Switzerland's Second Biennial Report under the UNFCCC

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Contents

Foreword

Switzerland's Second Biennial Report under the UNFCCC documents the information as required by the UNFCCC biennial reporting guidelines for developed country Parties. It is presented in the form of an update to the Sixth National Communication, complemented by the specific elements of a Biennial Report.

Having in place a comprehensive package of measures aimed at the reduction of greenhouse gas emissions, Switzerland is on track with its climate change mitigation efforts within the second commitment period under the Kyoto Protocol. Measures have been designed to allow for continuous adaptation, taking into account the need to substantially increase efforts beyond 2020. In addition, Switzerland honours its commitments towards developing country Parties as is indicated by the information on support provided.

Scientific evidence and practical experience leave no doubt that we are risking a world struggling with serious difficulties in the economic and social realms if no common path is found to responsibly deal with climate change. However, in Switzerland as in any country, the preparedness to forgo short-term rewards to gain long-term benefits is limited and a favourable environment for policy intervention depends on many factors. It is of utmost importance that the years ahead – at the national as well as at the international level – are characterised by the spirit of common responsibility and the joint determination to limit global warming to two degrees above pre-industrial levels at the most.

Switzerland is ready to be at the forefront of climate action but its full potential will only be unleashed if all countries join on the basis of their evolving responsibilities and capabilities. Together we can do our duty to safeguard a hospitable planet for future generations.

Christine Hoffmann
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December 2015

1 Information on greenhouse gas emissions and trends

1.1 Trends in greenhouse gas emissions and removals (1990–2013)

The BR CTF Tables include summaries of Switzerland's most recent greenhouse gas inventory covering the years 1990 to 2013. All data presented in this report are consistent with Switzerland's National Inventory Report of April 2015 (*FOEN*, 2015), where emissions were calculated using the 2006 IPCC Guidelines (*IPCC*, 2006) and revised Global Warming Potential (GWP) values. However, the corresponding CRF Tables are currently not available due to delays with the CRF reporter software.

1.1.1 Aggregate greenhouse gas emissions 2013

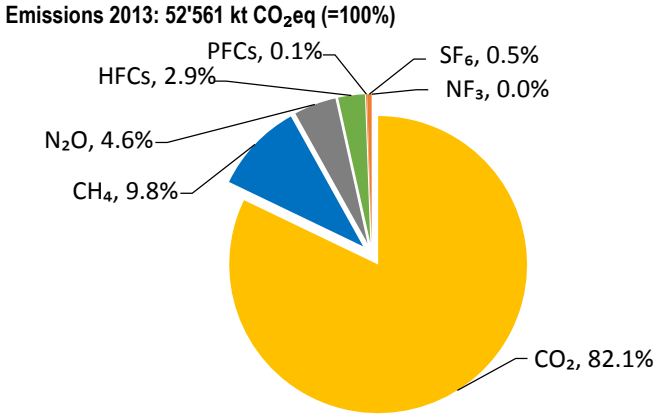
Switzerland's total greenhouse gas emissions (excluding emissions from LULUCF and international bunkers) were 52'561 Mt CO_2eq in 2013, corresponding to 6.5 t CO_2eq per capita (Tab. 1). The largest contributor gas was CO_2 with 43'173 Mt (5.3 t per capita) corresponding to a share of 82% in total greenhouse gas emissions (Fig. 1). Sector 1 'Energy' constituted the most important source with 41'452 Mt CO_2eq, dominated by CO_2 emissions from fuel consumption. Emissions of CH_4 and N_2O originated mainly from sector 3 'Agriculture'. All emissions of F-gases are attributed by definition to sector 2 'Industrial processes and product use'.

Tab. 1 > Switzerland's greenhouse gas emissions by sector and gas, 2013.

	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	NF_3	Total	Share
	kt CO_2eq								
1 Energy	40'913	305.6	233.1	0.0	0.0	0.0	0.0	41'452	*78.9%*
2 Industrial processes and product use	2'195	2.1	70.5	1'520	52.0	252.5	0.1	4'093	*7.8%*
3 Agriculture	42.0	3'999	1'909	0.0	0.0	0.0	0.0	5'949	*11.3%*
5 Waste	9.8	840.8	202.3	0.0	0.0	0.0	0.0	1'053	*2.0%*
6 Other	12.9	0.7	0.6	0.0	0.0	0.0	0.0	14.2	*0.0%*
Total (excluding LULUCF)	43'173	5'148	2'415	1'520	52.0	252.5	0.1	52'561	***100.0%***
4 LULUCF	-1'130	11.3	72.1	0.0	0.0	0.0	0.0	-1'046	*-2.0%*
Total (including LULUCF)	42'044	5'159	2'487	1'520	52.0	252.5	0.1	51'515	*98.0%*
International aviation bunkers	4'711	1.8	44.8	0.0	0.0	0.0	0.0	4'757	*9.1%*
International marine bunkers	26.0	0.0	0.2	0.0	0.0	0.0	0.0	26.2	*0.0%*

FOEN (2015)

Fig. 1 > Contribution of individual gases to Switzerland's greenhouse gas emissions (excluding LULUCF and international bunkers, including emissions from the sectors 1, 2, 3, 5, and 6), 2013.



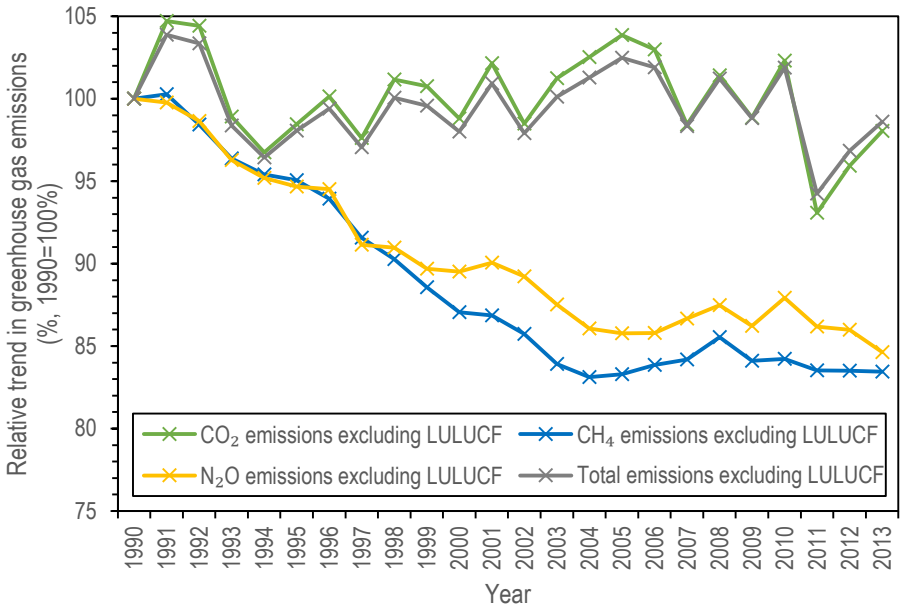
FOEN (2015)

1.1.2 Emission trends by greenhouse gas

Broken down by gas, the trends from 1990 to 2013 are as follows (Tab. 2, Tab. 3, Fig. 2 and Fig. 3):

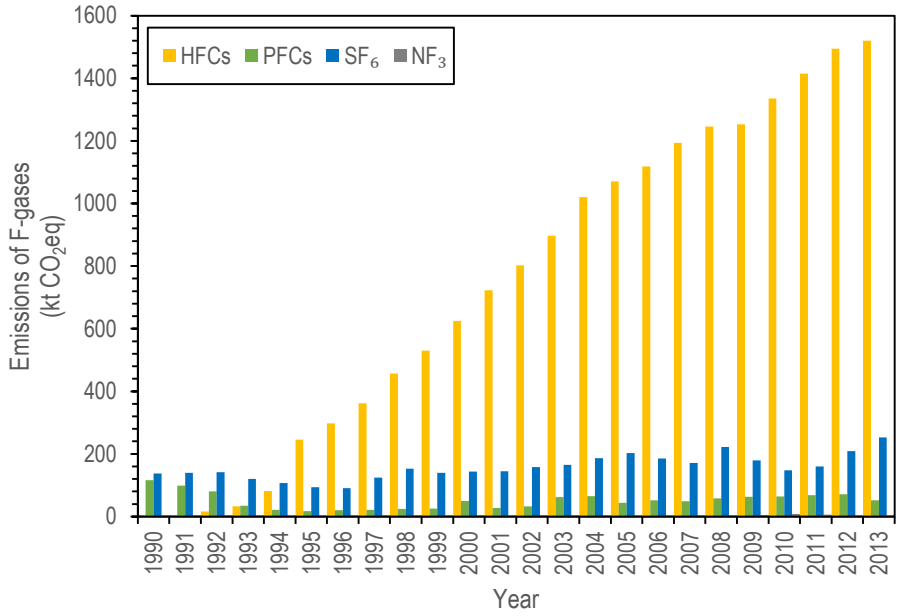
- Total greenhouse gas emissions excluding LULUCF do not show a clear trend between 1990 and 2013. However, the year-to-year changes in average meteorological conditions drive the amount of fuel needed for heating purposes. This results in minimum emissions of 94.2% in 2011 and maximum emissions of 103.9% in 1991, relative to the base year 1990.
- Net CO_2 emissions/removals from LULUCF also show considerable year-to-year variability, as heavy storms in 1990 and 1999 ('Lothar') and other factors had a large influence on the wood harvesting and tree mortality rates in forests. From 1990 to 2013 wood harvesting generally increased but was still exceeded by the growth of living biomass. Overall, a reduction in net removals within the LULUCF sector is observed between 1990 and 2013 (Fig. 7).
- Total greenhouse gas emissions evolve largely in parallel with the emissions of CO_2 between 1990 and 2013, since CO_2 persistently constitutes the major contributor and since the decrease of CH_4 and N_2O emissions is about offset by the increase of emissions of F-gases (Tab. 2, Fig. 2 and Fig. 3).
- CH_4 accounts for a share of 9.8% in total greenhouse gas emissions in 2013. Between 1990 and 2004, CH_4 emissions decreased by 16.9%. This decrease is mainly attributable to a reduction of livestock that entailed less emissions from enteric fermentation. Moreover, from 2000, a change in waste legislation banning the disposal of combustible solid waste in landfills contributed to this trend. However, CH_4 emissions remained about stable during the last decade because emissions from composting and anaerobic digestion of solid waste gained in importance.
- N_2O accounts for a share of 4.6% in total greenhouse gas emissions in 2013. Between 1990 and 2013, total N_2O emissions decreased by 15.4% as N_2O emissions from manure management and agricultural soils declined in concert with CH_4 emissions due to decreasing livestock populations and use of fertilizer.
- The share of all F-gases in total greenhouse gas emissions increased from 0.5% in 1990 to 3.5% in 2013. HFC emissions have substantially increased compared to 1990, because HFCs were introduced as substitutes for CFCs. In contrast, PFC emissions were 55.4% lower in 2013 compared to 1990. In 2013, SF_6 emissions were 84.3% higher compared to 1990, with relatively large year-to-year fluctuations.

Fig. 2 > Relative trends in emissions of the greenhouse gases CO_2, CH_4 and N_2O (excluding LULUCF and international bunkers, including emissions from the sectors 1, 2, 3, 5, and 6), 1990–2013. The increase of emissions of F-gases, which amounts to more than a factor of seven in 2013 relative to 1990, is shown in Fig. 3.



FOEN (2015)

Fig. 3 > Absolute changes in emissions of HFCs, PFCs, SF_6, and NF_3 in Switzerland, 1990–2013. NF_3 emissions are hardly visible (due to values close to zero, see Tab. 3).



FOEN (2015)

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

	1990		1995		2000		2005	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
CO_2	44'031	*82.6%*	43'352	*82.9%*	43'503	*83.3%*	45'731	*83.7%*
CH_4	6'169	*11.6%*	5'864	*11.2%*	5'371	*10.3%*	5'138	*9.4%*
N_2O	2'854	*5.4%*	2'702	*5.2%*	2'555	*4.9%*	2'449	*4.5%*
HFCs	0.0	*0.0%*	245.9	*0.5%*	625.1	*1.2%*	1'071	*2.0%*
PFCs	116.5	*0.2%*	17.5	*0.0%*	49.9	*0.1%*	44.2	*0.1%*
SF_6	137.0	*0.3%*	93.2	*0.2%*	143.8	*0.3%*	203.2	*0.4%*
NF_3	0.0	*0.0%*	0.0	*0.0%*	0.0	*0.0%*	0.0	*0.0%*
Total (excluding LULUCF)	**53'308**	***100.0%***	**52'276**	***100.0%***	**52'247**	***100.0%***	**54'635**	***100.0%***

	2010		2011		2012		2013	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
CO_2	45'050	*82.9%*	40'983	*81.6%*	42'242	*81.8%*	43'173	*82.1%*
CH_4	5'196	*9.6%*	5'152	*10.3%*	5'151	*10.0%*	5'148	*9.8%*
N_2O	2'509	*4.6%*	2'460	*4.9%*	2'454	*4.8%*	2'415	*4.6%*
HFCs	1'335	*2.5%*	1'415	*2.8%*	1'495	*2.9%*	1'520	*2.9%*
PFCs	64.6	*0.1%*	67.8	*0.1%*	71.3	*0.1%*	52.0	*0.1%*
SF_6	148.0	*0.3%*	159.5	*0.3%*	208.9	*0.4%*	252.5	*0.5%*
NF_3	8.5	*0.0%*	6.2	*0.0%*	0.4	*0.0%*	0.1	*0.0%*
Total (excluding LULUCF)	**54'311**	***100.0%***	**50'244**	***100.0%***	**51'623**	***100.0%***	**52'561**	***100.0%***

FOEN (2015)

