.27
2. Manufacturing Industries and Construction	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
3. Transport	0.47	0.53	0.59	0.58	0.61	0.63	0.67	0.69	0.69
4. Other Sectors	0.18	0.19	0.19	0.18	0.17	0.18	0.19	0.18	0.18
5. Other	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	0.22	0.20	0.17	0.17	0.20	0.19	0.19	0.16	0.17
A. Mineral Products	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Chemical Industry	0.22	0.20	0.17	0.17	0.20	0.19	0.19	0.16	0.17
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production									
E. Production of Halocarbons and SF6									
F. Consumption of Halocarbons and SF6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.36	0.34	0.33	0.31	0.30	0.28	0.26	0.24	0.23
4. Agriculture	8.98	8.94	8.85	8.64	8.45	8.45	8.42	8.06	8.02
A. Enteric Fermentation									
B. Manure Management	1.47	1.44	1.40	1.38	1.36	1.35	1.32	1.26	1.21
C. Rice Cultivation									
D. Agricultural Soils	7.52	7.50	7.45	7.26	7.09	7.10	7.09	6.80	6.81
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.02
A. Forest Land	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00
B. Cropland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	0.68	0.69	0.69	0.68	0.69	0.69	0.70	0.70	0.71
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0.60	0.61	0.61	0.60	0.61	0.60	0.60	0.60	0.61
C. Waste Incineration	0.06	0.06	0.06	0.06	0.05	0.06	0.06	0.06	0.07
D. Other	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04
7. Other (as specified in the summary table in CRF)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total N2O emissions including N2O from LULUCF	11.19	11.18	11.11	10.85	10.72	10.74	10.75	10.41	10.38
Total N2O emissions excluding N2O from LULUCF	11.15	11.16	11.09	10.83	10.70	10.72	10.73	10.37	10.36
Memo Items:									
International Bunkers	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13
Aviation	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.13	0.13
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass									

Note: All footnotes for this table are given on sheet 3.

Table 1(c) CHE_BR1_v0.3

Emission trends (N_2O) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*1999*	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
1. Energy	1.25	1.25	1.24	1.22	1.19	1.02	1.00	0.99	0.95	0.95
A. Fuel Combustion (Sectoral Approach)	1.25	1.25	1.24	1.22	1.19	1.02	1.00	0.99	0.95	0.95
1. Energy Industries	0.30	0.33	0.36	0.39	0.40	0.40	0.39	0.41	0.38	0.36
2. Manufacturing Industries and Construction	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
3. Transport	0.69	0.67	0.62	0.57	0.53	0.35	0.34	0.31	0.32	0.33
4. Other Sectors	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.16
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	0.18	0.19	0.20	0.21	0.19	0.20	0.17	0.19	0.19	0.22
A. Mineral Products	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
B. Chemical Industry	0.18	0.19	0.20	0.21	0.19	0.20	0.17	0.19	0.19	0.22
C. Metal Production	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Other Production										
E. Production of Halocarbons and SF6										
F. Consumption of Halocarbons and SF6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0.21	0.19	0.17	0.17	0.17	0.17	0.17	0.16	0.15	0.15
4. Agriculture	7.92	7.90	8.00	7.96	7.80	7.80	7.79	7.76	7.86	7.89
A. Enteric Fermentation										
B. Manure Management	1.17	1.13	1.10	1.06	1.05	1.03	1.03	1.03	1.02	1.06
C. Rice Cultivation										
D. Agricultural Soils	6.75	6.77	6.91	6.89	6.75	6.76	6.75	6.74	6.84	6.83
E. Prescribed Burning of Savannas	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01
A. Forest Land	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
B. Cropland	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
E. Settlements	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
F. Other Land	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	0.71	0.73	0.73	0.74	0.76	0.78	0.78	0.79	0.81	0.83
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0.60	0.62	0.61	0.61	0.62	0.63	0.63	0.64	0.66	0.67
C. Waste Incineration	0.07	0.07	0.07	0.08	0.09	0.09	0.09	0.09	0.09	0.09
D. Other	0.04	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07
7. Other (as specified in the summary table in CRF)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total N2O emissions including N2O from LULUCF	10.28	10.29	10.37	10.32	10.14	9.97	9.92	9.92	9.98	10.05
Total N2O emissions excluding N2O from LULUCF	10.27	10.27	10.36	10.30	10.12	9.96	9.90	9.90	9.97	10.03
Memo Items:										
International Bunkers	0.14	0.15	0.14	0.13	0.12	0.11	0.11	0.12	0.13	0.14
Aviation	0.14	0.15	0.14	0.13	0.12	0.11	0.11	0.12	0.12	0.13
Marine	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 Emissions from Biomass										

Note: All footnotes for this table are given on sheet 3.

Table 1(c) CHE_BR1_v0.3

Emission trends (N_2O) e: Submission 2014 v2.1, SWITZERLAND

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2009*	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
1. Energy	0.92	0.92	0.86	-5.98
A. Fuel Combustion (Sectoral Approach)	0.91	0.92	0.86	-6.08
1. Energy Industries	0.33	0.32	0.29	77.24
2. Manufacturing Industries and Construction	0.09	0.09	0.09	8.51
3. Transport	0.33	0.33	0.33	-30.43
4. Other Sectors	0.16	0.17	0.14	-23.09
5. Other	0.00	0.00	0.00	-47.42
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	40.78
1. Solid Fuels	NA, NO	NA, NO	NA, NO	0.00
2. Oil and Natural Gas	0.00	0.00	0.00	40.78
2. Industrial Processes	0.19	0.19	0.17	-20.56
A. Mineral Products	NA, NO	NA, NO	NA, NO	0.00
B. Chemical Industry	0.19	0.19	0.17	-20.56
C. Metal Production	NA, NO	NA, NO	NA, NO	0.00
D. Other Production				
E. Production of Halocarbons and SF6				
F. Consumption of Halocarbons and SF6				
G. Other	NA	NA	NA	0.00
3. Solvent and Other Product Use	0.14	0.15	0.14	-59.91
4. Agriculture	7.80	8.00	7.89	-12.22
A. Enteric Fermentation				
B. Manure Management	1.07	1.08	1.09	-26.01
C. Rice Cultivation				
D. Agricultural Soils	6.73	6.92	6.80	-9.53
E. Prescribed Burning of Savannas	NA	NA	NA	0.00
F. Field Burning of Agricultural Residues	NA, NO	NA, NO	NA, NO	0.00
G. Other	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	0.01	0.01	0.01	-57.81
A. Forest Land	0.00	0.00	0.00	-85.06
B. Cropland	0.01	0.01	0.01	-34.51
C. Grassland	NO	NO	NO	0.00
D. Wetlands	NE, NO	NE, NO	NE, NO	0.00
E. Settlements	NE, NO	NE, NO	NE, NO	0.00
F. Other Land	NE, NO	NE, NO	NE, NO	0.00
G. Other	NE	NE	NE	0.00
6. Waste	0.84	0.85	0.86	26.01
A. Solid Waste Disposal on Land				
B. Waste-water Handling	0.67	0.68	0.68	14.35
C. Waste Incineration	0.09	0.10	0.10	50.53
D. Other	0.07	0.07	0.08	311.59
7. Other (as specified in the summary table in CRF)	0.00	0.00	0.00	0.00
Total N2O emissions including N2O from LULUCF	9.91	10.13	9.93	-11.20
Total N2O emissions excluding N2O from LULUCF	9.89	10.11	9.92	-11.06
Memo Items:				
International Bunkers	0.13	0.14	0.15	51.01
Aviation	0.13	0.14	0.15	52.94
Marine	0.00	0.00	0.00	-48.54
Multilateral Operations	NO	NO	NO	0.00
CO2 Emissions from Biomass				

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change an

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Custom Footnotes

Table 1(d) CHE_BR1_v0.3
Emission trends (HFCs, PFCs and SF_6) Source: Submission 2014 v2.1, SWITZERLAND
(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a] *Base year [a]*	1991	1992	1993	1994	1995	1996	1997	1998
	(kt)kt	kt	kt	kt	kt	kt	kt	kt	kt
Emissions of HFCsc - (kt CO2 eq)	0.02	0.25	6.57	14.59	33.74	180.75	227.01	300.12	356.24
HFC-23	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	IE, NA, NO	0.00	0.00
HFC-32	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00	0.00	0.00	0.00
HFC-41	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-43-10mee	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-125	NA, NO	NA, NO	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HFC-134	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-134a	0.00	0.00	0.00	0.01	0.02	0.12	0.13	0.17	0.20
HFC-152a	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.03	0.04	0.04	0.04
HFC-143	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-143a	NA, NO	NA, NO	0.00	0.00	0.00	0.00	0.01	0.01	0.01
HFC-227ea	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00
HFC-236fa	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-245ca	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of PFCsc - (kt CO2 eq)	100.21	84.70	69.26	29.69	17.66	14.69	17.20	20.04	22.83
CF_4	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C 3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
$c\text{-}C_4F_8$	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_5F_{12}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_6F_{14}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of SF6(3) - (Gg CO2 equivalent)	143.62	145.92	148.21	126.35	112.04	97.73	94.42	130.61	160.18
SF_6	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.01

Note: All footnotes for this table are given on sheet 3.

Table 1(d) CHE_BR1_v0.3

Emission trends (HFCs, PFCs and SF_6) Source: Submission 2014 v2.1, SWITZERLAND

(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*1999*	2000	2001	2002	2003	2004	2005	2006	2007	2008
	kt	kt	kt	kt	kt	kt	kt	kt	kt	kt
Emissions of HFCsc - (kt CO2 eq)	418.70	498.54	593.71	635.19	707.87	818.16	900.68	926.36	960.23	1,025.58
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
HFC-41	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-43-10mee	0.00	0.00	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00
HFC-125	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.07	0.08	0.09
HFC-134	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-134a	0.21	0.24	0.27	0.29	0.31	0.35	0.37	0.36	0.37	0.38
HFC-152a	0.04	0.04	0.04	0.05	0.02	0.02	0.02	0.02	0.01	0.00
HFC-143	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-143a	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.07
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236fa	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
HFC-245ca	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of PFCsc - (kt CO2 eq)	35.88	69.09	45.22	40.29	57.01	52.53	32.88	32.36	28.86	39.06
CF_4	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C 3F8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	NA, NO	NA, NO	NA, NO	NA, NO
c-C_4F_8	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00	0.00	0.00	0.00	0.00
C_5F_{12}	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
Emissions of SF6(3) - (Gg CO2 equivalent)	146.90	157.79	157.09	168.27	174.06	189.84	212.99	200.87	185.75	244.72
SF_6	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Note: All footnotes for this table are given on sheet 3.