Tab. 3 > Switzerland's greenhouse gas emissions by gas (excluding international bunkers, including emissions from the sectors 1, 2, 3, 4, 5, and 6), 1990–2013. Also indicated are the relative changes in emissions in 2013 relative to 1990. In 1990, there were virtually no emissions of HFCs and no emissions of NF_3, therefore the relative increases are not indicated for these gases (for absolute changes see Fig. 3).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2eq								
CO_2 excluding net CO_2 from LULUCF	44'031	46'101	45'973	43'556	42'593	43'352	44'088	42'980	44'540
CO_2 including net CO_2 from LULUCF	40'951	43'207	43'089	39'637	39'718	39'657	41'013	39'559	41'394
CH_4 excluding CH_4 from LULUCF	6'169	6'186	6'072	5'946	5'885	5'864	5'795	5'649	5'569
CH_4 including CH_4 from LULUCF	6'205	6'200	6'084	5'958	5'903	5'885	5'811	5'694	5'585
N_2O excluding N_2O from LULUCF	2'854	2'848	2'816	2'748	2'717	2'702	2'697	2'602	2'597
N_2O including N_2O from LULUCF	2'941	2'930	2'897	2'830	2'800	2'786	2'780	2'689	2'678
HFCs	0.0	1.6	15.7	32.8	81.7	245.9	297.5	361.5	456.1
PFCs	116.5	98.5	80.6	34.7	20.9	17.5	20.4	21.0	23.8
SF_6	137.0	139.2	141.4	120.5	106.9	93.2	90.1	124.2	152.6
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total excluding LULUCF	**53'308**	**55'374**	**55'098**	**52'438**	**51'405**	**52'276**	**52'988**	**51'737**	**53'338**
Total including LULUCF	**50'350**	**52'577**	**52'308**	**48'613**	**48'630**	**48'684**	**50'012**	**48'449**	**50'290**

	1999	2000	2001	2002	2003	2004	2005	2006	2007
	kt CO_2eq								
CO_2 excluding net CO_2 from LULUCF	44'364	43'503	44'979	43'366	44'574	45'137	45'731	45'343	43'341
CO_2 including net CO_2 from LULUCF	42'004	42'964	45'933	44'127	42'922	42'044	43'264	43'653	41'104
CH_4 excluding CH_4 from LULUCF	5'463	5'371	5'358	5'288	5'177	5'128	5'138	5'173	5'193
CH_4 including CH_4 from LULUCF	5'474	5'382	5'370	5'309	5'200	5'139	5'150	5'186	5'209
N_2O excluding N_2O from LULUCF	2'560	2'555	2'571	2'547	2'498	2'457	2'449	2'449	2'474
N_2O including N_2O from LULUCF	2'640	2'635	2'650	2'628	2'579	2'535	2'532	2'531	2'554
HFCs	529.8	625.1	722.9	802.0	897.4	1'020	1'071	1'118	1'194
PFCs	25.6	49.9	27.8	32.9	61.7	65.3	44.2	51.5	49.1
SF_6	139.9	143.8	144.8	158.4	164.6	186.1	203.2	185.6	171.6
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total excluding LULUCF	**53'082**	**52'247**	**53'803**	**52'194**	**53'373**	**53'993**	**54'635**	**54'319**	**52'423**
Total including LULUCF	**50'814**	**51'800**	**54'848**	**53'056**	**51'825**	**50'990**	**52'263**	**52'724**	**50'282**

	2008	2009	2010	2011	2012	2013	Relative change base year 1990 to 2013
	kt CO_2eq						
CO_2 excluding net CO_2 from LULUCF	44'658	43'525	45'050	40'983	42'242	43'173	*-1.9%*
CO_2 including net CO_2 from LULUCF	43'141	41'675	42'951	38'200	40'417	42'044	*2.7%*
CH_4 excluding CH_4 from LULUCF	5'277	5'189	5'196	5'152	5'151	5'148	*-16.6%*
CH_4 including CH_4 from LULUCF	5'289	5'201	5'207	5'167	5'163	5'159	*-16.9%*
N_2O excluding N_2O from LULUCF	2'497	2'461	2'509	2'460	2'454	2'415	*-15.4%*
N_2O including N_2O from LULUCF	2'573	2'535	2'583	2'533	2'527	2'487	*-15.4%*
HFCs	1'245	1'253	1'335	1'415	1'495	1'520	*See caption*
PFCs	57.9	63.0	64.6	67.8	71.3	52.0	*-55.4%*
SF_6	222.2	179.6	148.0	159.5	208.9	252.5	*84.3%*
NF_3	0.1	5.1	8.5	6.2	0.4	0.1	*See caption*
Total excluding LULUCF	**53'957**	**52'676**	**54'311**	**50'244**	**51'623**	**52'561**	*-1.4%*
Total including LULUCF	**52'528**	**50'912**	**52'297**	**47'548**	**49'882**	**51'515**	*2.3%*

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1.1.3 Emission trends by sources and sinks

In the following, details about Switzerland's greenhouse gas emissions (and removals) by the different sectors are provided (Fig. 4 to Fig. 7, Tab. 4 and Tab. 5).

Sector 1 'Energy'

Sector 1 'Energy' represents the major source of greenhouse gases in Switzerland (78.9% of total emissions in 2013); thus, the respective tables and figures also distinguish source categories (1A1 to 1A5 and 1B). The following characteristics are noteworthy:

- Despite differing trends in the source categories, the overall emissions from sector 1 'Energy' remained at a relatively constant level since 1990 (Fig. 6), with some fluctuations mainly caused by year-to-year variations in meteorological conditions.
- At present, about 95% of Switzerland's electric power is generated by hydroelectric and nuclear power plants (Table 24 in *SFOE*, 2015). Therefore, source category 1A1 'Energy industries' plays a minor role (8.9% of total emissions from sector 1 'Energy' in 2013) and represents waste incineration plants rather than classical thermal power stations. While overall emissions from source category 1A1 'Energy industries' have increased by 43.8% since 1990, fluctuations are caused by varying combustion activities in the petroleum refinery industry, waste incineration and new installations for district heating.
- Emissions from source category 1A2 'Manufacturing industries and construction' contributed 13.0% to total emissions from sector 1 'Energy' in 2013. Emissions from this source category generally show a decreasing trend and were 14.1% lower in 2013 compared to 1990.
- Emissions from source category 1A3 'Transport' (39.2% of total emissions from sector 1 'Energy' in 2013) increased (by 11.2%) from 1990 to 2013, with fluctuations indicating a fairly strong correlation between emissions and economic development.
- Emissions from source category 1A4 'Other sectors' (38.0% of total emission from sector 1 'Energy' in 2013) result from the residential and commercial use of fossil fuels. Year-to-year variations reflect the impact of meteorological conditions on heating demand. Indeed, a strong correlation with the number of heating degree days, i.e. an index for cold weather conditions, is apparent. Throughout the record, emissions generally increase when heating degree days increase and vice versa. From 1990 to 2013, the number of buildings and apartments increased, as well as the average floor space per person and workplace, resulting in an increase of the total area heated by about 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. Overall, emissions from source category 1A4 'Other sectors' decreased and were 10.7% lower in 2013 compared to 1990.
- Source category 1A5 'Other' covers greenhouse gas emissions from off-road military vehicles including military aviation (0.3% of total emissions from sector 1 'Energy' in 2013). Emissions decreased steadily during the 1990s, due to decreased use of military vehicles and aircrafts. Since 2004 they stabilised at about 60% of the emissions in 1990.
- Emissions from category 1B 'Fugitive emissions from oil and natural gas' (0.6% of total emissions from sector 1 'Energy') are dominated by emissions from transmission and distribution of natural gas. While the natural gas net as well as the amount of gas increased substantially since 1990, emissions from category 1B 'Fugitive emissions from oil and natural gas' decreased thanks to the gradual replacement of cast-iron pipes with polyethylene pipes. In 2013, emissions were at 34.1% of the emissions in 1990.

Sector 2 'Industrial processes and product use'

Overall, emissions in sector 2 'Industrial processes and product use' showed a decreasing trend in the 1990s and a rebound between 1998 and 2013 (Fig. 5), driven by economic development in the respective sectors and the increasing emissions of F-gases. The share in total greenhouse gas emissions was 7.8% in 2013 (Tab. 4).

Sector 3 'Agriculture'

In sector 3 'Agriculture' declining livestock (cattle and swine) and reduced fertilizer use have led to a decrease in CO_2eq emissions until 2004. Since then, CH_4 emissions remained relatively stable (Fig. 5). Sector 3 'Agriculture' contributed 11.3% to total greenhouse gas emissions in 2013 (Tab. 4).

Sector 4 'Land use, land-use change and forestry'

Fig. 7 shows net emissions and removals from sector 4 'Land use, land-use change and forestry' (LULUCF) in Switzerland, which are dominated by biomass dynamics in forests. Throughout the period 1990–2013, except for 2001, the removals in the LULUCF sector were higher than the emissions. However, a strong year-to-year variation is evident. The reason for the positive value in 2001 is the winter storm 'Lothar' at the end of 1999 which caused great damages in the

forest stands and led to increased harvesting. While dead wood was a sink of CO_2 in 2005, it became a source of CO_2 in 2008. This resulted in a reduction of the removals over the respective period. In 2013, the LULUCF sector was a net CO_2 sink of 2.0% of total greenhouse gas emissions.

Sector 5 'Waste'

Sector 5 'Waste' contributed 2.0% to total greenhouse gas emissions in 2013. Emissions decreased steadily from 1990 to 2003 (Fig. 5). 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 CH_4 emissions from landfill sites and an increasing amount of municipal solid waste being incinerated in waste incineration plants. However, since about 2005, the increasing CH_4 emissions from biological treatment of solid waste are responsible for a reversion of the trend. Currently, total emissions from sector 5 'Waste' are increasing. Emissions from incineration of waste are reported under source category 1A1 'Energy industries' rather than sector 5 'Waste'. Taken together, waste-related emissions (including emissions from waste management activities reported under sector 5 'Waste', as well as the source categories 1A 'Energy industries' and 3D 'Agricultural soils') increased by 19.2% since 1990 (data not shown in Fig. 5).

Sector 6 'Other'

Sector 6 'Other' covers emissions from fire damage in buildings and motor vehicles, which are of minor importance (contribution of 0.03% to total greenhouse gas emissions in 2013). These emissions are not accounted for in the framework of the Kyoto Protocol and are, thus, not taken into account in the national emission reduction targets (however, in agreement with the BR CTF Tables, total emissions shown in the tables of this chapter include emissions from sector 6).

Tab. 4 > Switzerland's greenhouse gas emissions by sector (excluding LULUCF and international bunkers), selected years. Also indicated are the shares of the different sectors and source categories in total greenhouse gas emissions.

	1990		1995		2000		2005	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
1 Energy	41'707	*78.2%*	41'803	*80.0%*	42'061	*80.5%*	43'918	*80.4%*
1A1 Energy industries	2'558	*4.8%*	2'698	*5.2%*	3'216	*6.2%*	3'840	*7.0%*
1A2 Manufacturing industries and construction	6'260	*11.7%*	6'069	*11.6%*	5'775	*11.1%*	5'885	*10.8%*
1A3 Transport	14'613	*27.4%*	14'229	*27.2%*	15'900	*30.4%*	15'838	*29.0%*
1A4 Other sectors	17'666	*33.1%*	18'200	*34.8%*	16'660	*31.9%*	17'923	*32.8%*
1A5 Other (military)	205.7	*0.4%*	148.3	*0.3%*	136.4	*0.3%*	123.5	*0.2%*
1B Fugitive emissions from oil and natural gas	404.9	*0.8%*	458.7	*0.9%*	372.9	*0.7%*	307.9	*0.6%*
2 Industrial processes and product use	3'522	*6.6%*	2'873	*5.5%*	3'098	*5.9%*	3'775	*6.9%*
3 Agriculture	6'713	*12.6%*	6'413	*12.3%*	6'029	*11.5%*	5'993	*11.0%*
5 Waste	1'355	*2.5%*	1'173	*2.2%*	1'046	*2.0%*	935.2	*1.7%*
6 Other	12.2	*0.0%*	13.2	*0.0%*	14.1	*0.0%*	14.2	*0.0%*
Total (excluding LULUCF)	**53'308**	*100.0%*	**52'276**	*100.0%*	**52'247**	*100.0%*	**54'635**	*100.0%*

	2010		2011		2012		2013	
	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share	kt CO_2eq	Share
1 Energy	43'192	*79.5%*	39'145	*77.9%*	40'525	*78.5%*	41'452	*78.9%*
1A1 Energy industries	3'873	*7.1%*	3'620	*7.2%*	3'653	*7.1%*	3'678	*7.0%*
1A2 Manufacturing industries and construction	5'718	*10.5%*	5'271	*10.5%*	5'267	*10.2%*	5'377	*10.2%*
1A3 Transport	16'340	*30.1%*	16'224	*32.3%*	16'352	*31.7%*	16'245	*30.9%*
1A4 Other sectors	16'856	*31.0%*	13'645	*27.2%*	14'886	*28.8%*	15'768	*30.0%*
1A5 Other (military)	120.9	*0.2%*	108.1	*0.2%*	115.9	*0.2%*	116.9	*0.2%*
1B Fugitive emissions from oil and natural gas	283.4	*0.5%*	275.6	*0.5%*	251.4	*0.5%*	266.9	*0.5%*
2 Industrial processes and product use	4'017	*7.4%*	4'051	*8.1%*	4'056	*7.9%*	4'093	*7.8%*
3 Agriculture	6'108	*11.2%*	6'052	*12.0%*	6'015	*11.7%*	5'949	*11.3%*
5 Waste	980.6	*1.8%*	982.7	*2.0%*	1'012.8	*2.0%*	1'053	*2.0%*
6 Other	14.2	*0.0%*	14.2	*0.0%*	14.2	*0.0%*	14.2	*0.0%*
Total (excluding LULUCF)	**54'311**	*100.0%*	**50'244**	*100.0%*	**51'623**	*100.0%*	**52'561**	*100.0%*

FOEN (2015)

Tab. 5 > Greenhouse gas emissions and removals in different sectors and source categories (excluding international bunkers), 1990–2013. Also indicated are the relative changes in emissions in 2013 relative to 1990 (last column).