Table 1(d) CHE_BR1_v0.3

Emission trends (HFCs, PFCs and SF_6) e: Submission 2014 v2.1, SWITZERLAND

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2009	2010	2011	Change from base to latest reported year
	kt	kt	kt	%
Emissions of HFCsc - (kt CO2 eq)	1,065.13	1,119.04	1,171.45	5,199,794.59
HFC-23	0.00	0.00	0.00	100.00
HFC-32	0.02	0.02	0.03	100.00
HFC-41	NA, NO	NA, NO	NA, NO	0.00
HFC-43-10mee	0.00	0.00	0.00	100.00
HFC-125	0.09	0.10	0.09	100.00
HFC-134	NA, NO	NA, NO	NA, NO	0.00
HFC-134a	0.37	0.40	0.47	2,726,132.65
HFC-152a	0.00	0.00	0.00	100.00
HFC-143	NA, NO	NA, NO	NA, NO	0.00
HFC-143a	0.08	0.08	0.07	100.00
HFC-227ea	0.00	0.00	0.00	100.00
HFC-236fa	NA, NO	NA, NO	NA, NO	0.00
HFC-245ca	NA, NO	NA, NO	NA, NO	0.00
Unspecified mix of listed HFCsd - (kt CO_2 eq)	NA, NO	NA, NO	NA, NO	0.00
Emissions of PFCsc - (kt CO2 eq)	35.17	36.71	39.36	-60.72
CF_4	0.00	0.00	0.00	-73.96
C_2F_6	0.00	0.00	0.00	-78.63
C 3F8	0.00	0.00	0.00	15,376.25
C_4F_{10}	NA, NO	NA, NO	NA, NO	0.00
$c\text{-}C_4F_8$	0.00	0.00	0.00	100.00
C_5F_{12}	NA, NO	NA, NO	NA, NO	0.00
C_6F_{14}	0.00	0.00	0.00	100.00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA, NO	NA, NO	NA, NO	0.00
Emissions of SF6(3) - (Gg CO2 equivalent)	187.12	154.77	164.37	14.45
SF_6	0.01	0.01	0.01	14.45

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change an

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

Custom Footnotes

A.2. Quantified economy-wide emission reduction target

The GHG emission target of Switzerland for the period 2008-2012 was set at 8% below the emissions of 1990. Switzerland is committed to continue its emission reduction efforts under the Kyoto Protocol for the years 2013-2020 and has submitted an economy-wide emission reduction target of at least 20% by 2020 in comparison to the 1990 levels. Switzerland has offered to move from its target of a 20 % up to a 30% emission reduction by 2020, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities (FCCC/SB/2011/INF.1/Rev.1). Switzerland's objective under the Kyoto Protocol has been translated into national targets. The national legislation set in place to reach the emission target under the Convention is the CO_2 Act. It has been reinforced in 2013 to comply with the new target.

NC6, section 4.1.1. further describes the objectives and conditions defined in the CO_2 Act to comply with the international commitment under the Kyoto Protocol. It also details Switzerland's modalities related to the use of market-based mechanisms or to the approach to counting emissions and removal from LULUCF as well as any information related to Switzerland's compliance with the decision of the Conference of the Parties. For an overview of Switzerland's objectives and conditions to meet the terms of the reduction target, see also **Table 2(a-f)**).

Table 2(a) CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: base year[a]

Party	*Switzerland*	
Base year /base period	1990	
Emission reduction target	% of base year/base period	% of 1990 [b]
	20.00%	
Period for reaching target	BY-2020	

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Optional.

Table 2(b) CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: gases and sectors covered[a]

Gases covered		Base year for each gas (year):
CO_2		1990
CH_4		1990
N_2O		1990
HFCs		1990
PFCs		1990
SF_6		1990
NF_3		1990
Other Gases (specify)		
Sectors covered[b]	Energy	Yes
	Transport[f]	Yes
	Industrial processes[g]	Yes
	Agriculture	Yes
	LULUCF	Yes
	Waste	Yes
	Other Sectors (specify)	
	Other	No

Abbreviations : LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] More than one selection will be allowed. If Parties use sectors other than those indicated above, the explanation of how these sectors relate to the sectors defined by the IPCC should be provided.

[f] Transport is reported as a subsector of the energy sector.

[g] Industrial processes refer to the industrial processes and solvent and other product use sectors.

Table 2(c) CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: global warming potential values (GWP)[a]

Gases	GWP values [b]
CO_2	4th AR
CH_4	4th AR
N_2O	4th AR
HFCs	4th AR
PFCs	4th AR
SF_6	4th AR
NF_3	4th AR
Other Gases (specify)	

Abbreviations : GWP = global warming potential

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Please specify the reference for the GWP: Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) or the Fourth Assessment Report of the IPCC.

[h] Specify.

Table 2(d) CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: approach to counting emissions and removals from the LULUCF sector[a]

Role of LULUCF	LULUCF in base year level and target	Excluded
	Contribution of LULUCF is calculated using	Activity-based approach

Abbreviation : LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Table 2(e)I CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention[a]

Market-based mechanisms under the Convention	*Possible scale of contributions (estimated kt CO_2 eq)*
CERs	NE
ERUs	NE
AAUs[i]	NE
Carry-over units[j]	NE
Other mechanism units under the Convention (specify)[d]	

Abbreviations : AAU = assigned amount unit, CER = certified emission reduction, ERU = emission reduction unit.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[d] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17 .

[i] AAUs issued to or purchased by a Party.

[j] Units carried over from the first to the second commitment periods of the Kyoto Protocol, as described in decision 13/CMP.1 and consistent with decision XX/CMP.8.

Table 2(e)II CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: other market-based mechanisms[a]

Other market-based mechanisms (Specify)	*Possible scale of contributions (estimated kt CO_2 eq)*

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

Table 2(f) CHE_BR1_v0.3

Description of quantified economy-wide emission reduction target: any other information[a,b]

Switzerland will use carbon credits generated from the flexible mechanisms under the Kyoto Protocol (CERs and ERUs) and from the new market-based mechanisms under the Convention to reduce its emissions over the period 2013-2020. The exact amount of carbon credits is not yet known. The revised CO_2 Act for the 2013-2020 period defines Switzerland's -20% target as domestic, however carbon credits will play a role in the case of fossil fuel thermal power plants, the ETS, companies exempted from the CO_2 levy that are not participating in the ETS, as well as in the sanction mechanism. Furthermore, Switzerland will use additional carbon credits recognized under the Kyoto Protocol to meet the difference between the approach used under the national legislation (i.e. emission reduction target defined for the year 2020) and the one of the Kyoto Protocol (i.e. "carbon budget" approach used to calculate the QELRC). Under the Kyoto Protocol, Switzerland does not plan to buy AAUs from other countries but does not exclude the use of AAUs from other countries through the linking of its ETS with other schemes. Switzerland may use a limited amount of its own carried-over AAUs. For a possibly higher target than -20% by 2020 compared to 1990, in addition to the carbon credits that will be used for achieving the -20% target, carbon credits will also be used by Switzerland for maximum three fourth of the additional emission reductions beyond the -20% target by 2020 compared to 1990, as planned in the CO_2 Act for the 2013-2020 period.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] This information could include information on the domestic legal status of the target or the total assigned amount of emission units for the period for reaching a target. Some of this information is presented in the narrative part of the biennial report.

Custom Footnotes

Emission reductions target (% of 1990):The target is at least 20%, and could be increased up to 30%.

A.3. Progress in achievement of quantified economy-wide emission reduction targets and relevant information

A.3.a. Mitigation actions and their effects.

The Swiss Climate Policy relies on various sectoral policies. The Kyoto Protocol and the CO_2 Act provide the legal basis for the implementation of GHG emissions reduction measures in Switzerland. **Table 3** provides an overview of policies and measures with emissions reduction as target, together with a short description and estimate of their mitigation effects . Policies and measures are also highlighted in the different policy sectors of NC6, section 4.3. An outline of mitigation actions implemented or in process of implementation since the NC5 is specified in NC6, section 4.3.1.

Information on Switzerland's domestic institutional arrangements used for domestic compliance, monitoring, reporting, archiving of information and evaluation of the progress towards its economy-wide emission reduction target are also contained in diverse parts of the NC6:

- Institutional, legal and procedural arrangements related to the GHG inventory and to the national registry are governed by the Swiss National Inventory System (NIS). Led by the Federal Office for the Environment (FOEN), this entity ensure full compliance with the reporting requirement (NC6, section 3.4.2). The NIS board activities are reported in NC6, section 3.4.3.

- Institutional arrangements with regards to the flexible mechanisms are under the responsibility of the Designated National Authority "SwissFlex". Activities relating to the implementation of the flexible mechanisms as well as enquiries concerning the mechanisms and the examination and approval of project proposals are coordinated by an interdepartmental working group called IDA-Klima, HF6 (NC6, section 4.2).

- A system to evaluate the effectiveness of the policies and measures is being elaborated in order to respond to the requirements of the revised CO_2 Act (in force since 2013) (NC6, section 4.4.1).

- Economy-wide emission reduction targets as defined under the Framework Convention on Climate Change and the Kyoto Protocol are evaluated each year based on the National GHG Inventory Report. Prepared by the Federal Office for the Environment (FOEN), this evaluation report is a key component to check whether Switzerland is on track to meet its emission reduction target (NC6, section 4.4.2).

Table 3 CHE_BR1_v0.3

Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action [a]	*Sector(s) affected* [b]	*GHG(s) affected*	*Objective and/or activity affected*	*Type of instrument* [c]	*Status of implementation* [d]	*Brief description* [e]	*Start year of implementation*	*Implementing entity or entities*	*Estimate of mitigation impact (not cumulative, in kt CO_2 eq)*	
									2015	*2020*
First CO2 Act	Energy, Transport, Industry/industrial processes	CO_2	- 10% CO2 attributable to the use of fossil fuels as energy sources, over the period 2008 - 2012	Other (Other (Legal basis))	Implemented	The CO2 Act is the legal centrepiece of Swiss climate policy. It contains policies and measures to reach the set targets.	2000	FOEN	NA	NA
Revised CO2 Act	Energy, Transport, Industry/industrial processes	CO_2, CH_4, N_2O, HFCs, NF_3, PFCs, SF_6	- 20% emissions by 2020 in comparison to 1990; 40% reduction in the building sector; 10% reduction in the transport sector; 15% reduction in the industrial sector.	Other (Other (Legal basis))	Implemented	The CO2 Act is the legal centrepiece of Swiss climate policy. It contains policies and measures to reach the set targets.	2013	FOEN	NA	NA
Exemption from CO2 levy without participation in the ETS	Energy, Industry/industrial processes	CO_2, N_2O, PFCs	Emission reduction targets in order to obtain exemption from CO2 levy.	Economic	Implemented	Binding agreement to reduce emissions in industry	2008	FOEN (with SFOE support), targets developed with third parties	0.53	0.53
Voluntary agreements with trade & industry	Energy, Industry/industrial processes	CO_2	Emission reductions to comply with CO2 and Energy Act. Voluntary agreements without exemption from CO2 levy.	Voluntary Agreement	Implemented	Binding agreement to improve energy efficiency and / or CO2 emissions.	2000	SFOE, FOEN	NE	NE
Emissions trading scheme (cap and trade)	Energy, Industry/industrial processes	CO_2, N_2O, PFCs	Using market mechanisms to achieve greenhouse gas emissions reductions	Economic	Implemented	Tradeable emission allowances issued every year to the companies participating in the ETS and giving companies the possibility to avoid the CO2 levy.	2008	FOEN	0.4	0.8
Inclusion of aviation in an ETS	Transport	CO_2	Limit CO2 emissions of international aviation	Other (Market based)	Planned	Inclusion of aviation into the ETS is part of the current Swiss-EU negotiations for linking the respective ETS.	2016	FOCA, FOEN	NA	NA
Use of the flexible mechanisms of the Kyoto Protocol		CH_4, CO_2, HFCs, N_2O, NF_3, PFCs, SF_6	Using market mechanisms to help achieving emission reduction targets at least cost	Economic	Implemented	Surrendering emission reduction certificates to comply with negotiated agreements	2008	Entities according to the Kyoto Protocol; FOEN	NE	NE

CO2 levy		Energy, Industry/industrial processes	CO_2	Promotion of energy efficiency and less CO2 intensive energy sources. Reduce use of fossil heating fuels	Other (Fiscal)	Implemented	Incentive levy on fossil heating fuels in order to improve energy efficiency, use of low-carbon or carbonfree energy sources. Most of the revenues from the CO2 levy is redistributed to households and industry.	2008	FOEN	0.8	2
National building refurbishment programme (Part A)		Energy	CO_2	Refurbishing existing building envelope to reduce CO2 emissions	Other (Other (other (incentive and subvention)))	Implemented	The national building programme (Part A and Part B) increases the energy efficiency of buildings and promotes the use of renewable energies in the building sector. It is financed by one third of the revenue from the CO2 levy.	2010	FOEN, SFOE	0.4	0.9
National building refurbishment programme (Part B)		Energy	CO_2	Promotion of renewable energy, energy recuperation and optimization of building services	Other (Other (other (incentive and subvention)))	Implemented	The national building programme (Part A and Part B) increases the energy efficiency of buildings and promotes the use of renewable energies in the building sector. It is financed by one third of the revenue from the CO2 levy.	2010	SFOE, FOEN, Cantons	0.8	2
Cantonal building programme		Energy	CO_2	Promotion of renewable energy, energy recuperation and optimization of building services	Other (Other (other (incentive and subvention)))	Implemented	Supplementary to the national building refurbishment programme (Part B)	2010	Cantons / SFOE	0.07	0.07
Building codes with the Cantons		Energy	CO_2	Reduction of energy consumption of buildings	Regulatory	Implemented	The MuKEN constitutes a set of common energy and insulation standards to reduce energy consumption of buildings. Further developed in 2000 and 2008. MuKEn = Model instructions of the cantons in the energy sector.	1992	Cantons in coordination with SFOE	1.1	1.75
Climate Cent		Transport	CO_2	CO2 emissions reductions in Switzerland and abroad	Other (Voluntary Agreement)	Implemented	The Climate Cent Foundation is a voluntary measure of Swiss industry and aimed at efficient climate protection. It has commited vis-à-vis the Swiss Confederation to reducing 17 million tonnes of CO2 over the period 2008-2012, of which at least 2 million tonnes within Switzerland. The Climate Cent (0.015CHF/litre) was levied between 2008 and 2012 on fossil transport fuels.	2005	Climate Cent Foundation	NA	NA

Obligation for compensation for transport fossil fuel importers		Transport	CO_2	Offset part of the CO2 emissions caused by the use of transport fuels	Other (Economic)	Implemented	The CO2 Act gives the Federal Council the competence to fix the share of transport emissions to be offset between 5% and 40%. However, the share has been fixed to 0% in 2013 and will gradually increase to 10% by 2020.	2013	FOEN	0.30	1.50
CO2 emissions regulations for new passenger cars		Transport	CO_2	Reduction of average fuel consumption of new cars	Regulatory	Implemented	Obligation for car importers to reduce average emissions of new cars. The first target has been set at 130g CO2 /km by 2015	2012	SFOE, FEDRO	0.70	0.70
Obligation to offset emissions from gas fired combined cycle power plants		Transport	CO_2	Offset CO2 emissions from gas fired combined cycle power plants	Regulatory	Implemented	Obligation to compensate domestically the emissions to at least 70% until 2011, then the possibility to use the flexible mechanisms has been raised from 30 to 50% in 2011.	2008	FOEN	0.75	0.75
Energy strategy 2050		Energy	CO_2	Reduce energy consumption, increase energy efficiency, expand hydropower and new renewables	Regulatory|Economic|Other (other (incentive and subvention))	Planned	Long-term energy policy. Initial package of measures focussing on the consistent exploitation of the existing energy efficiency potentials and on the balanced utilisation of the potentials of hydropower and new renewable energy sources.	2016	Mainly SFOE, FOEN, cantons	NA	NA
Programme Swiss Energy		Energy	CO_2	Reduction of fossil fuel use and CO2 emissions by increasing energy efficiency and the use of renewable energy		Implemented	Sector specific targets. This Programme will be reinforced within the Energy strategy 2050.	2001	SFOE	NA	NA
Cleantech Masterplan		Energy	CO_2	Increase energy efficiency and renewable energy	Voluntary Agreement	Planned	The Cleantech Masterplan seeks to increase the innovative capacity of Swiss cleantech companies by encouraging close cooperation between scientific, business, government and political stakeholders.	2011	SERI, SECO, SFOE, FOEN, cantons, economy, science	NA	NA
Aircraft engine emissions charges		Transport	Other (Ozone)	Reduction of local and cruise NOx emissions	Other (Market based)	Implemented	The portion of the landing fees which is attributed to emission charges is used for measures to reduce local air pollution at airports.	1997, reinforced 2010	FOCA, Major Swiss airports	NA	NA
Increase of aircraft engine NOx stringency		Transport	Other (Ozone)	Reduction of local and cruise NOx emissions	Other (Regulatory)	Implemented	New NOx regulatory limit.	2011	ICAO, EASA, FOCA	NA	NA
Introduction of particle mass and number standard for aircraft engines		Transport	Other (Soot & contrails)	Reduction of nano-sized soot	Other (Regulatory)	Planned	Engine certification requirement. Estimated cost for regulation paid by governments and industry: > 20 Mio. US$	2016	ICAO, EASA, FOCA	NA	NA

Heavy vehicle fee (HVF)		Transport	CO_2	Reduction of transalpine traffic, increase of transport rates on rail and limited increase in heavy vehicles on the road. Internalization of external costs.	Fiscal|Economic|Other (planning)	Implemented	The HVF applies to heavy-goods vehicles with a permissible laden weight exceeding 3.5 tonnes	2001	ARE, FEDRO	0.16	0.18
EURO emission standards		Transport	Other (nitrogen oxides (NOx), total hydrocarbon (THC), non-methane hydrocarbons (NMHC), carbon monoxide (CO) and particulate matter (PM))	reduction of air pollutants	Other (Technology)	Implemented	The Euro emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states. These are regularly reinforced.	1974	FEDRO,FEDRO	NE	NE
Mineral oil tax reduction on biofuels and natural gas		Transport	CO_2	CO2 -emission reduction	Fiscal	Implemented	Tax incentives for low carbon transport fuels if compliant with ecological and social minimum standards	2008	FCA in collab. with FOEN (ecological minimum standards) and SECO (social minimum standards)	0.10	0.10
Energy label for new motor vehicles		Transport	CO_2	This label is intended to support efforts aimed at reducing the average fuel consumption of motor cars.	Information|Other (market based)|Regulatory	Implemented	It provides information about the fuel consumption (litres per 100 kilometres) and CO2 emissions (in grams per kilometre) in relation to the unladen weight of the vehicle.	2003	SFOE, FOEN	IE	IE
Ordinance on Chemical Risk Reduction		Industry/industrial processes		Reduction in use and emissions of synthetic GHGs in all main sectors	Regulatory	Implemented	It regulates substances and preparations that may endanger people or the environment	2003	FOEN, cantons		
			HFCs			Implemented				500.00	600.00
			PFCs			Implemented				10.00	16.00
			SF_6			Implemented				300.00	375.00

Ecological standards (Proof of Ecological Performance)		Agriculture	CH_4, N_2O, CO_2	Improve ecological performance	Other (Regulatory)	Implemented	Requirement for direct payments are based on appropriate soil nutrient balance, suitable proportion of ecological compensation areas, crop rotation system, soil protection, selective appliance of crop protection agents, animal welfare requirements	Early 1990th, continual development and improvement	Federal Office for Agriculture FOAG	NE	NE
Resource program (AP 2011; AP 2014-17)		Agriculture	CH_4, N_2O, CO_2	Efficient use of natural resources	Other (Other (voluntary participation))	Implemented	Subsidizing measures for more efficient use of natural resources	2008	Federal Office for Agriculture FOAG	NE	NE
Modifications in direct payments system (AP14-17)		Agriculture	CH_4, N_2O, CO_2	Progress in areas of sustainability	Other (Regulatory)	Implemented	Abolition of unspecific direct payments (livestock subsidies, general acreage payments); promotion of environmental-friendly production systems, efficient use of natural resources	2014	Federal Office for Agriculture FOAG	NE	NE
Climate Strategy Agriculture		Agriculture	CH_4, N_2O, CO_2	Mitigation of climate change, adaptation	Other (Other (declaration of intent))	Implemented	Declaration of intent to reduce emissions by one third with technical, operational and organizational measures and by one third with measures influencing food consumption and production. Framework for the implementation of specific future measures.	2011	Federal Office for Agriculture FOAG	NE	NE
Forest area conservation		Forestry/LULUCF	CO_2	The forest area cannot decrease.	Regulatory	Implemented	No deforestation without replacement by afforestation of the same area	1876	FOEN and cantonal forest services	NE	NE
Sustainable forest management		Energy, Forestry/LULUCF	CO_2	Sustainable forest management,	Regulatory	Implemented	Harvesting volumes shall not exceed growth increment in the forests	1993	FOEN and cantonal forest services	NE	NE
Wood action plan		Energy, Forestry/LULUCF	CO_2	Ecologically and economically effective use of wood	Information	Implemented	Increase of harvesting; sustainable harvestable wood harvest potentential shall be exhausted; (8.2*106 m3/a)	2009	FOEN and forest industry	0.80	1.20
Measures taken within Forest Policy 2020		Energy, Forestry/LULUCF	CO_2	Ensuring sustainable forest management and creating favorable conditions for an efficient and innovative forestry and wood industry.	Regulatory	Implemented	The sustainable harvestable wood harvest potential shall be exhausted (8.2*106 m3/a); mitigation of climate change (exploitation of increment, increasing substituation effect)	2011	FOEN and cantonal forest services	0.80	1.20

CO2-ordinance		Waste management/waste	CO_2	Reduction of CO2 output	Regulatory	Implemented	Submission of MSWI to emission trade or to an agreement on goals of the reduction of CO2-output	2013	FOEN	NE	NE
Environmental Protection Act (EPA)		Waste management/waste	CO_2	Reduce emissions from waste incineration	Regulatory	Implemented	waste recycling	1997	FOEN	NE	NE
Technical ordinance on waste (TOW)		Waste management/waste	CH_4, CO_2	Reduction of methane emissions	Regulatory	Implemented	interdiction of landfilling of combustible waste	2000	FOEN	0.16	0.18
MSWI-Climate-Charta		Waste management/waste	CO_2	Minimise emissions of pollutants, optimisation of energy production	Voluntary Agreement	Implemented	Clean production of district heat and electricity and recovery of metals from incineration residues	2012	Association of MSWI-operators (VBSA)	NE	NE

Note: The two final columns specify the year identified by the Party for estimating impacts (based on the status of the measure and whether an ex post or ex ante estimation is available).

Abbreviations: GHG = greenhouse gas; LULUCF = land use, land-use change and forestry.

[a] Parties should use an asterisk (*) to indicate that a mitigation action is included in the ‘with measures’ projection.

[b] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors, cross-cutting, as appropriate.