	1990	1991	1992	1993	1994	1995	1996	1997	1998
	kt CO_2eq								
1 Energy	41'707	44'177	44'207	42'026	40'890	41'803	42'717	41'749	43'298
1A1 Energy industries	2'558	2'851	2'946	2'617	2'661	2'698	2'917	2'912	3'273
1A2 Manufacturing industries and construction	6'260	6'562	6'138	5'967	5'896	6'069	5'872	5'798	5'995
1A3 Transport	14'613	15'105	15'428	14'359	14'545	14'229	14'290	14'847	15'058
1A4 Other sectors	17'666	19'021	19'052	18'439	17'159	18'200	19'042	17'603	18'408
1A5 Other (military)	205.7	188.2	179.8	171.4	165.8	148.3	137.3	147.3	146.3
1B Fugitive emissions from oil and natural gas	404.9	448.8	463.1	472.0	463.5	458.7	458.1	440.9	418.8
2 Industrial processes and product use	3'522	3'157	2'997	2'691	2'881	2'873	2'749	2'666	2'782
3 Agriculture	6'713	6'674	6'557	6'456	6'440	6'413	6'367	6'182	6'141
4 LULUCF	-2'958	-2'797	-2'790	-3'825	-2'775	-3'592	-2'976	-3'288	-3'048
5 Waste	1'355	1'354	1'324	1'253	1'181	1'173	1'142	1'126	1'103
6 Other	12.2	12.4	12.6	12.8	13.0	13.2	13.4	13.5	13.7
Total excluding LULUCF	**53'308**	**55'374**	**55'098**	**52'438**	**51'405**	**52'276**	**52'988**	**51'737**	**53'338**
Total including LULUCF	**50'350**	**52'577**	**52'308**	**48'613**	**48'630**	**48'684**	**50'012**	**48'449**	**50'290**

	1999	2000	2001	2002	2003	2004	2005	2006	2007
	kt CO_2eq								
1 Energy	43'093	42'061	43'489	41'892	43'109	43'457	43'918	43'567	41'526
1A1 Energy industries	3'298	3'216	3'358	3'434	3'427	3'712	3'840	4'056	3'739
1A2 Manufacturing industries and construction	5'857	5'775	6'040	5'594	5'709	5'841	5'885	6'072	5'879
1A3 Transport	15'667	15'900	15'602	15'528	15'697	15'777	15'838	15'952	16'273
1A4 Other sectors	17'746	16'660	17'993	16'851	17'822	17'691	17'923	17'053	15'226
1A5 Other (military)	132.0	136.4	133.6	139.6	125.1	113.7	123.5	127.3	119.9
1B Fugitive emissions from oil and natural gas	394.1	372.9	361.2	344.4	328.3	322.2	307.9	306.1	288.5
2 Industrial processes and product use	2'845	3'098	3'198	3'235	3'327	3'621	3'775	3'757	3'823
3 Agriculture	6'055	6'029	6'089	6'054	5'976	5'954	5'993	6'022	6'076
4 LULUCF	-2'268	-447.0	1'045	861.6	-1'548	-3'003	-2'372	-1'595	-2'141
5 Waste	1'076	1'046	1'013	998.9	947.0	947.7	935.2	959.5	983.5
6 Other	13.9	14.1	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Total excluding LULUCF	**53'082**	**52'247**	**53'803**	**52'194**	**53'373**	**53'993**	**54'635**	**54'319**	**52'423**
Total including LULUCF	**50'814**	**51'800**	**54'848**	**53'056**	**51'825**	**50'990**	**52'263**	**52'724**	**50'282**

	2008	2009	2010	2011	2012	2013	Relative change base year 1990 to 2013
	kt CO_2eq						
1 Energy	42'886	41'815	43'192	39'145	40'525	41'452	-0.6%
1A1 Energy industries	3'850	3'696	3'873	3'620	3'653	3'678	43.8%
1A2 Manufacturing industries and construction	5'904	5'607	5'718	5'271	5'267	5'377	-14.1%
1A3 Transport	16'640	16'443	16'340	16'224	16'352	16'245	11.2%
1A4 Other sectors	16'090	15'674	16'856	13'645	14'886	15'768	-10.7%
1A5 Other (military)	114.6	116.3	120.9	108.1	115.9	116.9	-43.2%
1B Fugitive emissions from oil and natural gas	286.5	277.5	283.4	275.6	251.4	266.9	-34.1%
2 Industrial processes and product use	3'904	3'796	4'017	4'051	4'056	4'093	16.2%
3 Agriculture	6'180	6'091	6'108	6'052	6'015	5'949	-11.4%
4 LULUCF	-1'429	-1'764	-2'015	-2'696	-1'741	-1'046	-64.6%
5 Waste	973.8	959.3	980.6	982.7	1'013	1'053	-22.3%
6 Other	14.2	14.2	14.2	14.2	14.2	14.2	16.1%
Total excluding LULUCF	**53'957**	**52'676**	**54'311**	**50'244**	**51'623**	**52'561**	-1.4%
Total including LULUCF	**52'528**	**50'912**	**52'297**	**47'548**	**49'882**	**51'515**	2.3%

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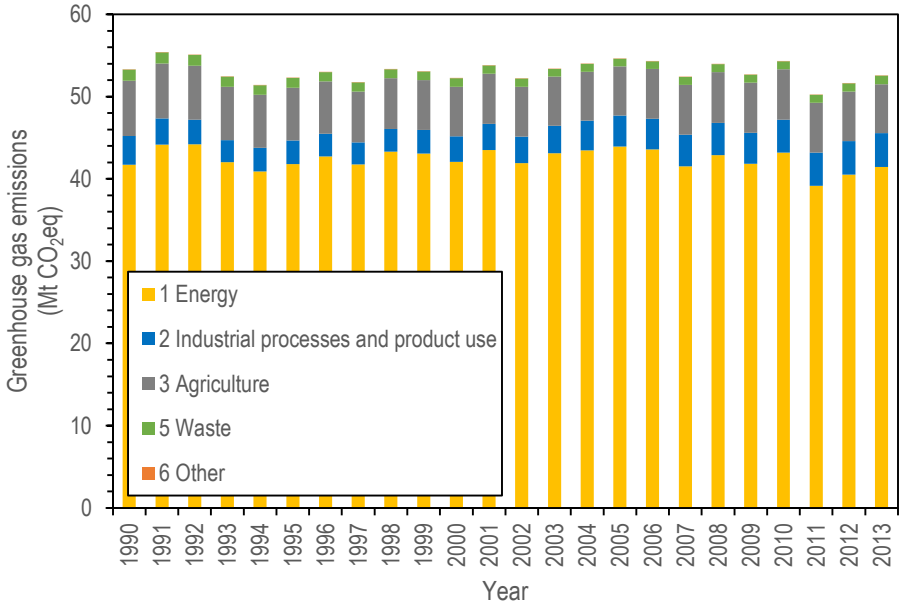
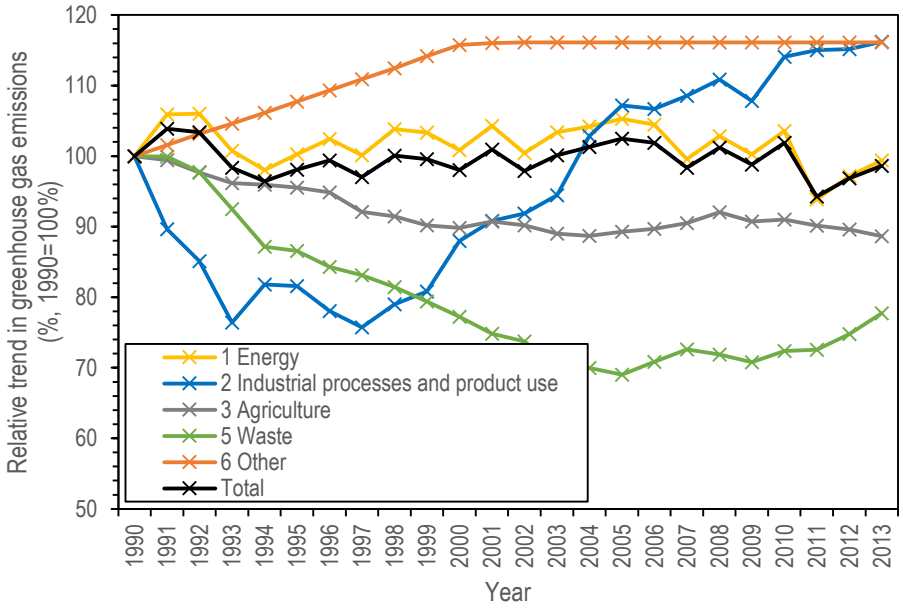
Fig. 4 > Greenhouse gas emissions by sector (excluding LULUCF and international bunkers), 1990–2013.



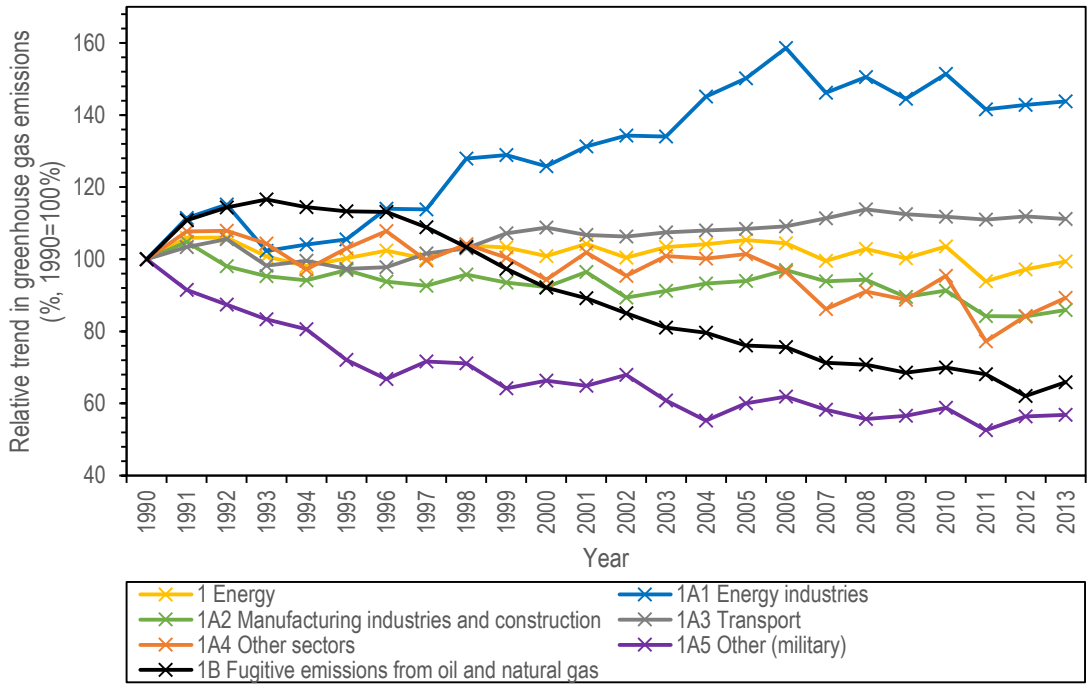
FOEN (2015)

Fig. 5 > Relative emission trends in the main sectors, 1990–2013.



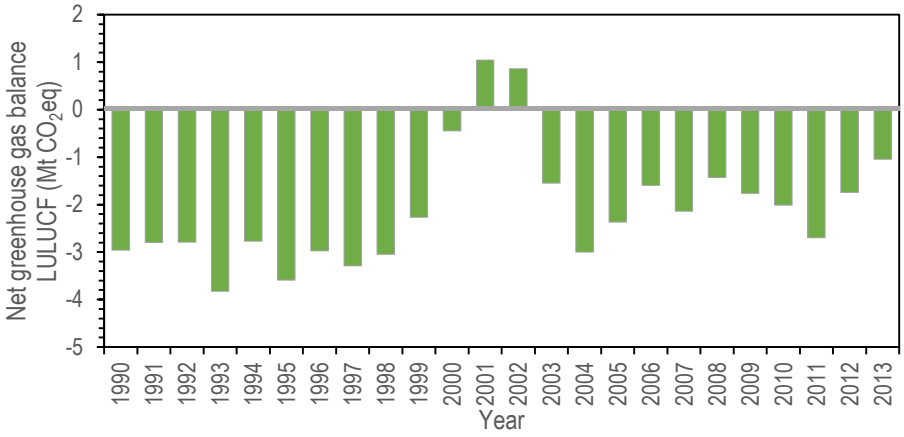
FOEN (2015)

Fig. 6 > Relative emission trends in sector 1 'Energy' and its source categories.



FOEN (2015)

Fig. 7 > Net greenhouse gas balance of sector 4 'Land use, land-use change and forestry' (LULUCF), 1990–2013. Positive values refer to emissions, negative values to removals. The contributions of CH_4 and N_2O are very small compared to CO_2.



FOEN (2015)

1.1.4 Emission trends of indirect greenhouse gases and SO_2

Emission trends for indirect greenhouse gases show a very pronounced decline (Tab. 6 and Fig. 8). From 1990 to 2013, emissions of the air pollutants NOx, CO, NMVOC, and SO_2 decreased by 51% to 75% owing to a strict air pollution control policy and the implementation of a large number of emission reduction measures. 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; *Swiss Confederation*, 1997).

In 2013, sector 1 'Energy' was by far the largest source of indirect greenhouse gas emissions (Tab. 7), with the only exception being NMVOC, where sector 2 'Industrial processes and product use' and sector 4 'LULUCF' substantially contribute to total emissions (the total shown in Tab. 7 includes NMVOC emissions from LULUCF). Fig. 9 shows the relative contributions of the various sectors for each individual gas in 2013 (data from Tab. 7, excluding NMVOC from LULUCF).