[c] To the extent possible, the following types of instrument should be used: economic, fiscal, voluntary agreement, regulatory, information, education, research, other.

[d] To the extent possible, the following descriptive terms should be used to report on the status of implementation: implemented, adopted, planned.

[e] Additional information may be provided on the cost of the mitigation actions and the relevant timescale.

[f] Optional year or years deemed relevant by the Party.

A.3.b. Estimates of emission reductions and removals and the use of units from the market-based mechanisms and LULUCF.

Switzerland committed to reduce its GHG emissions by 8% below the level of 1990 by 2008-2012. In order to reach the target, the forest management activity under KP Art. 3.4 (**Table 4(a)ii**) and the market-based mechanisms (emission reduction certificates and banking by companies, **Table 4(b)**) are considered. Switzerland's progress achieved in meeting the Kyoto Protocol target is presented in NC6, section 4.4.2, with first estimates for 2012 (see also the summary **Table 4**). In addition, progress made towards achievement of the three targets of the CO_2 Act, i.e. a CO_2 emissions reduction of 10% on the use of energy related fuels, of 8% on transport fuels and 15% on heating and process fuels compared to 1990 are also assessed.

Table 4 CHE_BR1_v0.3

Reporting on progress[a, b]

	Total emissions excluding LULUCF	*Contribution from LULUCF*[d]	*Quantity of units from market based mechanisms under the Convention*		*Quantity of units from other market based mechanisms*	
Year[c]	*(kt CO_2 eq)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO2 eq)*	*(number of units)*	*(kt CO2 eq)*
(1990)	52,791	NA	NA	NA	NA	NA
2008	53,826.70	1,297.39	NE	NE	NA	NA
2009	52,490.59	1,971.48	NE	NE	NA	NA
2010	54,240.18	2,675.27	NE	NE	NA	NA
2011	50,149.22	2722,33	NE, NO	NE, NO		
2012	NE	NA	NE, NO	NE, NO		

Abbreviation : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–-c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Parties may add additional rows for years other than those specified below.

[d] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

Custom Footnotes

Note that the values differ slightly from those in the NC6 due to the use of different submissions of the GHG inventory (September in BR).

Table 4(a)II

CHE_BR1_v0.3

Source: Submission 2014 v2.1, SWITZERLAND

Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol[a,b,c]

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	*Base year*[d]	*Net emissions/removals*[e]					*Accounting parameters*[h]	*Accounting quantity*[i]
		2008	2009	*2010*	*2011*	Total[g]		
	(kt CO_2 eq)							
A. Article 3.3 activities								
A.1. Afforestation and Reforestation								-111.08
A.1.1. Units of land not harvested since the beginning of the commitment period[j]		-23.02	-25.15	-23.67	-19.35	-91.2		-91.2
A.1.2. Units of land harvested since the beginning of the commitment period[j]								-19.89
CC11[1]		IE,NO	IE,NO	-6.68	-13.2	-19.89		-19.89
A.2. Deforestation		100.45	232.23	232.43	233.22	798.32		798.3236
B. Article 3.4 activities								
B.1. Forest Management (if elected)		-1,374.82	-2,178.56	-2,884.02	-2,936.20	-9,373.60		-9166.6667
3.3 offset[k]							687.24055	0
FM cap[l]							9166.6667	-9166.6667
B.2. Cropland Management (if elected)	0	NA	NA	NA	NA	NA	0	0
B.3. Grazing Land Management (if elected)	0	NA	NA	NA	NA	NA	0	0
B.4. Revegetation (if elected)	0	NA	NA	NA	NA	NA	0	0

Note: 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviations : CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Developed country Parties with a quantified economy-wide emission reduction target as communicated to the secretariat and contained in document FCCC/SB/2011/INF.1/Rev.1 or any update to that document, that are Parties to the Kyoto Protocol, may use table 4(a)II for reporting of accounting quantities if LULUCF is contributing to the attainment of that target.

[c] Parties can include references to the relevant parts of the national inventory report, where accounting methodologies regarding LULUCF are further described in the documentation box or in the biennial reports.

[d] Net emissions and removals in the Party's base year, as established by decision 9/CP.2.

[e] All values are reported in the information table on accounting for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, of the CRF for the relevant inventory year as reported in the current submission and are automatically entered in this table.

[f] Additional columns for relevant years should be added, if applicable.

[g] Cumulative net emissions and removals for all years of the commitment period reported in the current submission.

[h] The values in the cells "3.3 offset" and "Forest management cap" are absolute values.

[i] The accounting quantity is the total quantity of units to be added to or subtracted from a Party's assigned amount for a particular activity in accordance with the provisions of Article 7, paragraph 4, of the Kyoto Protocol.

[j] In accordance with paragraph 4 of the annex to decision 16/CMP.1, debits resulting from harvesting during the first commitment period following afforestation and reforestation since 1990 shall not be greater than the credits accounted for on that unit of land.

[k] In accordance with paragraph 10 of the annex to decision 16/CMP.1, for the first commitment period a Party included in Annex I that incurs a net source of emissions under the provisions of Article 3 paragraph 3, may account for anthropogenic greenhouse gas emissions by sources and removals by sinks in areas under forest management under Article 3, paragraph 4, up to a level that is equal to the net source of emissions under the provisions of Article 3, paragraph 3, but not greater than 9.0 megatonnes of carbon times five, if the total anthropogenic greenhouse gas emissions by sources and removals by sinks in the managed forest since 1990 is equal to, or larger than, the net source of emissions incurred under Article 3, paragraph 3.

[l] In accordance with paragraph 11 of the annex to decision 16/CMP.1, for the first commitment period of the Kyoto Protocol only, additions to and subtractions from the assigned amount of a Party resulting from Forest management under Article 3, paragraph 4, after the application of paragraph 10 of the annex to decision 16/CMP.1 and resulting from forest management project activities undertaken under Article 6, shall not exceed the value inscribed in the appendix of the annex to decision 16/CMP.1, times five.

Custom Footnotes

[1] This line has been added to Table 4(a)II produced by the BR application in order to explain the accounting quantity for A.1.2.

Table 4(b) CHE_BR1_v0.3

Reporting on progress[a, b, c]

Units of market based mechanisms			*Year* 2011	*Year* 2012
Kyoto Protocol units [d]	*Kyoto Protocol units*	*(number of units)*	NE, NO	NE, NO
		(kt CO_2 eq)	NE, NO	NE, NO
	AAUs	*(number of units)*	NE	NE
		(kt CO2 eq)	NE	NE
	ERUs	*(number of units)*	NE	NE
		(kt CO2 eq)	NE	NE
	CERs	*(number of units)*	NE	NE
		(kt CO2 eq)	NE	NE
	tCERs	*(number of units)*	NO	NO
		(kt CO2 eq)	NO	NO
	lCERs	*(number of units)*	NO	NO
		(kt CO2 eq)	NO	NO
Other units [d,e]	*Units from market-based mechanisms under the Convention*	*(number of units)*		
		(kt CO_2 eq)		
	Units from other market-based mechanisms	*(number of units)*		
		(kt CO_2 eq)		
Total		*(number of units)*	NE, NO	NE, NO
		(kt CO_2 eq)	NE, NO	NE, NO

Abbreviations : AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable.

Custom Footnotes

To meet its commitment,Switzerland will use AAUs and RMUs that were initially allocated to Switzerland, CERs and ERUs transferred from the Climate Cent Foundation as well as CERs and ERUs surrendered by companies to meet their emission reductions under the CO2 legislation. The Climate Cent Foundation will acquire a total amount of 14'000 to 15'000 kt CO_2 eq over the first commitment period 2008 – 2012. Companies may surrender an amount of certificates not exceeding 1'600 kt CO_2 eq over the period 2008 –2012. Switzerland will not use tCERs or lCERs to meet its commitment. Switzerland will not use units generated by other market-based mechanisms under the Convention since these units are not available yet.

A.4. Projections

Three scenarios have been established to project Switzerland's greenhouse gas emissions: a "with measures" scenario, a "with additional measures" scenario and a "without measures" scenario. Trends in emissions and removals according to these scenarios are reported in **Table 6(a), 6(b), 6(c)**.

The projections of greenhouse gas emissions in Switzerland have been fully revised over the past years, mainly as a result of the Swiss government decision to gradually phase-out nuclear power generation. The revised set of energy scenarios, available from 2012, complemented by scenarios in the agriculture and LULUCF sectors, have been used to estimate the emissions in 2020 and 2030. The key parameters have been adjusted in comparison to the 5th National Communication accordingly (**Table 5**).

More information regarding the models and methodology used to generate emissions projections and the changes applied since the previous report are reported in section NC6, section 5.4.

Table 5 CHE_BR1_v0.3

Summary of key variables and assumptions used in the projections analysis [a]

Key underlying assumptions		*Historical* [b]						Projected			
Assumption	*Unit*	*1990*	*1995*	2000	2005	2010	2011	2015	2020	2025	2030
Population	*thousands*	6,712.23	7,040.68	7,184.25	7,437.12	7,824.91	7,912.40	8,128.71	8,379.40	8,578.63	8,726.15
GDP	billion CHF (price 2010)	NA	NA	464.22	495.38	546.62	NA	584.20	617.91	645.60	670.50
International oil price	CHF / boe	NA	NA	57.80	69.20	79.30	NA	93.70	98.30	101.30	101.70
International oil price (WAM)	CHF / boe	NA	NA	57.80	69.20	79.30	NA	91.10	89.40	86.80	83.20
International gas price	CHF / t (price 2010)	NA	NA	231.00	339.00	321.00	NA	518.00	561.00	598.00	627.00
International gas price (WAM)	CHF / t (price 2010)	NA	NA	231.00	339.00	321.00	NA	505.00	512.00	517.00	525.00
Heating degree days		3,203.00	3,397.00	3,081.00	3,518.00	3,586.00	2,938.00	3,335.00	3,244.00	3,154.00	3,064.00
Cooling degree days		NA	NA	115.00	151.00	153.00	NA	169.00	186.00	203.00	219.00
Energy reference area	million m2	NA	NA	624.00	659.00	709.00	NA	754.00	799.00	836.00	863.00
Passenger transport	billion passenger km	94.30	93.30	100.10	106.00	114.20	NA	122.90	131.10	137.30	141.10
Passenger transport WAM	billion passenger km	94.30	93.30	100.10	106.00	114.20	NA	121.40	126.60	130.50	134.80
Passenger transport (share road to rail)	%	85.00	86.00	85.00	84.00	82.00	NA	81.00	80.00	79.00	79.00
Freight transport	billion t km	19.90	20.10	23.60	26.00	26.90	NA	30.40	34.20	37.00	39.10
Freight tranport WAM	billion t km	19.90	20.10	23.60	26.00	26.90	NA	30.70	34.50	37.00	38.70
Freight transport (share road to rail)	%	58.00	60.00	58.00	61.00	63.00	NA	61.00	58.00	57.00	56.00
Freight transport (share road to rail) WAM	*%*	58.00	60.00	58.00	61.00	63.00	NA	59.00	54.00	51.00	49.00

[a] Parties should include key underlying assumptions as appropriate.

[b] Parties should include historical data used to develop the greenhouse gas projections reported.