Tab. 6 > Emissions of indirect greenhouse gases and SO_2 (excluding NMVOC from LULUCF), 1990–2013.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	kt											
NOx	143	141	135	123	122	118	114	110	110	109	107	103
CO	800	766	713	628	577	536	516	487	466	453	426	405
NMVOC	302	284	264	236	216	199	187	174	161	152	143	135
SO_2	40	37	33	27	28	26	26	24	23	17	15	18

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	kt											
NOx	97	95	93	92	89	86	84	78	76	72	72	71
CO	377	365	347	330	306	288	278	262	251	230	223	216
NMVOC	124	116	106	102	98	95	94	91	90	87	85	84
SO_2	15	15	15	16	15	13	13	11	12	10	10	10

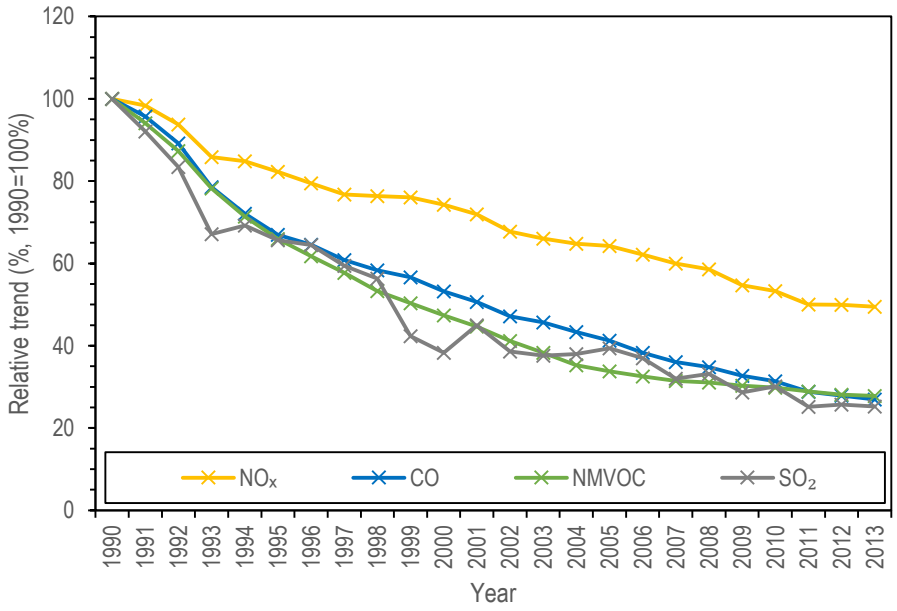
FOEN (2015)

Tab. 7 > Emissions of indirect greenhouse gases and SO_2 by source, 2013. Total NMVOC emissions include NMVOC from LULUCF (in contrast to the data shown in Tab. 6).

	NO_x	CO	NMVOC	SO_2
	kt			
1 Energy	67.09	207.61	27.52	9.21
2 Industrial processes and product use	0.37	4.74	50.19	0.78
3 Agriculture	3.03	n.o.	3.90	n.o.
4 LULUCF	i.e., n.e.	i.e., n.e.	95.53	n.e.
5 Waste	0.39	2.52	2.25	0.09
6 Other	0.08	0.80	0.13	0.01
Total	**70.96**	**215.67**	**179.53**	**10.09**

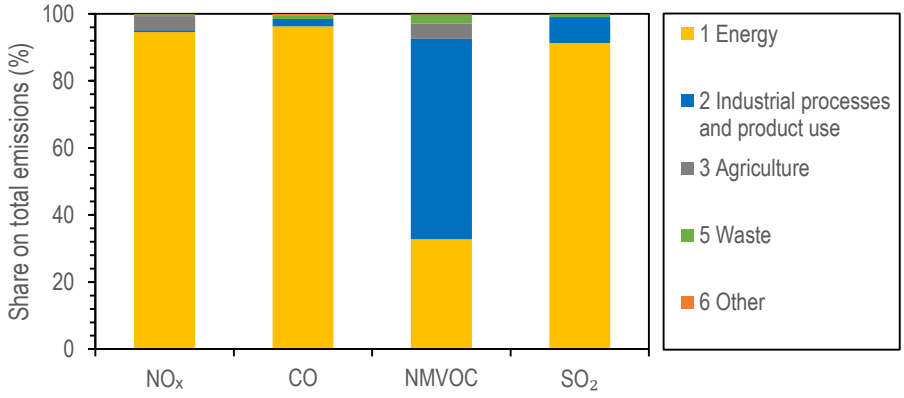
FOEN (2015); i.e., included elsewhere; n.e., not estimated; n.o., not occurring

Fig. 8 > Relative trends of emissions of indirect greenhouse gases and SO_2 (excluding NMVOC from LULUCF), 1990–2013.



FOEN (2015)

Fig. 9 > Relative contributions of individual sectors to emissions of indirect greenhouse gases and SO_2 (excluding LULUCF), 2013.

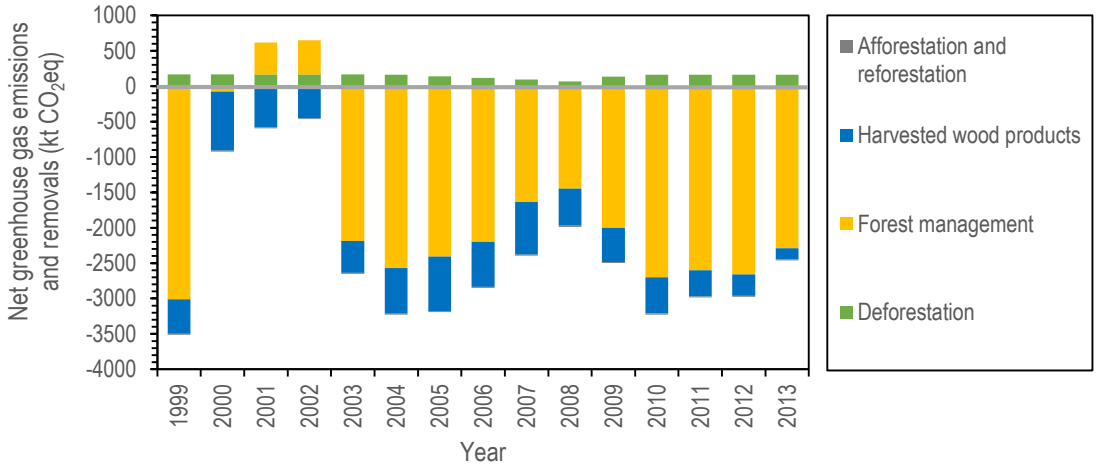


FOEN (2015)

1.1.5 Activities under Article 3, paragraph 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 (*FOEN*, 2006, section F). In accordance with Annex I to Decision 2/CMP.7 (Annex I, paragraph 13), credits from forest management are capped in the second commitment period; for Switzerland the cap amounts to 3.5% of total greenhouse gas emissions (excluding LULUCF) in 1990. An overview of greenhouse gas sources and sink activities for the years 1999 to 2013 is given in Fig. 10 and Tab. 8.

Fig. 10 > Net emissions and removals of greenhouse gases for activities under Article 3, paragraph 3 (afforestation, reforestation, deforestation) and paragraph 4 (forest management) of the Kyoto Protocol, 1999–2013. Positive values refer to emissions, negative values refer to removals.



FOEN (2015)

Tab. 8 > Overview of net emissions (positive values) and removals (negative values) for activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol, 1999–2013.

Greenhouse gas source and sink activities	1999	2000	2001	2002	2003	2004	2005	2006
	Net emissions/removals (kt CO_2eq)							
A Article 3.3 activities	**156.4**	**155.8**	**154.6**	**153.4**	**152.2**	**151.3**	**125.0**	**102.4**
A.1 Afforestation and reforestation	-11.0	-11.4	-11.9	-12.3	-12.7	-13.2	-13.9	-14.5
A.2 Deforestation	167.4	167.2	166.5	165.7	164.9	164.5	138.8	116.9
B Article 3.4 activities	**-3'499**	**-912**	**-132**	**31.3**	**-2'636**	**-3'213**	**-3'179**	**-2'834**
B.1 Forest management including biomass burning	-3'013	-74.9	450.7	484.9	-2'187	-2'569	-2'408	-2'201
Gains in living biomass (above and below ground)	-12'457	-12'466	-12'475	-12'484	-12'494	-12'503	-12'527	-12'645
Losses living biomass (above and below ground)	10'012	12'901	13'298	13'140	10'668	10'326	10'804	10'881
Change in litter pool	-324.8	-266.7	-169.9	-34.7	-204.3	-211.6	-455.6	-230.7
Change in dead wood pool	-280.5	-280.5	-239.7	-190.8	-219.7	-215.7	-265.0	-244.5
Change in soil pool (mineral soils)	-1.8	-2.3	-2.7	-3.0	-3.2	-3.6	-4.1	-4.6
Change in soil pool (organic soils)	37.7	37.7	37.8	37.8	37.8	37.8	37.9	37.9
Biomass burning	0.4	1.8	1.8	20.4	28.1	1.0	2.3	5.0
C Harvested wood products	-485.5	-837.5	-582.3	-453.5	-448.8	-644.4	-771.7	-633.4

Greenhouse gas source and sink activities	2007	2008	2009	2010	2011	2012	2013
	Net emissions/removals (kt CO_2eq)						
A Article 3.3 activities	**80.0**	**53.0**	**117.5**	**145.2**	**146.2**	**147.1**	**147.6**
A.1 Afforestation and reforestation	-15.0	-15.5	-16.0	-15.3	-14.8	-14.3	-14.3
A.2 Deforestation	95.0	68.6	133.4	160.5	161.0	161.4	161.9
B Article 3.4 activities	**-2'379**	**-1'972**	**-2'483**	**-3'211**	**-2'970**	**-2'960**	**-2'449**
B.1 Forest management including biomass burning	-1'637	-1'448	-2'004	-2'701	-2'600	-2'661	-2'291
Gains in living biomass (above and below ground)	-12'797	-12'935	-12'951	-12'957	-12'964	-12'970	-12'976
Losses living biomass (above and below ground)	11'320	11'400	10'936	10'657	10'605	10'499	10'722
Change in litter pool	33.1	307.3	272.4	-55.1	48.3	72.9	175.7
Change in dead wood pool	-237.3	-256.5	-296.6	-380.5	-331.9	-298.0	-247.9
Change in soil pool (mineral soils)	-4.8	-4.6	-4.3	-4.3	-4.4	-4.5	-4.5
Change in soil pool (organic soils)	37.9	38.0	38.0	38.0	38.0	38.0	38.0
Biomass burning	11.6	2.6	2.1	1.2	8.3	1.1	1.2
C Harvested wood products	-741.8	-524.6	-479.5	-509.6	-369.8	-299.5	-158.1

FOEN (2015)

1.2 Switzerland's National Greenhouse Gas Inventory System

1.2.1 General information

In the following, Switzerland's National Greenhouse Gas Inventory System is presented in brief. An in-depth description is provided in Switzerland's National Inventory Report (*FOEN*, 2015, chapter 1).

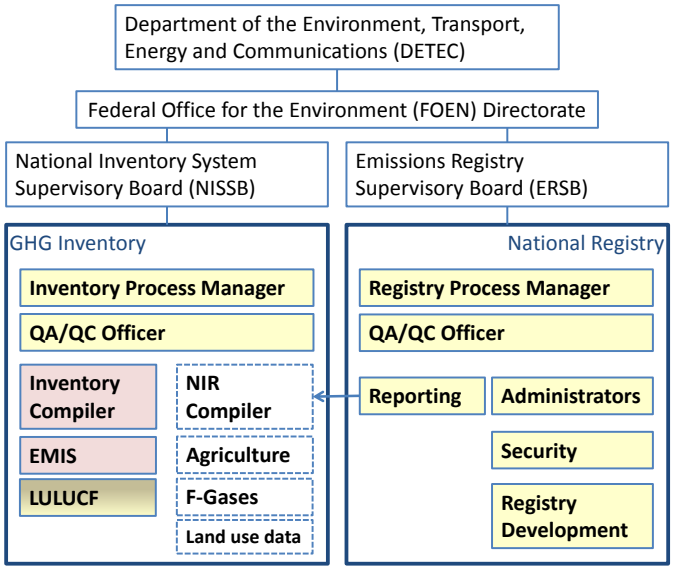
Name and contact information of national entity with overall responsibility

Federal Office for the Environment (FOEN)
National Greenhouse Gas Inventory System, Dr. Paul Filliger
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*

Roles and responsibilities: Institutional, legal and procedural arrangements

As shown in Fig. 11, Switzerland's National Greenhouse Gas Inventory System (NIS) is developed and managed under the auspices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC). As stipulated in the revised CO_2 Act of 23 December 2011 (Article 39), the Federal Office for the Environment (FOEN), an office of the DETEC, is responsible for the assessment of matters relating to climate protection. Accordingly, the FOEN coordinates the NIS.

Fig. 11 > Institutional setting of Switzerland's National Greenhouse Gas Inventory System (NIS). The coloured boxes correspond to divisions of the FOEN (yellow: Climate Division; red: Air Pollution Control and Chemicals Division; beige: Forest Division). The white boxes correspond to mandated experts outside the FOEN (marked with dashed lines) or to executive committees.



FOEN (2015)

In 2004, as part of the Swiss Climate Reporting Project, the FOEN directorate mandated its Climate, Economics and Environmental Monitoring Divisions 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. With the formal approval of Switzerland's First Initial Report under Article 7, paragraph 4, of the Kyoto Protocol (*FOEN*, 2006) by the Federal Council on 8 November 2006, the 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 the national greenhouse gas inventory preparation. With the overall responsibility carried by the Climate Division of FOEN, the NIS covers the following elements (having regard to the provisions of Article 5, paragraph 1, of the Kyoto Protocol):

- 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 and maintaining the QA/QC system.
- Official consideration and approval of data.
- Upgrading and updating of the national air pollution database EMIS.
- Data documentation and storage.
- Management of the national registry.

Two supervisory boards are currently in place with separate mandates and responsibilities. The **NIS supervisory board (NISSB)** oversees all aspects related to the national greenhouse gas inventory and the reporting obligations under the UNFCCC (including reporting of the national registry in the National Inventory Report). It is independent of the inventory preparation process and, by its composition, combines technical expertise and political authority. The **Emission Registry supervisory board (ERSB)** on the other hand deals with management issues related to the national registry. The main tasks of the two supervisory boards 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 or registry project managers.
- 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 greenhouse gas inventory is coordinated by the **inventory process manager**. The process of inventory planning, preparation and management is well-established with responsibilities and decision-making power assigned to specific people or groups. The **inventory QA/QC officer** is responsible for enforcement of the defined quality standards of the national greenhouse gas inventory. The inventory QA/QC officer also advises the NIS supervisory board on matters relating to the conformity of the greenhouse gas inventory with reporting requirements.

The **greenhouse gas inventory working group** constitutes a fundamental element of the national greenhouse gas inventory and 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, to 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 **greenhouse gas inventory core group** meets four times per year and 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 greenhouse gas inventory core group, which is also responsible for ensuring the conformity of the inventory with the relevant guidelines. The greenhouse gas inventory 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 national air pollution database EMIS, key category analyses, and for the CRF Tables).

- The lead authors of the National Inventory Report (responsible for the report and carrying out centralized data assessments such as uncertainty analysis).
- Selected sectoral experts.
- The inventory QA/QC officer.

The greenhouse gas 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 greenhouse gas inventory are institutions of the federal administration, research institutions, industry associations, and other private entities (see *FOEN*, 2015 for details). Everyone is obliged by Article 46 of the Federal Act on the Protection of the Environment (*Swiss Confederation*, 1983) to provide the authorities with the information required to enforce the law and, if necessary, to conduct or acquiesce in the conduct of enquiries.

At the operational level, the national registry is largely run independently of the national greenhouse gas inventory. Its operation is coordinated by the **registry process manager**, whose work is overseen by the **registry QA/QC officer**.

1.2.2 Process of inventory preparation

The Air Pollution Control and Chemicals Division of FOEN maintains the national air pollution database EMIS, which contains all data needed to prepare the greenhouse gas inventory. The database was established at SAEFL (former name of FOEN) in the late 1980s. Its initial purpose was to record and monitor emissions of air pollutants, but it has since been extended to cover greenhouse gases as well. Its structure corresponds to the EMEP/CORINAIR system for classifying emission-generating activities. The data needed to prepare the national greenhouse gas inventory in the common reporting format (CRF), as requested by the UNFCCC, is collected by various data suppliers and compiled centrally by the FOEN. At the same time, background information on data sources, activity data, emission factors and methods used for emission estimation is documented in the database and/or the National Inventory Report. 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.

Fig. 12 > Data collection for the national air pollution database EMIS, from where the data is transferred via the CRF reporter to the CRF Tables. The CRF Tables are submitted by means of the UNFCCC submission portal and documented in the National Inventory Report. The authors of the National Inventory Report and the reviewers control the correctness of the data transferred from the database into the report (figures and tables shown in the National Inventory Report are exported directly from the database). The authors further check the correspondence between the exports and the CRF Tables. Abbreviations: See glossary.

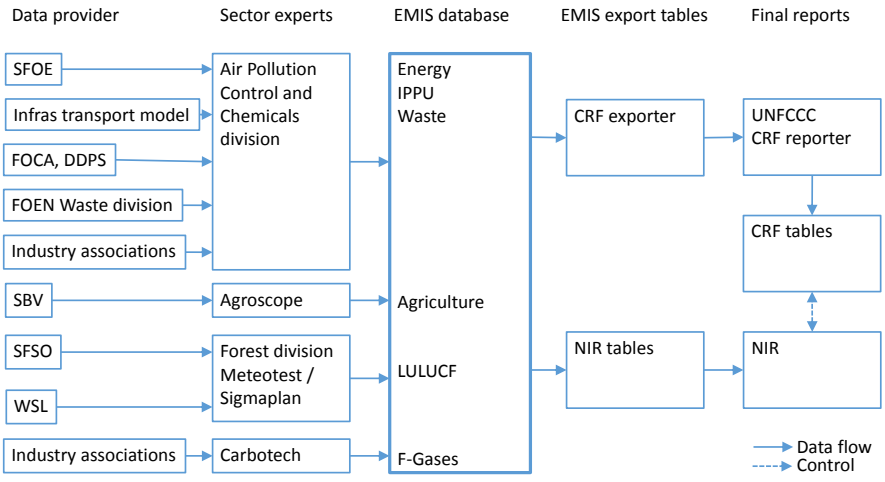


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Fig. 12 illustrates the data collection and processing steps leading to the CRF Tables required for reporting under the UNFCCC and the Kyoto Protocol. Most important input data for the national air pollution database EMIS comprise the SFOE Swiss overall energy statistics, the SFOE Swiss wood energy statistics, various 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, as well as extracts from the national forest inventory and the national forest statistics. Emissions and removals from sector 4 'Land use, land-use change and forestry' (LULUCF) and KP-LULUCF are calculated by the Forest Division of FOEN; a detailed description of the calculation of these emissions can be found in *FOEN* (2015, chapter 6). Emissions from sector 3 'Agriculture' are compiled by Agroscope, the Swiss Centre of Excellence for Agricultural Research (affiliated with the Federal Office for Agriculture, FOAG). Emissions from all other sectors are calculated or compiled by the Air Pollution Control and Chemicals Division of FOEN.

Methodologies: General description

Emissions calculations for the various sectors rely on standard methodologies (tier 1, tier 2, or tier 3) according to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (*IPCC*, 2006). Under the UNFCCC, these guidelines have been adopted for mandatory use in reporting on greenhouse gas inventories. For the sector 1 'Energy', import and fuel consumption statistics (fuel sales in the transport sector) taken from the Swiss overall energy statistics (e.g. *SFOE*, 2015) are used as input data, while for the other sectors national statistics and data surveys are consulted. In order to check the quality and completeness of the inventory for sector 1 'Energy', the sectoral approach is compared to a reference approach (see *FOEN*, 2015 for more details).

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 greenhouse gas inventory core group. Substantial recalculations that impact the national total are presented to the NIS supervisory board for approval.

1.2.3 Key category analysis

A key category analysis is performed annually following the 2006 IPCC Guidelines (*IPCC*, 2006). Level and trend assessments are performed for both Approach 1 and Approach 2, considering the emissions from the base year 1990 and the latest year reported. Emissions from sector 4 'Land use, land-use change and forestry' (LULUCF) are included in the key category analysis. Under Approach 2, emissions are weighed with their uncertainty estimates. Tab. 9 presents an overview of the resulting key categories for 2013. More details are provided in the National Inventory Report (*FOEN*, 2015).

1.2.4 Quality assurance and quality control (QA/QC) and verification plans

The NIS has an established quality management system (QMS) that complies with the requirements of ISO 9001:2008. Certification has been obtained in 2007 and is upheld since through annual audits. The QMS is designed to comply with the UNFCCC reporting guidelines (*UNFCCC*, 2014a) to ensure and continuously improve transparency, consistency, comparability, completeness, accuracy, and confidence in national greenhouse gas emission and removal estimates. While a detailed description of the QA/QC procedures, including verification plans, is given in *FOEN* (2015, in its section 1.2.3), the most important elements are summarised in the following.

General QC procedures

Routine annual quality control procedures comprise checks related to new data and database operations, spot-checks for transcription errors, correct use of conversion factors and units, and correct calculations:

- There are checklists for the most important sectoral data suppliers and EMIS database experts.
- Consistency of data between categories is to a large extent ensured by the design of the database, where specific emission factors and activity data that apply to various categories are used jointly by all categories to calculate emissions.
- Recalculations are compiled in a document and made available to the members of the greenhouse gas inventory core group.
- QC procedures regarding the CRF Tables comprise a detailed comparison of the CRF Tables of the previous submission with those of the current submission for the base year and the latest common year. In addition, the

time-series consistency is incrementally checked by comparing the latest inventory year with the preceding year.

- Finally, Switzerland's National Inventory Report is subject to an internal review prior to submission.

Category-specific QC procedures

Whenever new emission factors are considered, they are compared to the IPCC default values and to the values used in previous years. Similarly, if new activity data have become available for a particular category, a comparison between existing and new activity data is made. The general procedures regarding category-specific QC are also described in the quality manual (*FOEN*, 2015a), while specific activities are documented in the corresponding sectoral chapters.

Quality assurance procedures

As required by ISO 9001 there are periodic internal audits covering all processes. In addition, an external organisation is mandated to conduct the annual audit of the ISO 9001 quality management system. Results and suggestions for improvements from expert peer reviews commissioned on a case-by-case basis for specific sectors, as well as recommendations and encouragements from the UNFCCC expert review teams are added to the inventory development plan and considered by the core group for implementation in future submissions.

Verification activities

In sector 1 'Energy', the standard verification activity carried out on an annual basis is the reference approach. In addition, the FOEN supports a long-term monitoring programme from which Switzerland's emissions of some fluorinated greenhouse gases can be estimated based on atmospheric measurements. A similar research project is currently looking into developing an independent estimate of CH_4 emissions in Switzerland based on atmospheric measurements and inverse modelling of atmospheric transport.

Treatment of confidentiality issues

Nearly all of the data necessary to compile the Swiss greenhouse gas inventory are publicly available. There are a few exceptions (data referring to a single enterprise, disaggregated emissions of F-gases, some data regarding civil aviation, and unpublished land use statistics), however, these will be made available to the ERT upon request.

Public access to the greenhouse gas inventory

FOEN operates a website (*www.climatereporting.ch*) where the Swiss greenhouse gas inventories (National Inventory Report, CRF Tables, UNFCCC review reports), the Swiss national communications and other reports submitted under the UNFCCC and the Kyoto Protocol are available. On this website, further background information (e.g. internal reports) quoted in the Swiss greenhouse gas inventory is provided.

1.2.5 Procedures for official consideration and approval of the inventory

The process for the official consideration of the greenhouse gas inventory is defined in the mandate of the NIS supervisory board. At the NIS supervisory board meeting taking place after the completion of the inventory (generally in mid-March) the inventory project management hands over the National Inventory Report and the CRF Tables to the members of the board for consideration. Subsequently, the chair of the NIS supervisory board presents the inventory for official approval to the FOEN directorate.

Tab. 9 > Overview of key categories resulting from the key category analysis using both Approach 1 and 2 (for 1990 and 2013, as well as for the trend between these two years). Key categories are ordered by NFR code. Categories which are not key categories are not shown.

IPCC source categories and fuels if applicable		Green house gas	Approach 1			Approach 2		
			Level		Trend	Level		Trend
			1990	2013		1990	2013	
1A1	1. Energy; A. Fuel combustion activities; 1. Energy industries; Gaseous Fuels	CO_2	●	●	●			
1A1	1. Energy; A. Fuel combustion activities; 1. Energy industries; Liquid Fuels	CO_2	●	●	●			
1A1	1. Energy; A. Fuel combustion activities; 1. Energy industries; Other Fuels	CO_2	●	●	●	●	●	●
1A2	1. Energy; A. Fuel combustion activities; 2. Manufacturing industries and construction; Gaseous Fuels	CO_2	●	●	●		●	●
1A2	1. Energy; A. Fuel combustion activities; 2. Manufacturing industries and construction; Liquid Fuels	CO_2	●	●	●			
1A2	1. Energy; A. Fuel combustion activities; 2. Manufacturing industries and construction; Other Fuels	CO_2		●	●		●	●
1A2	1. Energy; A. Fuel combustion activities; 2. Manufacturing industries and construction; Solid Fuels	CO_2	●	●	●	●	●	●
1A3a	1. Energy; A. Fuel combustion activities; 3. Transport; Domestic aviation	CO_2	●		●			
1A3b	1. Energy; A. Fuel combustion activities; 3. Transport; Road transportation; Gasoline	CH_4			●			●
1A3b	1. Energy; A. Fuel combustion activities; 3. Transport; Road transportation; Diesel	CO_2	●	●	●			
1A3b	1. Energy; A. Fuel combustion activities; 3. Transport; Road transportation; Gasoline	CO_2	●	●	●			
1A3b	1. Energy; A. Fuel combustion activities; 3. Transport; Road transportation; Gasoline	N_2O			●			●
1A4a	1. Energy; A. Fuel combustion activities; 4. Other sectors; Commercial/institutional; Gaseous Fuels	CO_2	●	●	●		●	●
1A4a	1. Energy; A. Fuel combustion activities; 4. Other sectors; Commercial/institutional; Liquid Fuels	CO_2	●	●	●			
1A4b	1. Energy; A. Fuel combustion activities; 4. Other sectors; Residential; Biomass	CH_4			●			
1A4b	1. Energy; A. Fuel combustion activities; 4. Other sectors; Residential; Gaseous Fuels	CO_2	●	●	●	●	●	●
1A4b	1. Energy; A. Fuel combustion activities; 4. Other sectors; Residential; Liquid Fuels	CO_2	●	●	●			
1A4c	1. Energy; A. Fuel combustion activities; 4. Other sectors; Agriculture/forestry/fishing; Liquid Fuels	CO_2	●	●				
1A5	1. Energy; A. Fuel combustion activities; 5. Other; Liquid Fuels	CO_2	●		●			
1B2	1. Energy; B. Fugitive emissions from fuels; 2. Oil and natural gas and other em. from energy production	CH_4	●	●	●	●		●
2A1	2. Industrial processes and product use; A. Mineral industry; 1. Cement production	CO_2	●	●	●			
2A4	2. Industrial processes and product use; A. Mineral industry; 4. Other process uses of carbonates	CO_2	●		●	●		●
2C3	2. Industrial processes and product use; C. Metal industry; 3. Aluminium production	CO_2	●		●			
2C3	2. Industrial processes and product use; C. Metal industry; 3. Aluminium production	PFC			●			
2F1	2. Industrial processes and product use; F. Product uses as substitutes for ODS; 1. Refrig. and AC	HFC		●	●		●	●
2G	2. Industrial processes and product use; G. Other product manufacture and use	HFC			●			
2G	2. Industrial processes and product use; G. Other product manufacture and use	SF_6		●				
2G	2. Industrial processes and product use; G. Other product manufacture and use	N_2O				●		●
3A	3. Agriculture; A. Enteric fermentation	CH_4	●	●	●	●	●	●
3B	3. Agriculture; B. Manure management	CH_4	●	●	●	●	●	●
3B1–3B4	3. Agriculture; B. Manure management; 1. Cattle, 2. Sheep, 3. Swine, 4. Other livestock	N_2O				●		
3B5	3. Agriculture; B. Manure management; 5. Indirect N_2O emissions	N_2O	●	●		●	●	●
3Da	3. Agriculture; D. Agricultural soils; Direct emissions from managed soils	N_2O	●	●	●	●	●	●
3Db	3. Agriculture; D. Agricultural soils; Indirect emissions from managed soils	N_2O	●	●	●	●	●	●
4 III	4. LULUCF; N mineralization	N_2O				●		
4A1	4. LULUCF; A. Forest land; 1. Forest land remaining forest land	CO_2	●	●		●	●	
4A2	4. LULUCF; A. Forest land; 2. Land converted to forest land	CO_2	●	●	●	●	●	●
4B1	4. LULUCF; B. Cropland; 1. Cropland remaining cropland	CO_2	●	●	●	●	●	●
4C1	4. LULUCF; C. Grassland; 1. Grassland remaining grassland	CO_2				●	●	●
4C2	4. LULUCF; C. Grassland; 2. Land converted to grassland	CO_2			●		●	●
4D1	4. LULUCF; D. Wetlands; 1. Wetlands remaining wetlands	CO_2						●
4E2	4. LULUCF; E. Settlements; 2. Land converted to settlements	CO_2	●	●	●	●	●	●
4G	4. LULUCF; G. Harvested wood products	CO_2	●		●	●		●
5A	5. Waste; A. Solid waste disposal	CH_4	●	●	●	●	●	●
5B	5. Waste; B. Biological treatment of solid waste	CH_4		●	●	●	●	●
5D	5. Waste; D. Wastewater treatment and discharge	CH_4		●			●	

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1.3 Switzerland's National Registry

1.3.1 General information

Name and contact information of the registry administrator

Federal Office for the Environment (FOEN)
Swiss Emissions Trading Registry
Climate Division, Mr. Matthias Kohler
CH–3003 Bern, Switzerland
Phone: +41 (0)58 462 05 66
Email: *emissionsregistry@bafu.admin.ch*
Registry: *https://www.emissionsregistry.admin.ch*
Web: *http://www.bafu.admin.ch/emissions-trading*

Cooperation with other Parties

Switzerland uses a registry software based on the Community Registry software, which was initially developed by the European Union in 2004. Further developments, updates and releases of the software are undertaken in cooperation with Dr. Lippke & Dr. Wagner GmbH. As of today, the same software is used by Monaco.