Custom Footnotes

Table 6(a) CHE_BR1_v0.3

Information on updated greenhouse gas projections under a 'with measures' scenario [a]

	GHG emissions and removals [b] (kt CO_2 eq)							GHG emission projections (kt CO_2 eq)	
	Base Year	1990	1995	2000	2005	2010	2011	2020	2030
Sector [d,e]									
Energy	27,485.10	27,485.10	27,648.50	26,502.75	28,644.85	27,668.46	23,782.11	23,476.39	20,468.88
Transport	14,598.13	14,598.13	14,228.34	15,900.89	15,830.65	16,381.66	16,207.55	13,297.57	10,177.10
Industry/industrial processes	3,851.07	3,851.07	3,008.65	3,196.58	3,749.15	3,945.95	3,969.03	3,799.11	3,090.82
Agriculture	6,092.10	6,092.10	5,819.29	5,495.70	5,474.18	5,647.19	5,603.54	5,320.52	5,320.52
Forestry/LULUCF	-3,155.63	-3,155.63	-3,891.36	-1,227.06	-4,197.24	-2,404.73	-3,410.94	861.31	811.31
Waste management/waste	1,010.98	1,010.98	852.45	748.31	663.02	596.92	586.99	596.23	767.54
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	41,486.83	41,486.83	39,771.34	42,787.90	42,172.07	43,619.39	38,549.06	38,970.94	32,453.59
CO_2 emissions excluding net CO_2 from LULUCF	44,661.01	44,661.01	43,673.22	44,020.16	46,374.09	46,028.17	41,965.61	38,679.66	32,212.31
CH_4 emissions including CH_4 from LULUCF	4,683.49	4,683.49	4,271.87	3,915.98	3,771.83	3,767.30	3,735.04	3,568.41	3,654.87
CH_4 emissions excluding CH_4 from LULUCF	4,675.30	4,675.30	4,268.61	3,915.72	3,771.48	3,767.11	3,733.80	3,566.13	3,652.59
N_2O emissions including N_2O from LULUCF	3,467.55	3,467.55	3,329.50	3,187.87	3,074.18	3,138.25	3,078.99	3,475.89	3,543.84
N_2O emissions excluding N_2O from LULUCF	3,457.19	3,457.19	3,322.22	3,182.94	3,069.75	3,134.39	3,074.62	2,908.15	2,976.10
HFCs	0.02	0.02	180.75	498.54	900.68	1,119.04	1,171.45	1,157.36	807.82
PFCs	100.21	100.21	14.69	69.09	32.88	36.71	39.36	29.50	29.49
SF_6	143.62	143.62	97.73	157.79	212.99	154.77	164.37	149.03	146.54
Other (specify)	12.13	12.13	13.08	14.05	14.14	14.22	14.23	14.11	14.11
CO_2	10.96	10.96	11.90	12.87	12.95	13.02	13.03	12.92	12.92
CH_4	0.55	0.55	0.56	0.56	0.57	0.58	0.58	0.57	0.57
SF_6	NA	NA	NA	NA	NA	NA	NA	NA	NA
PFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
HFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total with LULUCF [f]	49,893.85	49,893.85	47,678.96	50,631.22	50,178.77	51,849.68	46,752.50	47,365.24	40,650.26
Total without LULUCF	53,049.48	53,049.48	51,570.30	51,858.29	54,376.01	54,254.41	50,163.44	46,503.94	39,838.96

Abbreviations : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Custom Footnotes

Table 6(b) CHE_BR1_v0.3

Information on updated greenhouse gas projections under a 'without measures' scenario[a]

	GHG emissions and removals[b] *(kt CO_2 eq)*							GHG emission projections (kt CO_2 eq)	
	Base Year	1990	1995	2000	2005	2010	2011	2020	2030
Sector[d,e]									
Energy	27,485.10	27,485.10	27,648.50	26,502.75	28,644.85	27,668.46	23,782.11	24,683.01	24,253.38
Transport	14,598.13	14,598.13	14,228.34	15,900.89	15,830.65	16,381.66	16,207.55	14,680.40	12,508.73
Industry/industrial processes	3,851.07	3,851.07	3,008.65	3,196.58	3,749.15	3,945.95	3,969.03	4,887.49	4,958.99
Agriculture	6,092.10	6,092.10	5,819.29	5,495.70	5,474.18	5,647.19	5,603.54	5,706.22	5,689.68
Forestry/LULUCF	-3,155.63	-3,155.63	-3,891.36	-1,227.06	-4,197.24	-2,404.73	-3,410.94	-788.69	-788.69
Waste management/waste	1,010.98	1,010.98	852.45	748.31	663.02	596.92	586.99	544.74	566.00
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	41,486.83	41,486.83	39,771.34	42,787.90	42,172.07	43,619.39	38,549.06	39,906.86	36,459.57
CO_2 emissions excluding net CO_2 from LULUCF	44,661.01	44,661.01	43,673.22	44,020.16	46,374.09	46,028.17	41,965.61	41,265.59	38,318.29
CH_4 emissions including CH_4 from LULUCF	4,683.49	4,683.49	4,271.87	3,915.98	3,771.83	3,767.30	3,735.04	3,724.67	3,698.13
CH_4 emissions excluding CH_4 from LULUCF	4,675.30	4,675.30	4,268.61	3,915.72	3,771.48	3,767.11	3,733.80	3,722.39	3,695.85
N_2O emissions including N_2O from LULUCF	3,467.55	3,467.55	3,329.50	3,187.87	3,074.18	3,138.25	3,078.99	3,657.35	3,678.35
N_2O emissions excluding N_2O from LULUCF	3,457.19	3,457.19	3,322.22	3,182.94	3,069.75	3,134.39	3,074.62	3,089.61	3,110.61
HFCs	0.02	0.02	180.75	498.54	900.68	1,119.04	1,171.45	2,177.97	2,590.08
PFCs	100.21	100.21	14.69	69.09	32.88	36.71	39.36	29.58	29.64
SF_6	143.62	143.62	97.73	157.79	212.99	154.77	164.37	216.72	232.32
Other (specify)	12.13	12.13	13.08	14.05	14.14	14.22	14.23	14.11	14.11
CO_2	10.96	10.96	11.90	12.87	12.95	13.02	13.03	12.92	12.92
CH_4	0.55	0.55	0.56	0.56	0.57	0.58	0.58	0.57	0.57
SF_6	NA	NA	NA	NA	NA	NA	NA	NA	NA
PFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
HFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total with LULUCF[f]	49,893.85	49,893.85	47,678.96	50,631.22	50,178.77	51,849.68	46,752.50	49,727.26	46,702.20
Total without LULUCF	53,049.48	53,049.48	51,570.30	51,858.29	54,376.01	54,254.41	50,163.44	50,515.97	47,990.90

Abbreviations : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

Table 6(c) CHE_BR1_v0.3

Information on updated greenhouse gas projections under a 'with additional measures' scenario [a]

	GHG emissions and removals [b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base Year	1990	1995	2000	2005	2010	2011	2020	2030
Sector [d,e]									
Energy	27,485.10	27,485.10	27,648.50	26,502.75	28,644.85	27,668.46	23,782.11	22,163.52	16,171.24
Transport	14,598.13	14,598.13	14,228.34	15,900.89	15,830.65	16,381.66	16,207.55	11,035.36	6,729.80
Industry/industrial processes	3,851.07	3,851.07	3,008.65	3,196.58	3,749.15	3,945.95	3,969.03	3,664.14	2,781.61
Agriculture	6,092.10	6,092.10	5,819.29	5,495.70	5,474.18	5,647.19	5,603.54	5,320.52	4,562.37
Forestry/LULUCF	-3,155.63	-3,155.63	-3,891.36	-1,227.06	-4,197.24	-2,404.73	-3,410.94	1,811.31	2,361.31
Waste management/waste	1,010.98	1,010.98	852.45	748.31	663.02	596.92	586.99	596.23	767.54
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	41,486.83	41,486.83	39,771.34	42,787.90	42,172.07	43,619.39	38,549.06	36,360.58	26,297.59
CO_2 emissions excluding net CO_2 from LULUCF	44,661.01	44,661.01	43,673.22	44,020.16	46,374.09	46,028.17	41,965.61	35,119.30	24,506.31
CH_4 emissions including CH_4 from LULUCF	4,683.49	4,683.49	4,271.87	3,915.98	3,771.83	3,767.30	3,735.04	3,564.01	3,159.64
CH_4 emissions excluding CH_4 from LULUCF	4,675.30	4,675.30	4,268.61	3,915.72	3,771.48	3,767.11	3,733.80	3,561.73	3,157.36
N_2O emissions including N_2O from LULUCF	3,467.55	3,467.55	3,329.50	3,187.87	3,074.18	3,138.25	3,078.99	3,465.57	3,241.98
N_2O emissions excluding N_2O from LULUCF	3,457.19	3,457.19	3,322.22	3,182.94	3,069.75	3,134.39	3,074.62	2,897.83	2,674.24
HFCs	0.02	0.02	180.75	498.54	900.68	1,119.04	1,171.45	1,038.60	565.55
PFCs	100.21	100.21	14.69	69.09	32.88	36.71	39.36	29.49	29.47
SF_6	143.62	143.62	97.73	157.79	212.99	154.77	164.37	132.83	79.64
Other (specify)	12.13	12.13	13.08	14.05	14.14	14.22	14.23	14.11	14.11
CO_2	10.96	10.96	11.90	12.87	12.95	13.02	13.03	12.92	12.92
CH_4	0.55	0.55	0.56	0.56	0.57	0.58	0.58	0.57	0.57
SF_6	NA	NA	NA	NA	NA	NA	NA	NA	NA
PFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
NF_3	NA	NA	NA	NA	NA	NA	NA	NA	NA
N_2O	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
HFCs	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total with LULUCF [f]	49,893.85	49,893.85	47,678.96	50,631.22	50,178.77	51,849.68	46,752.50	44,605.19	33,387.98
Total without LULUCF	53,049.48	53,049.48	51,570.30	51,858.29	54,376.01	54,254.41	50,163.44	42,793.89	31,026.68

Abbreviations : GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

A.5. Provision of financial, technological and capacity-building support to developing country Parties.

Three government entities – the Swiss Agency for Development and Cooperation (SDC), the State Secretariat for Economic Affairs (SECO), and the Federal Office for the Environment (FOEN) – have specific roles while cooperating closely to assure effectiveness and coherence in Switzerland's activities related to international climate related financial and technology support.

In February 2011, the Swiss Parliament decided to increase the level of Official Development Assistance (ODA) to 0.5% of Gross National Income (GNI). As part of this decision, a new and additional amount of CHF 140 million was allocated with immediate effect for the purpose of Swiss Fast-Start-Finance. This amount is new and additional to prior levels of Swiss climate change financing for developing countries from public sources.

Tables 7(a) and 7(b) show Switzerland's contribution in 2011 and 2012, divided into four categories: adaptation, mitigation, cross-cutting, and core/general. The overall level of climate change specific finance provided by Switzerland has increased from 147.62 million CHF in 2011 (41.74 million CHF multilateral, 105.88 million CHF bilateral) to 164.40 million CHF in 2012 (21.43 million CHF multilateral, 142.97 CHF bilateral). The Swiss core contributions provided to multilateral institutions, of which a substantial share is allocated to finance climate change adaptation and mitigation action, has increased from 406.17 million CHF in 2011 to 421.68 million CHF in 2012.