Description of the database structure and capacity of Switzerland's National Registry

Information on the database structure and capacity of the national registry is regarded as confidential.

Conformity to the technical standards for data exchange

Switzerland's National Registry environment was completely renewed in April 2014. In order to connect the new registry environment to the International Transaction Log (ITL) a Registry Readiness Questionnaire was submitted to the ITL. The questionnaire corresponds to the plans and associated documents that must be submitted by a candidate registry requesting initialization with the ITL, as identified in the Technical Specifications of the Data Exchange Standards (DES). In autumn 2015 Switzerland's National Registry reached compliance with DES 2.0.

Procedures employed to minimize and manage discrepancies and to correct problems

In case of discrepancies, the conformity of Switzerland's 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 the application support team, and the Federal Office of Information Technology, Systems and Telecommunication (FOITT).

Security measures

Information on security measures is regarded as confidential.

Information publicly accessible by means of the user interface

Non-confidential information is publicly available on the Swiss Emissions Trading Registry website *https://www.emissionsregistry.admin.ch*. The national allocation plan is accessible under 'Allocation' in the Public Information menu. Information made available to the public is conforming to the criteria defined in Annex E to decision 13/CMP.1:

- § 45 13/CMP.1: Report 'Accounts' at *https://www.emissionsregistry.admin.ch*.
- § 46 13/CMP.1: No report available as no ERUs were issued by Switzerland.
- § 47 13/CMP.1: Information on unit holding and transactions for each calendar year is available in the SEF Tables at *http://www.climatereporting.ch*.
- § 48 13/CMP.1: Report 'Accounts' at *https://www.emissionsregistry.admin.ch*.

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 Switzerland's National Registry (Decision 13/CMP.1, paragraph 47(d)).
- The identity of the acquiring accounts to which ERUs, CERs, AAUs and RMUs were transferred from Switzerland's National Registry (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)).

Internet address of the interface to Switzerland's National Registry

The user interface is located on the Switzerland's National Registry website: *https://www.emissionsregistry.admin.ch*.

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

Information on the data backup strategy is regarded as confidential.

Test procedures

Basic tests are performed by the application support provider Dr. Lippke & Dr. Wagner GmbH, on the international transaction log (ITL) DEVELOPER environment. The Annex H test during the registry initialization process successfully tested the software of Switzerland's National Registry against the ITL. New versions, updates or bug fixes of the registry software are tested in the REGISTRY environment before implementation in the PRODUCTION environment. Major changes are tested including the REGISTRY environment of the ITL. If test end criteria are reached, the new version or update is installed in the production environment.

1.3.2 Recent changes

Since the last National Communication and Biennial Report the following changes took place:

- Switzerland continues to cooperate with Monaco, but no longer hosts the registry of Monaco on Swiss servers.
- Switzerland's National Registry environment was completely renewed in April 2014. In order to connect the new registry environment to the International Transaction Log (ITL) a Registry Readiness Questionnaire was submitted to the ITL. The questionnaire corresponds to the plans and associated documents that must be submitted by a candidate registry requesting initialization with the ITL, as identified in the Technical Specifications of the Data Exchange Standards (DES). Based on the documentation provided, Switzerland has successfully passed the ITL readiness review and was able to switch to full operation with the new registry environment on 22 April 2014. For more detailed information, please refer to chapter 13 of Switzerland's National Inventory Report submitted on 15 April 2015 (*FOEN*, 2015).
- In autumn 2015 Switzerland's National Registry reached compliance with DES 2.0.

1.3.3 Status of Switzerland's National Registry as of 2015

Switzerland's National Registry got fully operational with the international transaction log (ITL) on 4 December 2007. Tab. 10 shows the total quantities of Kyoto Protocol units in the Swiss Registry related to the first commitment period 2008–2012 (CP1), Tab. 11 the total quantities of Kyoto Protocol units in the Swiss Registry related to the second commitment period 2013–2020 (CP2), by account type at the beginning of 2015 (submission of SEF Tables in 2015).

Tab. 10 > Total quantities of CP1 Kyoto Protocol units by account type at the beginning of 2015.

Standard Electronic Format (SEF) Table 1

	Unit type					
Account type	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**
Party holding accounts	242'650'590	558'645	8'652'013	17'286'778	–	–
Entity holding accounts	10'836'240	26'962'275	–	17'598'412	106'695	–
Article 3.3/3.4 net source cancellation accounts	172'587	–	628'867	–		
Non-compliance cancellation accounts	–	–	–	–		
Other cancellation accounts	128'586	116'253	–	1'760'680	8'098	–
Retirement account	–	–	–	–	–	–
tCER replacement account for expiry	–	–	–	–	–	
ICER replacement account for expiry	–	–	–	–		
ICER replacement account for reversal in storage	–	–	–	–		–
ICER replacement account for non-submission of certification report	–	–	–	–		–
Total	**253'788'003**	**27'637'173**	**9'280'880**	**36'645'870**	**114'793**	**–**

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Tab. 11 > Total quantities of CP2 Kyoto Protocol units by account type at the beginning of 2015.

Standard Electronic Format (SEF) Table 1

	Unit type					
Account type	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**ICERs**
Party holding accounts	–	–	–	–	–	–
Entity holding accounts	–	–	–	3'679'785	–	–
Retirement account	–	–	–	–	–	–
Previous period surplus reserve account	–					
Article 3.3/3.4 net source cancellation accounts	–	–	–	–		
Non-compliance cancellation account	–	–	–	–		
Voluntary cancellation account	–	–	–	31'122	–	–
Cancellation account for remaining units after carry-over	–	–	–	–	–	–
Article 3.1 ter and quater ambition increase cancellation account	–					
Article 3.7 ter cancellation account	–					
tCER cancellation account for expiry					–	
ICER cancellation account for expiry						–
ICER cancellation account for reversal of storage						–
ICER cancellation account for non-submission of certification report						–
tCER replacement account for expiry	–	–	–	–	–	
ICER replacement account for expiry	–	–	–	–		
ICER replacement account for reversal of storage	–	–	–	–		–
ICER replacement account for non-submission of certification report	–	–	–	–		–
Total	**–**	**–**	**–**	**3'710'907**	**–**	**–**

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2 Quantified economy-wide emission reduction target

While all information regarding Switzerland's quantified economy-wide emission reduction target is summarised in BR CTF Table 2, this chapter provides further background information in textual form. Information on progress in the achievement of the quantified economy-wide emission reduction targets is provided in section 3.14 as well as in BR CTF Table 4.

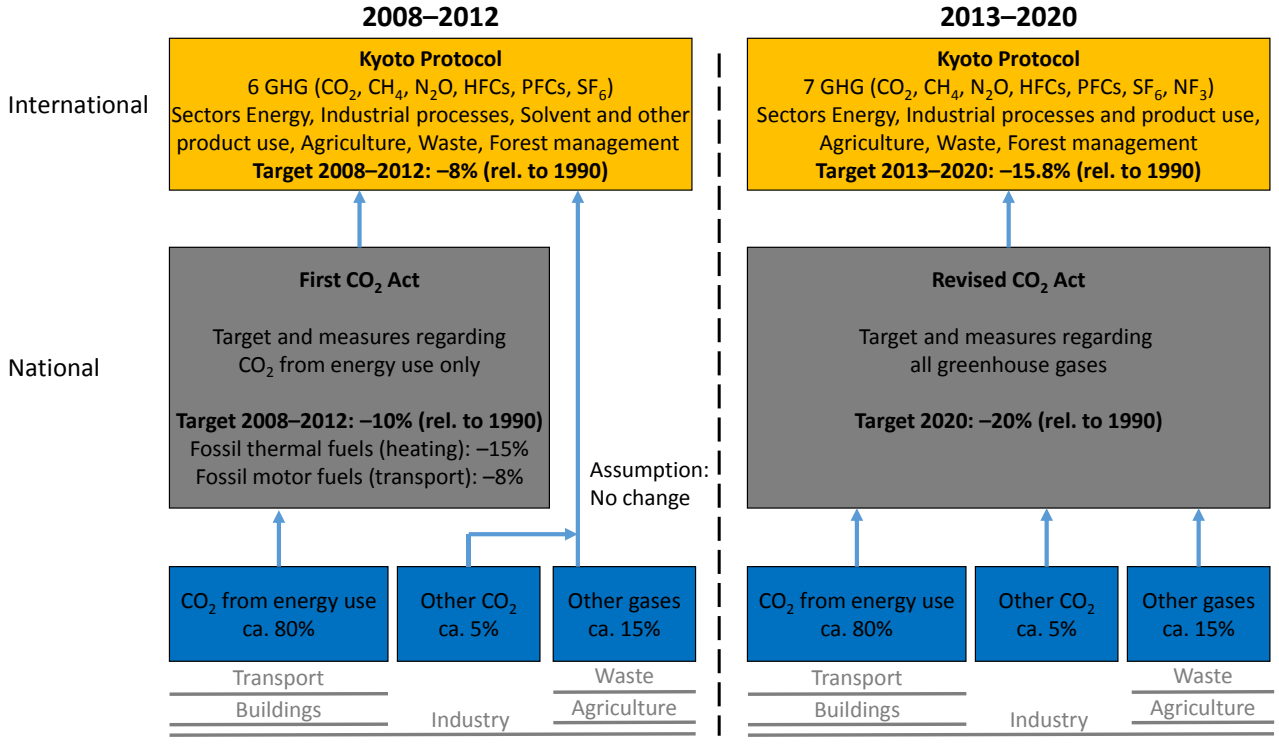
2.1 National and international context

By ratifying the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, Switzerland committed to contribute to the stabilization of greenhouse gas emissions at a level that would prevent dangerous anthropogenic interference with the climate system. To deepen its commitment, Switzerland, in 2003, ratified the Kyoto Protocol, 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 to further emission reductions for the second commitment period (2013–2020), submitting its instrument of acceptance of the Doha amendment to the Kyoto Protocol to the UNFCCC on 28 August 2015. In parallel to the emission reduction commitment for the second commitment period under the Kyoto Protocol, Switzerland has committed a corresponding target under the UNFCCC's system of 'pledge and review'. In Switzerland, the policies and measures needed to comply with the national and international commitments have been set in place and are continuously adapted to meet agreed targets (see chapter 3).

2.2 Description of Switzerland's quantified economy-wide emission reduction target

Switzerland's national and international emission reduction targets for both the first (2008–2012) and the second (2013–2020) commitment period under the Kyoto Protocol are illustrated in Fig. 13.

Fig. 13 > Switzerland's national and international emission reduction targets for both the first (left, 2008–2012) and second (right, 2013–2020) commitment period under the Kyoto Protocol.



Under the first commitment period of the Kyoto Protocol, the national greenhouse gas emission target of Switzerland was set at 8% below the emissions in 1990 (mean value 2008–2012). Switzerland translated this reduction commitment into national targets for energy related CO_2 emissions. Within the first CO_2 Act (*Swiss Confederation*, 1999b), which entered into force on 1 May 2000, CO_2 emissions from fossil fuels were required to decrease by 10% over the period 2008–2012 compared to 1990. This overall objective was split between fossil thermal fuels (for heating and processes) with a reduction target of 15%, and fossil motor fuels (for transport) with a reduction target of 8%. The first CO_2 Act covered CO_2 only, i.e. approximately 80% of the greenhouse gas emissions regulated by the Kyoto Protocol. However, the CO_2 reduction target of -10% was consistent with the Kyoto target of -8% on condition that the collective emissions of the other greenhouse gases remained unchanged.

For the period beyond 2012, Switzerland committed to a quantified economy-wide emission reduction target of 20% below the emissions of the year 1990, to be reached by 2020. This target is consistent with Switzerland's quantified emission limitation or reduction commitment of 84.2% (percentage of base year emissions) for the years 2013–2020, as inscribed in the Doha Amendment to the Kyoto Protocol. This emission reduction target is unconditional under both the Kyoto Protocol and the Convention. The international commitments covering the period 2013–2020 are implemented nationally by means of the revised CO_2 Act, which entered into force on 1 January 2013 (*Swiss Confederation*, 2011) and now covers all greenhouse gases. Based on this law, Switzerland will reduce its domestic greenhouse gas emissions by at least 20% by 2020 relative to 1990 levels.

2.2.1 Gases and sectors covered

In the international context, the quantified economy-wide emission reduction target covers the full set of reported greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3). While the first CO_2 Act translated Switzerland's commitment under the Kyoto Protocol into national targets related to CO_2 emissions only, the revised CO_2 Act covers the same gases and sectors as the Kyoto Protocol. All targets include the emissions from the sectors 'Energy', 'Industrial processes and product use', 'Agriculture', 'Land use, land-use change, and forestry' (Article 3.3 KP and forest management), and 'Waste'. Only emissions from the sector 'Other' (sector 6 in the Common Reporting Format) are not included.