Alongside public sector activities, the Swiss private sector plays an important role in terms of technology transfer. In many fields of environmentally sound technologies, Swiss companies are leading in the development, diffusion and implementation of state-of-the-art solutions and pursue climate-related activities in the order of several billion CHF per year.

Due to restrictions of the reporting framework and technical interface for the Biennial Report (especially tables **7** and **7(a)** certain items had to be reallocated to the categories provided by the reporting framework. The reallocation lead to a loss in detail and accuracy, especially with respect to the total Swiss payments for adaptation and mitigation activities. For a more detailed analysis see section 7.4 of the 6th National Communication.

Table 7 CHE_BR1_v0.3

Provision of public financial support: summary information in 2011[a]

Allocation channels	*Year*									
	Swiss franc - CHF					*USD[b]*				
	Core/ general[c]	*Climate-specific[d]*				*Core/ general[c]*	*Climate-specific[d]*			
		Mitigation	*Adaptation*	*Cross-cutting[e]*	*Other[f]*		*Mitigation*	*Adaptation*	*Cross-cutting[e]*	*Other[f]*
Total contributions through multilateral channels:	406,165,058.77	2,690,513.00	4,200,013.00	34,853,621.00	NA	457,753,926.25	3,032,247.27	4,733,475.71	39,280,537.59	NA
Multilateral climate change funds[g]	1,500,000.00	NA	4,200,013.00	11,744,871.00	NA	1,690,521.81	NA	4,733,475.71	13,236,640.37	NA
Other multilateral climate change funds[h]	1,500,000.00	NA	NA	241,534.00	NA	1,690,521.81	NA	NA	272,212.33	NA
Multilateral financial institutions, including regional development banks	313,029,108.77	NA	NA	20,823,750.00	NA	352,788,356.55	NA	NA	23,468,669.00	NA
Specialized United Nations bodies	91,635,950.00	2,690,513.00	NA	2,285,000.00	NA	103,275,047.89	3,032,247.27	NA	2,575,228.22	NA
Total contributions through bilateral, regional and other channels	NA	46,817,770.00	59,064,682.00	NA	NA	NA	52,764,307.43	66,566,755.34	NA	NA
Total	406,165,058.77	49,508,283.00	63,264,695.00	34,853,621.00	NA	457,753,926.25	55,796,554.70	71,300,231.05	39,280,537.59	NA

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should provide an explanation on methodology used for currency exchange for the information provided in table 7, 7(a) and 7(b) in the box below.

[c] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities which are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

Custom Footnotes

Each Party shall provide an indication of what new and additional financial resources they have provided, and clarify how they have determined that such resources are new and additional. Please provide this information in relation to table 7(a) and table 7(b).

Documentation Box:

The currency exchange for 2011 is 0.8873 and has been taken from the following document: http://www.estv.admin.ch/wehrpflichtersatzabgabe/dienstleistungen/00263/index.html?lang=fr

Table 7 CHE_BR1_v0.3

Provision of public financial support: summary information in 2012[a]

Allocation channels	*Year*									
	Swiss franc - CHF					*USD[b]*				
	Core/ general[c]	*Climate-specific[d]*				*Core/ general[c]*	*Climate-specific[d]*			
		Mitigation	*Adaptation*	*Cross-cutting[e]*	*Other[f]*		*Mitigation*	*Adaptation*	*Cross-cutting[e]*	*Other[f]*
Total contributions through multilateral channels:	421,683,372.54	1,980,315.00	1,000,000.00	18,447,733.00	NA	449,603,766.44	2,111,435.12	1,066,211.75	19,669,189.69	NA
Multilateral climate change funds[g]	1,000,000.00	NA	1,000,000.00	11,544,383.00	NA	1,066,211.75	NA	1,066,211.75	12,308,756.80	NA
Other multilateral climate change funds[h]	1,000,000.00	NA	NA	67,888.00	NA	1,066,211.75	NA	NA	72,382.98	NA
Multilateral financial institutions, including regional development banks	332,980,352.54	NA	NA	5,211,350.00	NA	355,027,564.28	NA	NA	5,556,402.61	NA
Specialized United Nations bodies	87,703,020.00	1,980,315.00	NA	1,692,000.00	NA	93,509,990.41	2,111,435.12	NA	1,804,030.28	NA
Total contributions through bilateral, regional and other channels	NA	75,640,143.00	67,329,165.00	NA	NA	NA	80,648,409.21	71,787,146.81	NA	NA
Total	421,683,372.54	77,620,458.00	68,329,165.00	18,447,733.00	NA	449,603,766.44	82,759,844.33	72,853,358.56	19,669,189.69	NA

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should provide an explanation on methodology used for currency exchange for the information provided in table 7, 7(a) and 7(b) in the box below.

[c] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities which are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the "UNFCCC biennial reporting guidelines for developed country Parties" in decision 2/CP.17.

Custom Footnotes

Each Party shall provide an indication of what new and additional financial resources they have provided, and clarify how they have determined that such resources are new and additional. Please provide this information in relation to table 7(a) and table 7(b).

Documentation Box:

The currency exchange for 2011 is 0.9379 and has been taken from the following document: http://www.estv.admin.ch/wehrpflichtersatzabgabe/dienstleistungen/00263/index.html?lang=fr

Table 7(a) CHE_BR1_v0.3

Provision of public financial support: contribution through multilateral channels in 2011[a]

Donor funding	Total amount				Status[b]	Funding source[f]	Financial instrument[f]	Type of support[f, g]	Sector[c]
	Core/general[d]		Climate-specific[e]						
	Swiss franc - CHF	USD	Swiss franc - CHF	USD					
Total contributions through multilateral channels	406,165,058.77	457,753,926.25	41,744,147.00	47,046,260.57					
Multilateral climate change funds[g]	1,500,000.00	1,690,521.81	15,944,884.00	17,970,116.08					
1. Global Environment Facility[1]	NA	NA	9,636,000.00	10,859,912.09	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	NA	NA	1,000,000.00	1,127,014.54	Provided	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund	NA	NA	750,000.00	845,260.90	Provided	ODA	Grant	Cross-cutting	Cross-cutting
4. Adaptation Fund	NA	NA	3,200,013.00	3,606,461.17	Provided	ODA	Grant	Adaptation	Cross-cutting
5. Green Climate Fund	NA	NA	143,426.00	161,643.19	Provided	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities[2]	NA	NA	973,911.00	1,097,611.86	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	1,500,000.00	1,690,521.81	241,534.00	272,212.33					
GFDRR	1,500,000.00	1,690,521.81	NA	NA	Provided	ODA	Grant	Adaptation	Cross-cutting
Ministerial Consultations Pretoria	NA	NA	241,534.00	272,212.33	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks	313,029,108.77	352,788,356.55	20,823,750.00	23,468,669.00					
1. World Bank[3]	237,663,286.00	267,849,978.59	20,773,750.00	23,412,318.27	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	NA	NA	NA	NA	Provided	ODA	Grant	Mitigation	NA
3. African Development Bank	58,249,913.50	65,648,499.38	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	13,353,000.00	15,049,025.13	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
5. European Bank for Reconstruction and Development	NA	NA	NA	NA	Provided	NA	NA	NA	NA
6. Inter-American Development Bank	2,599,441.27	2,929,608.10	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other	1,163,468.00	1,311,245.35	50,000.00	56,350.73					
OECD	1,163,468.00	1,311,245.35	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
OECD Climate Change Research Collaborative	NA	NA	50,000.00	56,350.73	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Specialized United Nations bodies	91,635,950.00	103,275,047.89	4,975,513.00	5,607,475.49					
1. United Nations Development Programme	54,000,000.00	60,858,785.08	NA	NA					
1. UNDP	54,000,000.00	60,858,785.08	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	6,500,000.00	7,325,594.50	NA	NA					
2.1 UNEP core contribution	4,500,000.00	5,071,565.42	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2.2 UNEP Ozone Fund	2,000,000.00	2,254,029.08	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. Other	31,135,950.00	35,090,668.31	4,975,513.00	5,607,475.49					
3.1 UNCCD	410,950.00	463,146.62	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3.2 IFAD	14,100,000.00	15,890,904.99	NA	NA	Provided	ODA	Grant	Cross-cutting	Agriculture
3.3 UNITAR (climate change, environmental law)	NA	NA	300,000.00	338,104.36	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3.4 UNIDO (Cleaner Production Center / Ressource Efficient Cleaner Production Program)	NA	NA	2,690,513.00	3,032,247.27	Provided	ODA	Grant	Mitigation	Cross-cutting
3.5 UNISDR	500,000.00	563,507.27	NA	NA	Provided	ODA	Grant	Adaptation	Cross-cutting
3.6 IPCC	NA	NA	1,885,000.00	2,124,422.41	Provided	ODA	Grant	Cross-cutting	Cross-cutting
IUCN	2,125,000.00	2,394,905.89	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
CGIAR	14,000,000.00	15,778,203.54	NA	NA	Provided	ODA	Grant	Cross-cutting	Agriculture
GEO GEOSs	NA	NA	100,000.00	112,701.45	Provided	ODA	Grant	Cross-cutting	Cross-cutting
WCC-3	NA	NA	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting

Table 7(a) CHE_BR1_v0.3

Provision of public financial support: contribution through multilateral channels in 2012[a]

Donor funding	*Total amount*				*Status[b]*	*Funding source[f]*	*Financial instrument[f]*	*Type of support[f, g]*	*Sector[c]*
	Core/general[d]		*Climate-specific[e]*						
	Swiss franc - CHF	*USD*	*Swiss franc - CHF*	*USD*					
Total contributions through multilateral channels	421,683,372.54	449,603,766.44	21,428,048.00	22,846,836.56					
Multilateral climate change funds [g]	1,000,000.00	1,066,211.75	12,544,383.00	13,374,968.55					
1. Global Environment Facility[1]	NA	NA	9,834,000.00	10,485,126.35	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund	NA	NA	1,000,000.00	1,066,211.75	Provided	ODA	Grant	Adaptation	Cross-cutting
3. Special Climate Change Fund	NA	NA	750,000.00	799,658.81	Provided	ODA	Grant	Cross-cutting	Cross-cutting
4. Adaptation Fund	NA	NA	NA	NA	Provided	ODA	Grant	Adaptation	Cross-cutting
5. Green Climate Fund	NA	NA	131,000.00	139,673.74	Provided	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities[2]	NA	NA	761,495.00	811,914.92	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other multilateral climate change funds	1,000,000.00	1,066,211.75	67,888.00	72,382.98					
GFDRR	1,000,000.00	1,066,211.75	NA	NA	Provided	ODA	Grant	Adaptation	Cross-cutting
Climate Vulnerable Forum Costa Rica	NA	NA	67,888.00	72,382.98	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks	332,980,352.54	355,027,564.28	5,211,350.00	5,556,402.61					
1. World Bank[3]	259,045,044.00	276,196,869.60	5,076,350.00	5,412,464.02	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. International Finance Corporation	NA	NA	NA	NA	Provided	NA	NA	NA	NA
3. African Development Bank	59,849,851.54	63,812,614.93	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
4. Asian Development Bank	13,533,000.00	14,429,043.61	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
5. European Bank for Reconstruction and Development	NA	NA	NA	NA	Provided	NA	NA	NA	NA
6. Inter-American Development Bank	NA	NA	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
7. Other	552,457.00	589,036.14	135,000.00	143,938.59					
OECD	552,457.00	589,036.14	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
OECD Climate Change Research Collaborative			135,000.00	143,938.59	Provided	ODA	Grant	Cross-cutting	Cross-cutting
Specialized United Nations bodies	87,703,020.00	93,509,990.41	3,672,315.00	3,915,465.40					
1. United Nations Development Programme	54,000,000.00	57,575,434.48	NA	NA					
1. UNDP	54,000,000.00	57,575,434.48	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	7,400,000.00	7,889,966.94	NA	NA					
2.1 UNEP core contribution	4,900,000.00	5,224,437.57	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
2.2 UNEP Ozone Fund	2,500,000.00	2,665,529.37	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3. Other	26,303,020.00	28,044,588.99	3,672,315.00	3,915,465.40					
3.1 UNCCD	978,020.00	1,042,776.42	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3.2 IFAD	7,200,000.00	7,676,724.60	NA	NA	Provided	ODA	Grant	Cross-cutting	Agriculture
3.3 UNITAR (climate change, environmental law)	NA	NA	300,000.00	319,863.52	Provided	ODA	Grant	Cross-cutting	Cross-cutting
3.4 UNIDO (Cleaner Production Center / Ressource Efficient Cleaner Production Program)	NA	NA	1,980,315.00	2,111,435.12	Provided	ODA	Grant	Mitigation	Cross-cutting
3.5 UNISDR	1,000,000.00	1,066,211.75	NA	NA	Provided	ODA	Grant	Adaptation	Cross-cutting
3.6 IPCC	NA	NA	1,192,000.00	1,270,924.41	Provided	ODA	Grant	Cross-cutting	Cross-cutting
IUCN	3,125,000.00	3,331,911.72	NA	NA	Provided	ODA	Grant	Cross-cutting	Cross-cutting
CGIAR	14,000,000.00	14,926,964.50	NA	NA	Provided	ODA	Grant	Cross-cutting	Agriculture
GEO GEOSs	NA	NA	50,000.00	53,310.59	Provided	ODA	Grant	Cross-cutting	Cross-cutting
WCC-3	NA	NA	150,000.00	159,931.76	Provided	ODA	Grant	Cross-cutting	Cross-cutting

Footnotes Table (7a)

Abbreviations: ODA = official development assistance, OOF = other official flows.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[d] This refers to support to multilateral institutions that Parties cannot specify as climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

[g] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Custom Footnotes

1. According to the evaluation report of GEF-5 32% of the core funding were invested in climate change activities.

2. UNFCCC Trust Fund for Supplementary Activities (2011: CHF 973'911.00) -> UNFCCC contribution: CHF 330'485.00; UNFCCC Trust Fund for Supplementary Activities and other voluntary contributions: CHF 643'426.00

UNFCCC Trust Fund for Supplementary Activities (2012: CHF 761'495.00) -> UNFCCC contribution: CHF 341'495.00; UNFCCC Trust Fund for Supplementary Activities and other voluntary contributions: CHF 420'000.00

3. A proportion of Switzerland's core contributions to multilateral organisations may be allocated to climate change activities, the exact amount of which cannot be assessed reliably. Climate-specific (2011) : 1.1 CIF / SREP (Scaling up Rewable Energy Program): CHF 9'350'000.00; 1.2 Forest Carbon Partnership Facility: CHF 4'071'250.00; .3 Carbon Finance Assist Trust Fund: CHF 1'402'500.00; 1.4 Partnership for Market Readiness: CHF 5'950'000.00; Total: CHF 20'773'750.00

A proportion of Switzerland's core contributions to multilateral organisations may be allocated to climate change activities, the exact amount of which cannot be assessed reliably. Climate-specific (2012) : 1.1 CIF / SREP (Scaling up Rewable Energy Program): CHF 3'825'000.00; 1.2 Forest Carbon Partnership Facility: CHF 87124.00; .3 Carbon Finance Assist Trust Fund: CHF 1'164'226.00; 1.4 Partnership for Market Readiness: CHF 0.00; Total: CHF 5'076'350.00

General comments:

A proportion of Switzerland's core contributions to multilateral organisations may be allocated to climate change activities but Switzerland is not able to report on these internal decisions.

Many institutions could not be allocated to any given institutional category.

Switzerland provides funding to a number of multilateral organisations as implementing partners for regional and bilateral activities. This funding is reported in the Bilateral and Multi-Bilateral Funding table.

Table 7(b) CHE_BR1_v0.3

Provision of public financial support: contribution through bilateral, regional and other channels in 2011[a]

Recipient country/ region/project/programme[b]	Total amount: Climate-specific[f]		Status[c]	Funding source[g]	Financial instrument[g]	Type of support[g, h]	Sector[d]	Additional information[e]
	Swiss franc - CHF	USD						
Total contributions through bilateral, regional and other channels	105,882,452.00	119,331,062.77						
Africa Regional / SDC Africa Regional Programs and Projects (Adaptation)	834,922.00	940,969.23	Provided	ODA	Grant	Adaptation	Cross-cutting	
Africa Regional / SDC Africa Regional Programs and Projects (Mitigation)	460,910.00	519,452.27	Provided	ODA	Grant	Mitigation	Cross-cutting	
East and Southern Africa / SDC E&S Africa Adaptation	5,678,820.00	6,400,112.70	Provided	ODA	Grant	Adaptation	Cross-cutting	
East and Southern Africa / SDC E&S Africa Mitigation	2,338,508.00	2,635,532.51	Provided	ODA	Grant	Mitigation	Cross-cutting	
West Africa / SDC West Africa Adaptation	1,722,196.00	1,940,939.93	Provided	ODA	Grant	Adaptation	Cross-cutting	
West Africa / SDC West Africa Mitigation	299,751.00	337,823.73	Provided	ODA	Grant	Mitigation	Cross-cutting	
Asia Regional / SDC Asia Regional Programs and Projects (Adaptation)	250,000.00	281,753.63	Provided	ODA	Grant	Adaptation	Cross-cutting	
East Asia / SDC East Asia Adaptation	12,573,323.00	14,170,317.82	Provided	ODA	Grant	Adaptation	Cross-cutting	
East Asia / SDC East Asia Mitigation	5,495,963.00	6,194,030.20	Provided	ODA	Grant	Mitigation	Cross-cutting	
South Asia / SDC South Asia Adaptation	11,000,619.00	12,397,857.55	Provided	ODA	Grant	Adaptation	Cross-cutting	
South Asia / SDC South Asia Mitigation	4,269,088.00	4,811,324.24	Provided	ODA	Grant	Mitigation	Cross-cutting	
CIS / SDC CIS Adaptation Programs and Projects	3,685,387.00	4,153,484.73	Provided	ODA	Grant	Adaptation	Cross-cutting	
CIS / SDC CIS Mitigation Programs and Projects	275,553.00	310,552.24	Provided	ODA	Grant	Mitigation	Cross-cutting	
New EU Member States / SECO Programs and Projects in New EU Member States	90,777.00	102,307.00	Provided	ODA	Grant	Mitigation	Cross-cutting	
West Balkans / SDC West Balkans Adaptation	125,787.00	141,763.78	Provided	ODA	Grant	Adaptation	Cross-cutting	
West Balkans / SDC West Balkans Mitigation	141,471.00	159,439.87	Provided	ODA	Grant	Mitigation	Cross-cutting	
Latin America / SDC Latin American Adaptation Programs and Projects	10,778,176.00	12,147,161.05	Provided	ODA	Grant	Adaptation	Cross-cutting	
Latin America / SDC Latin American Mitigation Programs and Projects	6,791,833.00	7,654,494.53	Provided	ODA	Grant	Mitigation	Cross-cutting	
Middle East and North Africa / SDC Middle East and North Africa Adaptation Programs and	276,970.00	312,149.22	Provided	ODA	Grant	Adaptation	Cross-cutting	
Middle East and North Africa / SDC Middle East and North Africa Mitigation Programs and	178,000.00	200,608.59	Provided	ODA	Grant	Mitigation	Cross-cutting	
Global / Humanitarian Aid	5,671,074.00	6,391,382.85	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / SDC Global Adaptation Programs and Projects	5,088,283.00	5,734,568.92	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / SDC Global Mitigation Programs and Projects	3,099,647.00	3,493,347.23	Provided	ODA	Grant	Mitigation	Cross-cutting	
Global / Climate Change Adaptation relevant ODA bi- and multi-bilateral programming of	1,379,125.00	1,554,293.93	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / Climate Change Mitigation relevant ODA bi- and multi-bilateral programming of SECO	23,376,269.00	26,345,395.02	Provided	ODA	Grant	Mitigation	Cross-cutting	

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as provided, committed and/or pledged. Parties will provide the information for as many status categories as appropriate in the following order of priority: provided, committed, pledged.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under "Other".

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Custom Footnotes

The climate change relevant part of all SDC funded projects was calculated as follows: The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 1-50%, principal: 51-100%)

The climate change relevant part of all SECO funded projects was calculated as follows: The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 50%, principal: 85%)

Table 7(b) CHE_BR1_v0.3

Provision of public financial support: contribution through bilateral, regional and other channels in 2012[a]

Recipient country/ region/project/programme[b]	Total amount – Climate-specific[f] – Swiss franc - CHF	Total amount – Climate-specific[f] – USD	Status[c]	Funding source[g]	Financial instrument[g]	Type of support[g, h]	Sector[d]	Additional information[e]
Total contributions through bilateral, regional and other channels	142,969,308.00	152,435,556.02						
Africa Regional / SDC Africa Regional Programs and Projects (Adaptation)	1,633,613.00	1,741,777.37	Provided	ODA	Grant	Adaptation	Cross-cutting	
Africa Regional / SDC Africa Regional Programs and Projects (Mitigation)	304,083.00	324,216.87	Provided	ODA	Grant	Mitigation	Cross-cutting	
East and Southern Africa / SDC E&S Africa Adaptation	9,233,141.00	9,844,483.42	Provided	ODA	Grant	Adaptation	Cross-cutting	
East and Southern Africa / SDC E&S Africa Mitigation	4,999,719.00	5,330,759.14	Provided	ODA	Grant	Mitigation	Cross-cutting	
West Africa / SDC West Africa Adaptation	4,399,139.00	4,690,413.69	Provided	ODA	Grant	Adaptation	Cross-cutting	
West Africa / SDC West Africa Mitigation	561,623.00	598,809.04	Provided	ODA	Grant	Mitigation	Cross-cutting	
Asia Regional / SDC Asia Regional Programs and Projects (Adaptation)	574,000.00	612,005.54	Provided	ODA	Grant	Adaptation	Cross-cutting	
East Asia / SDC East Asia Adaptation	12,094,674.00	12,895,483.53	Provided	ODA	Grant	Adaptation	Cross-cutting	
East Asia / SDC East Asia Mitigation	4,223,305.00	4,502,937.41	Provided	ODA	Grant	Mitigation	Cross-cutting	
South Asia / SDC South Asia Adaptation	10,026,540.00	10,690,414.76	Provided	ODA	Grant	Adaptation	Cross-cutting	
South Asia / SDC South Asia Mitigation	4,022,895.00	4,289,257.92	Provided	ODA	Grant	Mitigation	Cross-cutting	
CIS / SDC CIS Adaptation Programs and Projects	2,854,062.00	3,043,034.44	Provided	ODA	Grant	Adaptation	Cross-cutting	
CIS / SDC CIS Mitigation Programs and Projects	297,533.00	317,233.18	Provided	ODA	Grant	Mitigation	Cross-cutting	
New EU Member States / SDC Adaptation Projects in New EU Member States	48,547.00	51,761.38	Provided	ODA	Grant	Adaptation	Cross-cutting	
New EU Member States / SDC Mitigation Projects in New EU Member States	26,564.00	28,322.85	Provided	ODA	Grant	Mitigation	Cross-cutting	
New EU Member States / SECO Programs and Projects in New EU Member States	2,430,000.00	2,590,894.55	Provided	ODA	Grant	Mitigation	Cross-cutting	
West Balkans / SDC West Balkans Adaptation	162,602.00	173,368.16	Provided	ODA	Grant	Adaptation	Cross-cutting	
West Balkans / SDC West Balkans Mitigation	155,655.00	165,961.19	Provided	ODA	Grant	Mitigation	Cross-cutting	
Latin America / SDC Latin American Adaptation Programs and Projects	14,016,073.00	14,944,101.72	Provided	ODA	Grant	Adaptation	Cross-cutting	
Latin America / SDC Latin American Mitigation Programs and Projects	10,038,344.00	10,703,000.32	Provided	ODA	Grant	Mitigation	Cross-cutting	
Middle East and North Africa / SDC Middle East and North Africa Adaptation Programs and	170,379.00	181,660.09	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / Humanitarian Aid	6,848,530.00	7,301,983.15	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / SDC Global Adaptation Programs and Projects	4,862,854.00	5,184,832.07	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / SDC Global Mitigation Programs and Projects	3,785,366.00	4,036,001.71	Provided	ODA	Grant	Mitigation	Cross-cutting	
Global / Climate Change Adaptation relevant ODA bi- and multi-bilateral programming of	405,011.00	431,827.49	Provided	ODA	Grant	Adaptation	Cross-cutting	
Global / Climate Change Mitigation relevant ODA bi- and multi-bilateral programming of SECO	44,795,056.00	47,761,015.03	Provided	ODA	Grant	Mitigation	Cross-cutting	