2.2.2 Global Warming Potential (GWP) values

For the first commitment period under the Kyoto Protocol, Switzerland used the Global Warming Potential (GWP) values provided by the IPCC in its Second Assessment Report ('1995 IPCC GWP values', *IPCC*, 1995) based on the effect of greenhouse gases 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 effect of greenhouse gases over a 100-year time horizon, as included in Annex III to decision 15/CP.17. These GWP values are also reflected in Annex I of the Ordinance for the Reduction of CO_2 Emissions (CO_2 Ordinance, *Swiss Confederation*, 2012) for the period 2013–2020.

2.2.3 Approach to counting emissions and removals from the LULUCF sector

According to Article 3.7 of the Kyoto Protocol, the LULUCF sector is only included in the calculation of the assigned amount in case this sector constituted a net source of greenhouse gases in 1990. In Switzerland, the LULUCF sector was a net sink in 1990 and is therefore excluded from the base year level and target.

The reporting of the LULUCF sector under the UNFCCC follows the land-based approach. The activity-based approach is valid for accounting under the Kyoto Protocol. Under Article 3.3 of the Kyoto Protocol, Switzerland accounts for afforestation, reforestation as well as deforestation, and under Article 3.4 of the Kyoto Protocol for forest management.

2.2.4 Supplemental use of market-based mechanisms

Switzerland's climate policy generally aims at domestic reductions of greenhouse gas emissions. However, Switzerland will use carbon credits generated from the flexible mechanisms under the Kyoto Protocol, i.e. Certified Emission Reductions (CERs) from the Clean Development Mechanism and Emission Reduction Units (ERUs) from Joint Implementation, as well as from the new market-based mechanisms under the Convention to compensate for some of its

emissions over the period 2013–2020. Carry-over units, i.e. units carried over from the first to the second commitment period, may also be used. While the amount of carbon credits needed by Switzerland in order to reach its emission reduction targets for the second commitment period is not yet known, further details on the modalities pertaining to the supplemental use of credits are given in the following:

- The revised CO_2 Act defines Switzerland's 20% reduction target as domestic. However, carbon credits for emission reductions achieved abroad will play a role in the case of (i) the obligation to offset emissions from gas-fired combined-cycle power plants (section 3.3.6), (ii) the emissions trading scheme (section 3.2.5), (iii) negotiated reduction commitments (for exemption from the CO_2 levy, section 3.2.6), (iv) the partial compensation of CO_2 emissions from transport fuel use (section 3.4.5). For the latter three measures, foreign carbon credits will only be used in case agreed or set targets are not achieved (i.e. as part of the sanction mechanism to enforce the law).
- Switzerland will use additional carbon credits recognized under the Kyoto Protocol to meet eventual differences between the approaches used under national legislation (i.e. emission reduction target defined for the year 2020) and under the Kyoto Protocol (i.e. 'carbon budget' approach used to calculate the quantified emission limitation or reduction commitment (QELRC) for the 2013–2020 period). Such carbon credits are also available from the Climate Cent Foundation (section 3.4.4), which is obligated to use excess revenues (from the period 2005–2012) for the acquisition of carbon credits and to hand these over to the government.
- In case the Federal Council further increases the reduction target in order to comply with international agreements, parts of the additional reductions in greenhouse gas emissions may be achieved through measures carried out abroad.
- Switzerland is applying qualitative restrictions on the use of carbon credits. In this context, as of 2013 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), subject to the condition that the quality of the credits is guaranteed.
- Under the Kyoto Protocol, Switzerland does not plan to acquire Assigned Amount Units (AAUs) from other countries but does not exclude to use such units through the possible linking of its emissions trading scheme with other schemes. Switzerland may use some of its own carried-over AAUs.

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3 Policies and measures

3.1 Introduction

This chapter describes policies and measures implemented (or planned to be implemented) in Switzerland in order to achieve emission reductions in the national and international context. The introduction (section 3.1) provides the general policy context, including the general framework of environmental legislation and some further background information on institutional arrangements at the domestic level. The subsequent sections presenting individual mitigation actions are organized by sector and elaborate on each mitigation action listed in BR CTF Table 3. Section 3.2 focuses on policies that are effective across sector boundaries. Section 3.3 deals with (non-transport) policies and measures related to energy efficiency, reduced energy consumption, and renewable energy. Section 3.4 encompasses aspects of transport infrastructure, sustainable modes of transport, and vehicle emission standards. The remaining mitigation actions cover the following areas: Industrial processes and product use (section 3.5), agriculture (section 3.6), land use, land-use change, and forestry (section 3.7), waste (section 3.8), and measures affecting longer-term trends in anthropogenic greenhouse gas emissions (section 3.9). Sections 3.10 and 3.11 briefly address policies and measures no longer in place, changes in the presentation of policies and measures, and policies and measures leading to an increase in greenhouse gas emissions. Finally, actions related to economic and social consequences of response measures (adverse effects) are addressed in section 3.12, while information regarding monitoring and evaluation of progress towards the economy-wide emission reduction target is presented in sections 3.13 and 3.14. The box below highlights the core elements contributing to the reduction of greenhouse gas emissions in Switzerland.

Core elements of Swiss climate policy:

- **Revised CO_2 Act of 2011 (legal framework):** The fully revised CO_2 Act replaces the first CO_2 Act of May 2000. It entered in force in January 2013 and covers the period until 2020. The main target is to reduce greenhouse gas emissions by 20% by 2020 compared to the 1990 level. Reductions are to be achieved domestically.
- **CO_2 levy on heating and process fuels:** The CO_2 levy was introduced in 2008 and is continued in the period up to 2020. Companies can be exempted from the CO_2 levy if certain conditions are met. The rate of the levy is adjusted by the Federal Council if emissions do not decrease in line with the pre-set target. Adjustments were made on 1 January 2014 and 1 January 2016. If necessary, a further increase may be applied by 1 January 2018.
- **Emissions trading scheme:** Some 55 companies that together are responsible for over 10% of national CO_2 emissions are exempted from the CO_2 levy but included in Switzerland's emissions trading scheme. Trading of domestic emission allowances and emission reduction certificates from abroad allows these companies to reduce emissions where costs are lowest. Further companies may voluntarily participate in the emissions trading scheme.
- **National buildings refurbishment programme:** This programme reduces CO_2 emissions by improving the existing buildings envelope and promoting renewable energy, energy recuperation and optimization of building technology. The programme is managed by the federal government and the cantons and financed via a share of one-third of the revenues from the CO_2 levy and additional funds from the cantons.
- **Partial compensation of CO_2 emissions from transport fuel use:** Transport fuel producers and importers must compensate for part of the CO_2 emissions attributable to the use of fossil motor fuels by financing domestic emission reduction projects. The proportion of emissions to be compensated will gradually be increased from 2 to 10% between 2014 and 2020. The required funding comes from a surcharge on the price of motor fuels imported into Switzerland.
- **CO_2 emission regulations for new passenger cars:** Since 2012, car importers are required to reduce emissions from passenger cars that are registered in Switzerland for the first time. In line with European Union provisions, the CO_2 emissions from new passenger cars must be reduced to an average of 130 gram CO_2 per kilometre by the end of 2015. Tightening emissions target values and extending them to other categories of vehicles is planned for the period after 2015.
- **Obligation to offset emissions from gas-fired combined-cycle power plants:** Should fossil fuel power plants become necessary to cover Switzerland's future electricity supply, operators will be obliged to fully compensate for their CO_2 emissions. At least half the compensation must be achieved through domestic projects.

3.1.1 General policy context

The Federal Constitution of the Swiss Confederation forms the overarching context for environmental and climate policy in Switzerland. The commitment to long-term preservation of natural resources is listed prominently in the opening paragraphs as one of the main aims (*Swiss Confederation*, 1999a, Article 2). In pursuit of this commitment, the federal government has established an Interdepartmental Sustainable Development Committee (ISDC) which defines 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 set out its main policy focus areas for sustainable development in its 'Sustainable Development Strategy 2012–2015' (*Swiss Federal Council*, 2012), adopted as part of the federal government's regular legislative planning cycle. This strategy represented 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.

Sustainable development strategy

The current strategy – the fourth of its kind since 1997 – centres around an Action Plan featuring measures that are grouped according to the 10 key challenges facing sustainable development in Switzerland. With a view to achieving the goals defined, the strategy 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.

At present, the strategy is being updated for the period 2016–2019. A broad range of stakeholders has been invited to participate in this process. The adoption of the renewed strategy by the Federal Council is planned to take place in early 2016.

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. The reduction of energy consumption, the increased use of renewable energies, and management of natural hazards form part of this endeavour. 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 greenhouse gas emissions at a level that would prevent dangerous anthropogenic interference with the climate system. In addition, Switzerland has ratified the Kyoto Protocol in 2003. For the first commitment period, Switzerland's national greenhouse gas emission target was 8% below 1990 emissions (mean value over the first commitment period, 2008–2012). Switzerland has committed to continue its emission reduction efforts under the second commitment period, with a national greenhouse gas emission target of 15.8% below 1990 levels (mean value over the second commitment period, 2013–2020).

Separation of responsibilities between federal and cantonal level

The measures contributing to the national emission targets are implemented by different authorities. In Switzerland, the principle of subsidiarity is deeply ingrained (*Swiss Confederation*, 1999a, Articles 3 and 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 of policy in general and environmental policy in particular lie within the remit of the federal authorities, the concrete legislation and its implementation often remain within the competences of the cantons (*Swiss Confederation*, 1999a, Article 74). Consequently, the funding of measures is also divided between federal, cantonal and private entities, depending on the individual measures. For some measures, federal funds are made available to cantonal implementing agencies on condition that additional funds matching the federal contribution are allocated by these.

The priority given to principles such as subsidiarity and close cooperation with the private sector leads to numerous 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.

3.1.2 Environmental and climate policy

The principles and instruments of Switzerland's environmental policy are stipulated in the Federal Act on the Protection of the Environment (*Swiss Confederation*, 1983), in force since 1985 and revised several times since. Fiscal incentives are recognized as an essential instrument for promoting the efficient use of resources. The Federal Act on the Reduction of CO_2 Emissions (first and revised CO_2 Act, *Swiss Confederation*, 1999b, 2011) supplements the Environmental Protection Act and provides the basis for Switzerland's national policy on climate change. As stipulated in the revised CO_2 Act of 23 December 2011 (Article 39), the Federal Office for the Environment (FOEN) is responsible for matters relating to climate protection. The related Ordinance for the Reduction of CO_2 Emissions (*Swiss Confederation*, 2012), in its chapter 11, details the responsibilities for the implementation of specific measures.

Swiss environmental policy is addressing a wide spectrum of issues, ranging from pollution of air, water and soil, and exposure to noise, to protecting stratospheric ozone or reducing and managing waste. Several policy areas are linked directly or indirectly to the reduction of Swiss greenhouse gas emissions.

The Environmental Protection Act is based on three main principles:

- Principle of precaution.
- Control/limitation of ecological damage at the 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 impact 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 January 2015 (*Swiss Federal Council*, 2015), documenting the current state of the environment and the effectiveness of the measures taken to date.

Apart from the Environmental Protection Act and the CO_2 Act, there are various other legal provisions that are related to environmental and climate issues. The Energy Act (*Swiss Confederation*, 1998a), the Forest Act (*Swiss Confederation*, 1991), the Spatial Planning Act (*Swiss Confederation*, 1979), the Agriculture Act (*Swiss Confederation*, 1998b), the Road Traffic Act (*Swiss Confederation*, 1958), the Heavy Vehicle Charges Act (*Swiss Confederation*, 1997), the Mineral Oil Tax Act (*Swiss Confederation*, 1996) and the Technical Ordinance on Waste (*Swiss Confederation*, 1990) have components that contribute to environmental policy goals including greenhouse gas emissions reduction and reduction of greenhouse gas precursor gases.

In view of the international dimension of environmental problems, Switzerland seeks to enhance and support international efforts to tackle problems at the 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 solve environmental problems in multilateral contexts.

3.1.3 Domestic institutional arrangements

No fundamental changes in domestic institutional arrangements, including legal, administrative and procedural arrangements have occurred since the submission of Switzerland's Sixth National Communication and First Biennial Report under the UNFCCC. The status of, and progress in, the development and implementation of strategies, programmes, policies and measures related to mitigation commitments under the UNFCCC and its Kyoto Protocol are documented in the subsequent sections of this chapter. Institutional arrangements related to Switzerland's National Greenhouse Gas Inventory System and the National Registry are documented in chapter 1 of this report (sections 1.2 and 1.3, respectively). The legal and institutional framework for the implementation of the UNFCCC and its Kyoto Protocol can be summarized as follows:

Switzerland's climate policy is based on Article 74 (environmental protection) and Article 89 (energy policy) of the Federal Constitution. The legal centrepiece defining objectives, instruments, measures and general rules of implementa-

tion of climate policy is the Federal Act on the Reduction of CO_2 Emissions (CO_2 Act). This Act also contains provisions related to enforcement and evaluation. The implementation of the CO_2 Act is further detailed in the Ordinance for the Reduction of CO_2 Emissions (CO_2 Ordinance), where, inter alia, specific responsibilities for the implementation of measures are assigned. Tab. 12 gives detailed references to enforcement and administrative procedures for some core provisions of the CO_2 Act and the CO_2 Ordinance.

Tab. 12 > Enforcement and implementation responsibilities for core provisions of the CO_2 Act and the CO_2 Ordinance.