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

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[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] Cross-cutting type of support refers to funding for activities which are cross-cutting across mitigation and adaptation.

Custom Footnotes

The climate change relevant part of all SDC funded projects was calculated as follows: The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 1-50%, principal: 51-100%)

The climate change relevant part of all SECO funded projects was calculated as follows: The climate change relevant part is weighed individually for each project and the disbursement level calculated accordingly (significant: 50%, principal: 85%)

Table 8

Provision of technology development and transfer support

Most projects funded by Switzerland include technology transfer components. Since they form an integral part of a project, it is not possible to account for them separately.

Table 9
Provision of capacity-building support

All projects funded by Switzerland include capacity-building components. Since they form an integral part of each project, it is not possible to account for them separately.

Abbreviations and Acronyms

AAU	Assigned amount units
AOD	Aerosol optical depth
ARE	Swiss Federal Office for Spatial Development
ART	Agroscope Reckenholz-Tänikon Research Station
AVHRR	Advanced Very High Resolution Radiometer
BSRN	Baseline Surface Radiation Network
C2SM	Centre for Climate Systems Modelling
CADP	Climate Adaptation Development Programme
CATCOS	Capacity Building and Twinning for Climate Observing Systems
CCI	Climate Change Initiative
CDC	Caisse des Dépôts et Consignations
CDM	Clean development mechanism
CER	Certified emission reduction
CFCs	Chlorofluorocarbons
CH_4	Methane
CHF	Swiss francs
CHR	International Commission for the Hydrology of the Rhine basin
CIS	Commonwealth of Independent States
CMP	Meeting of the Parties to the Kyoto Protocol
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Conference of the Parties
CORE	Federal Energy Research Commission
CORINAIR	CORe INventory of AIR emissions
COST	European Cooperation in the Area of Scientific and Technical Research
CRF	Common reporting format
CRMG	Commodity Risk Management Group
CRT	Continuously Regenerating Trap
CTI	Commission for Technology and Innovation
DEM	Digital Elevation Model
DES	Data exchange standard
DETEC	Federal Department of Environment, Transport, Energy and Communications
DGC	Directorate General of Customs
EAE	Energy Agency for Electrical Appliances
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
ECMWF	European Centre for Medium-Range Weather Forecasts
ECC	Essential Climate Variables

EEA	European Environmental Agency
EKK	Cryospheric commission
EMEP	European Monitoring and Evaluation Programme
EMIS	Swiss national air pollution data base
EMPA	Swiss Federal Laboratories for Materials Testing and Research
EnAW	The Energy Agency for the Economy
EPA	Environmental Protection Act
EPFL	Swiss Federal Institute of Technology Lausanne
ETH/ETHZ	Swiss Federal Institute of Technology Zürich
ERC	European Research Council
ERU	Emission reduction units
ESA	European Space Agency
ESC	Energy Science Centre
ETS	Emission Trading System
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUVC	European ultraviolet radiometer calibration centre
FAL	Swiss Federal Research Station for Agroecology and Agriculture
FCPF	Forest Carbon Partnership Facility
FDFA	Federal Department of Foreign Affairs
FDHA	Federal Department of Home Affairs
FEDRO	Federal Roads Office
FFA	Federal Finance Administration
FOAG	Swiss Federal Office for Agriculture
FOCA	Federal Office of Civil Aviation
FOCP	Federa Office for Civil Protection
FOEN	Federal Office for the Environment
FOITT	Federal Office of Information Technology, Systems and Telecommunication
FOPH	Federal Office of Public Health
SFSO	Federal Office of Statistics
GAW	Global Atmosphere Watch
GAW-WCC	GAW-World Calibration Centre
GAW-WORCC	GAW-World Optical depth Research and Calibration Centre
GCM	GCOS Cooperation Mechanism
GCOS	Global Climate Observing System
GCTE	Global Change and Terrestrial Ecosystems
GCW	Global Cryosphere Watch
GDP	Gross domestic product
GEF	Global Environment Facility
GEP	Global Environmental Programme (of SDC)
Gg	Gigagram (1,000 tonnes)

GHG	Greenhouse gas
GNP	Gross national product
GOOS	Global Ocean Observing System
GPCC	Global Programme Climate Change
GRDC	Global Runoff Data Centre
GRUAN	GCOS Reference Upper Air Network
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network – Glaciers
GTN-L	Global Terrestrial Network –Lakes
GTN-P	Global Terrestrial Network – Permafrost
GTN-R	Global Terrestrial Network – River discharge
GTOS	Global Terrestrial Observing System
GUAN	GCOS Upper Air Network
GWh	Giga Watt hours
GWP	Global warming potential
HCL	Hydrochloric acid
HDD	Heating degree days
HF	Hydrogen fluoride
HFCs	Hydrofluorocarbons
HGV	Heavy goods vehicle
HVF	Heavy vehicle fee
IAR	Independent assessment report
IEA	International Energy Agency
ICAO	International Civil Aviation Organization
ICPR	International Commission for the Protection of the Rhine
ICSU	International Council for Science
ICT	Information and communication technology
IDM	Internal document management system
IDP	Inventory development plan
IGBP	International Geosphere Biosphere Programme
IISD	International Institute for Sustainable Development
IHDP	International Human Dimensions Programme
ISOT	Isotopes in the water cycle network
ITC	International Trade Centre
ITTO	International Tropical Timber Organization
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual property rights
ISDC	Interdepartmental Sustainable Development Committee
JI	Joint implementation
ITL	International transaction log

km	kilometre
kW	kilo Watt
LCA	Life Cycle Analysis
lCER	Long-term certified emissions reduction
LDC	Least Developed Countries
LKO	Light climatic observatory
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land Use Change and Forestry
LWF	Long-term Forest Ecosystem Research Programme
LWST	Lake Water Surface Temperature
MDGs	UN Millennium Development Goals
MeteoSwiss	Federal Office of Meteorology and Climatology
MRI	Mountain Research Initiative
MSWI	Swiss municipal solid waste incinerator plants
NABEL	National Air Pollution Monitoring Network
NADUF	National River Monitoring and Survey Programme
NAPOL	National pollen monitoring network
NAQUA	National groundwater observation programme
NAWA	National Surface Water Quality Monitoring Programme
NBCN	Swiss National Basic Climatological Network
NC3	Switzerland’s third National Communication
NC4	Switzerland’s fourth National Communication
NCCR	National Centre of Competence in Research
NFI	National Forest Inventory
NFS	National Science Foundation
NGO	Non-governmental organization
NH_3	Ammonia
NIR	National Inventory Report
NIS	National Inventory System
NMVOC	Non-methane volatile organic compound
NO_X	Nitrogen oxides
N_2O	Nitrous oxide
ÖBU	Swiss Association for Environmentally Conscious Management
OcCC	Swiss Advisory Body on Climate Change
OCCR	Oeschger Centre for Climate Change Research
OECD	Organization for Economic Cooperation and Development
p.a.	per annum
PAGES	IGBP Past Global Changes
PCDD	Polychlorinated dibenzodioxins
PCDF	Polychlorinated dibenzofuranes
PERMOS	Swiss Permafrost Monitoring Network

PFCs	Perfluorocarbons
PJ	Petajoule (277.8 GWh)
PLANAT	National Platform for Natural Hazards
PM	Particulate matter
PMOD/WRC	Physikalisch-meteorologisches Observatorium Davos / World Radiation Centre
ProClim	Swiss Forum for Climate and Global Change
PV	Photovoltaics
QA	Quality Assurance
QC	Quality Control
QMS	Quality management system
RBCN	Regional Basic Climatological Network
RCM	Regional Climate Model
REDD	Reducing Emissions from Deforestation and land Degradation
REPIC	Renewable Energy & Energy Efficiency Promotion in International Co-operation
RES	Reference Energy System
RMU	Carbon removal unit
SACRaM	Swiss Alpine Climate Radiation Monitoring network
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCNAT	Swiss Academy of Sciences
SDC	Swiss Agency for Development and Cooperation
seco	State Secretariat for Economic Affairs
SEF	Standard electronic format
SERI	State Secretariat for Education, Research and Innovation
SF_6	Sulphur hexafluoride
SFOE	Swiss Federal Office of Energy
SIA	Swiss Society of Engineers and Architects
SICCP	Swiss Interdepartmental Committee for Climate Policy
SLF	Swiss Federal Institute for Snow and Avalanche Research
SLM	Sustainable Land Management
SMEs	Small and medium enterprises
SNB	Swiss National Bank
SO_2	Sulphur dioxide
SQL	Structured Query Language
tCER	Temporary certified emissions reduction
TFA	Treated floor area
TOW	Technical ordinance on waste
TWh	Tera Watt hour
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme

UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
VOC	Volatile organic compounds
VAT	Value-added tax
vkm	vehicle kilometres
VTG	Defence Sector within the Federal Department of Defence Civil Protection and Sport
WCC	World Calibration Centre
WCRP	World Climate Research Programme
WGMS	World Glacier Monitoring Service
WISER	Water Isotope System for Data Analysis, Visualization , and Electronic Retrieval
WMO	World Meteorological Organization
WORCC	World Optical depth Research and Calibration Centre
WRC	World Radiation Center
WSL	Swiss Federal Institute for Forests, Snow and Landscape Research
WUVCC	World UV Calibration Center
WWF	World Wildlife Fund