Instrument/measure	CO_2 Act	CO_2 Ordinance	Enforcement	Implementation level
Objectives	Article 3	Article 3	If a sector-specific interim target is not achieved, then the DETEC, after hearing the cantons and affected parties, shall request the Federal Council for additional measures.	Confederation
CO_2 levy on heating and process fuels	Articles 29–25	Articles 93–103	The CO_2 Ordinance defines a reduction pathway that needs to be followed (Article 94). If the targets set in the CO_2 Ordinance are not met, the CO_2 levy is to be increased.	Confederation
Emissions trading scheme	Articles 15–21	Articles 40–65	Companies taking part in the emissions trading scheme have to cover every year the emissions caused with emission allowances or emission reduction certificates (CERs). Not surrendering enough allowances entails a sanction of CHF 125 per tonne CO_2eq not covered.	Confederation
Negotiated reduction commitments (for exemption from the CO_2 levy)	Article 31	Articles 66–79	Companies have to commit to reduce their greenhouse gas emissions. If commitments are not fulfilled, a sanction of CHF 125 is due per tonne CO_2eq that has been emitted in excess.	Confederation
National buildings refurbishment programme (Parts A and B)	Article 34	Part A: Articles 104–113 Part B: Article 17 of the Energy Ordinance	Parts A and B: Annual reporting on effectiveness of implementation.	Part A: Contractual agreement between confederation and cantons Part B: Cantons
Building codes of the cantons (reduction of CO_2 emissions in the building sector)	Article 9	Article 16	Regulated at cantonal level. Cantons have to report annually to the federal level on their activities.	Cantons
Obligation to offset emissions from gas-fired combined-cycle power plants	Articles 22–25	Articles 80–92	If the obligation to fully compensate the emissions is not fulfilled, the operator of the power plant has to pay a contractual sanction for non-compliance with the commitment.	Confederation
CO_2 emission regulations for new passenger cars	Articles 10–13	Articles 17–37	CO_2 Act, Article 13: If targets are not met, importers of passenger cars have to pay a sanction.	Confederation
Partial compensation of CO_2 emissions from transport fuel use	Articles 26–28	Articles 86–92	If the obligation to compensate is not fulfilled, a sanction of CHF 160 per tonne CO_2 must be paid. Additionally, the missing emission reductions must be covered by CERs.	Confederation

The Federal Office for the Environment (FOEN) publishes recommendations on the implementation of the legal provisions in cases where more detailed information is necessary. These recommendations do not have legal force but are giving more precise instructions on the application of the legal instruments. In the context of the current CO_2 Act and the current CO_2 Ordinance, FOEN has published recommendations related to the emissions trading scheme, the exemption from the CO_2 levy for energy intensive companies, and the implementation of compensation projects in Switzerland[1].

The CO_2 Act (Article 5 and 6) and the related CO_2 Ordinance (Article 4 and Annex 2) provide the legal basis for the implementation and use of the flexible mechanisms of the Kyoto Protocol. SwissFlex, the national secretariat for the flexible mechanisms, is the Designated National Authority under the Clean Development Mechanism and Designated Focal Point under the Joint Implementation. It 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. Besides FOEN, the members of this group are drawn from the Swiss Federal Office of Energy (SFOE), the State Secretariat for Eco-

[1] See *http://www.bafu.admin.ch/publikationen/publikation/01726/index.html?lang=en*

nomic Affairs (SECO), the Swiss Agency for Development and Cooperation (SDC) and the Federal Department of Foreign Affairs (FDFA). So far, the Swiss Designated Focal Point has issued some 150 letters of approval for projects under the Joint Implementation to Swiss or Swiss-based entities. The homepage of the national secretariat for the flexible mechanisms can be found here: *www.bafu.admin.ch/emissions-trading*.

3.2 Cross-sectoral policies and measures

3.2.1 Overview

Climate policy being a relatively novel area of policy intervention, this section describes measures that cannot be assigned to one of the 'classical' policy sectors that deal with or affect the quality of the environment in general and climate change mitigation in particular. While measures addressed in later sections may have side effects beyond their specific policy domain, the following measures are clearly cross-sectoral in nature in that they impact on several sectors at the same time.

Tab. 13 gives an overview of the most relevant cross-sectoral policies and measures. More details and background information on each policy and measure are presented in the following subsections.

Tab. 13 > Summary of cross-sectoral climate policies (including legal framework) and measures.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (for a particular year, not cumulative, in Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
First CO_2 Act (1999)	-10% CO_2 from fossil fuel use by 2008–2012 relative to 1990	CO_2	Regulatory	No longer in place (replaced by revised CO_2 Act)	FOEN	[a]	[a]	[a]	[a]	[a]	[a]
Revised CO_2 Act (2011)	-20% CO_2eq by 2020 relative to 1990	All Kyoto greenhouse gases	Regulatory	Implemented since 2013	FOEN	[a]	[a]	[a]	[a]	[a]	[a]
CO_2 levy on heating and process fuels	Incentive for energy efficiency and less CO_2 intensive energy sources, reduced use of fossil heating fuels	CO_2	Fiscal, economic	Implemented since 2008	FOEN	n.a.	n.a.	n.a.	0.2[b]	0.8[b]	2.0[b]
Emissions trading scheme	Making market mechanisms available to emission intensive companies	CO_2, N_2O, PFCs	Economic	Implemented since 2008	FOEN	n.a.	n.a.	n.a.	n.e.	0.4	0.8
Negotiated reduction commitments (for exemption from the CO_2 levy)	Emission reduction targets agreed with companies wishing to obtain exemption from the CO_2 levy	CO_2, N_2O, PFCs	Regulatory	Implemented since 2008	FOEN (in cooperation with SFOE)	n.a.	n.a.	n.a.	i.e.[c]	i.e.[c]	i.e.[c]

[a] The CO_2 Act is the legal framework for various measures. The expected mitigation impact corresponds to the objective indicated in the second column.

[b] For the purposes of estimating the mitigation impact the levy was fixed at CHF 36 CHF per tonne of CO_2 for the period 2010–2015. For 2016–2020 it was assumed that the CO_2 levy would be raised to CHF 72 per tonne of CO_2.

[c] The estimated mitigation impact is included under the mitigation impact of the CO_2 levy on heating and process fuels. For 2020, the contribution of negotiated reduction commitments (for exemption from the CO_2 levy) is estimated to account for about 0.4 Mt CO_2eq.

i.e., included elsewhere; n.a., not applicable; n.e., not estimated

3.2.2 First CO_2 Act (1999)

The first CO_2 Act (*Swiss Confederation*, 1999b) entered into force in May 2000. It formed the legal framework for implementing Switzerland's emissions reduction commitment under the Kyoto Protocol by limiting CO_2 emissions from fossil fuel use for heating and transport to 10% below 1990 levels over the period 2008–2012. The overall target was further divided into a reduction target of 15% on heating and process fuels and 8% on transport fuels. These targets were set to assure compliance with the Kyoto target, provided that the aggregate level of other greenhouse gas emissions (expressed in CO_2 equivalents) remains unchanged compared to 1990 (see section 2.2, Fig. 13).

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

- Voluntary actions in various areas.
- A subsidiary CO_2 levy on fossil heating and process fuels.
- Measures in other policy areas (waste, agriculture, F-gases) that are relevant to climate change mitigation.

- An emissions trading scheme (cap and trade) and the complementary use of the flexible mechanisms of the Kyoto Protocol.

3.2.3 Revised CO_2 Act (2011)

The fully revised CO_2 Act (*Swiss Confederation*, 2011) is the current centrepiece of Swiss climate policy. It entered into force on 1 January 2013 and covers the period from 2013–2020. Apart from defining objectives it forms the foundation for several measures to reach the set targets. Some measures developed or initiated in the context of the first CO_2 Act, such as the CO_2 levy on heating and process fuels, the national buildings refurbishment programme, and the CO_2 emission limits for new passenger cars, are continued.

The national reduction target contained in the revised CO_2 Act stipulates the reduction of domestic greenhouse gas emissions by at least 20% by 2020 compared to the 1990 level. In contrast to the first CO_2 Act, all gases covered by the Kyoto Protocol are addressed (see section 2.2). The revised CO_2 Act sets incentives to increase the use of renewable energies, to improve energy efficiency and to develop innovative low-emission technologies. In addition, it gives the Confederation the responsibility to coordinate the measures aimed at adaptation to the impacts of climate change at the national level.

The reduction target of -20% is shared between the building, industry and transport sectors. For 2015, the CO_2 Ordinance sets interim targets which correspond to reductions of -22% for the building sector, -7% for the industry sector and zero emissions growth for the transport sector compared to 1990 levels. An evaluation of sectoral performance towards the interim targets will be performed as soon as the respective inventory data become available in 2017. If the targets are not reached, the DETEC will propose additional measures to the Federal Council. Only indicative sectoral targets exist regarding reductions by 2020 (-40% for the building sector, -15% for the industry sector, and -10% for the transport sector).

3.2.4 CO_2 levy on heating and process fuels

By increasing the price of fossil heating and process fuels, the CO_2 levy sets an incentive to use fossil fuels more efficiently, to invest in low carbon technologies, and to switch to low-carbon or carbon-free energy sources. The CO_2 levy was introduced in January 2008 at an initial rate of CHF 12 per tonne of CO_2. As intermediary targets set out in the CO_2 Act were not met, the rate gradually increased to reach CHF 36 per tonne of CO_2 by 1 January 2010, CHF 60 per tonne of CO_2 by 1 January 2014 and CHF 84 per tonne of CO_2 by 1 January 2016. The CO_2 Act foresees a maximum increase to CHF 120 per tonne of CO_2 by 2018 if greenhouse gas emissions from heating fuels do not correspond to trends in line with legal requirements.

As a basic principle, proceeds from the CO_2 levy are refunded to the Swiss population (on a per capita basis) and to the business community (in proportion to wages paid). However, following a parliamentary decision in June 2009, up to a third (CHF 300 million per year) of the revenues from the CO_2 levy is earmarked to finance the national buildings refurbishment programme (see section 3.3.3). This programme is partly co-funded out of cantonal budgets and co-managed by the federal government and the cantons.

3.2.5 Emissions trading scheme

Switzerland introduced its emissions trading scheme in 2008 in order to give companies, especially those industries with substantial CO_2 emissions resulting from the use of heating and process fuels as well as from cement production, the possibility to be exempted from the CO_2 levy. The emissions trading scheme is based on the cap and trade principle. For the period 2013–2020, Switzerland's emissions trading scheme has been aligned with the European Union's emissions trading scheme with a view to link both systems. Notable amendments include the mandatory nature of the emissions trading scheme 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 European Union. Conclusion of a related bilateral agreement between Switzerland and European Union authorities is pending.

3.2.6 Negotiated reduction commitments (for exemption from the CO_2 levy)

Companies with substantial CO_2 emissions may apply for exemption from the CO_2 levy without participation in the emissions trading scheme, provided they commit to emission reductions. Companies have to elaborate emission reduction targets, which take into account the technological potential and economic viability of measures. The CO_2 levy can be waived only for companies engaged in activities explicitly laid out in the CO_2 Ordinance and with annual CO_2 emissions of at least 100 tonnes. Guidelines and ordinances regulate the procedures for exemption from the CO_2 levy and consequences (sanctions) in case of non-compliance.

3.3 Energy

3.3.1 Overview and legal framework

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

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

In the aftermath of the nuclear incident in Fukushima in 2011, the Federal Council and the Swiss Parliament decided to decommission the existing nuclear power plants at the end of their life time and to redefine the Switzerland's energy policy. The so-called 'Energy Strategy 2050' has been elaborated and adopted by the Federal Council in 2012 (*Swiss Federal Council*, 2013a). The Energy Strategy 2050 is under parliamentary discussion and is expected to enter into force in 2017 at the earliest. It sets a number of priorities to assure the future electricity supply, such as reduction in energy consumption, broadening of the portfolio of energies used, expansion and restructuring of the electricity transmission grid as well as energy storage.

As part of its Energy Strategy 2050, the Federal Council is placing emphasis on increased energy savings (energy efficiency), the expansion of hydropower and new renewable energies. In addition and if necessary, 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) as well as enhanced imports are options foreseen in the strategy.

Within the context of the Energy Strategy 2050, priority areas particularly relevant to climate policy goals are:

- **Reduction in energy consumption:** In order to stabilise total electricity consumption at some 64 terawatt-hours (TWh) per year towards the end of the decade (2012: 63.4 TWh), 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 the SwissEnergy programme, described below) and measures regarding the production of heat.
- **Broadening of electricity supply:** Hydropower and new renewable electricity generation should be bolstered in particular. Their share in the current energy mix needs to be expanded substantially. This is the main aim of the feed-in remuneration (electricity network surcharge), raising funds for promotional measures. However, in order to meet demand, fossil fuel-based electricity generation may need to be expanded by constructing gas-fired combined-cycle power plants intended to provide peak load, but also combined heat and power plants for base load in winter. The government is retaining its climate policy objectives (see section 3.3.6), therefore emissions caused by new fossil-fuel based power plants must be compensated.

- **Expansion and restructuring of electricity transmission grid and energy storage:** The increasing share of intermittent power production by renewable energies (wind, solar) requires the expansion and restructuring of transmission grids and of the pool of power plants to ensure temporary power balancing as well as the necessary storage and reserve capacities. 'Smart grids' are important prerequisites for future domestic production infrastructures and electricity exchange. They 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.
- **Strengthening energy research:** 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 (see section 3.9).

To implement the new energy strategy, the planned amendment of the Swiss Energy Act contains reference values 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. On this basis, the new energy strategy shall contribute to achieve the long term goals of Switzerland's climate policy – to reduce greenhouse gas emissions to 1 to 1.5 tonnes per year and person by 2050.

In parallel to the strategy developed by the Federal Council, two popular initiatives have been launched addressing different aspects of the future orientation of Switzerland's energy policy. These are also taken into account by the Swiss Parliament during deliberations on a first legislative package of measures related to Energy Strategy 2050. The package is still under consideration by the Houses of Parliament.

The Federal Council decided in October 2015 upon the second package of the Energy Strategy 2050 which is expected to take effect as of 2020. This package seeks the transition from the current subsidy based system to a mainly incentive based system. The Federal Council proposes a constitutional amendment in order to give democratic legitimacy to the new approach. The possibility to introduce incentive levies on heating and process fuels, on transport fuels, as well as on electricity is part of the Federal Council's proposal. Incentive taxes should be set such as to make an essential contribution to the objectives of energy and climate policy. The revenues of the levies shall be redistributed to the population and the economy. Earmarking of the revenue is no longer possible without changing the constitution.

Tab. 14 gives an overview of the most climate relevant policies and measures in the energy sector. The following subsections provide more details and background information on each policy and measure.

Tab. 14 > Summary of policies and measures in the energy sector.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (for a particular year, not cumulative, Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
SwissEnergy programme	Promotion of energy efficiency and the increased use of renewables	CO_2	Information, education	Implemented since 2001, running until 2019	SFOE	n.a.	n.a.	n.e.	n.e.	n.e.	n.a.
National buildings refurbishment programme	Part A: Refurbishment of existing buildings envelope	CO_2	Economic	Implemented since 2010, running until 2019	SFOE, FOEN	n.a.	n.a.	n.a.	0.01	0.4	0.9
	Part B: Incentives for renewable energy, energy recuperation and optimization of building technology	CO_2	Economic	Implemented since 2010, running until 2019	Cantons	n.a.	n.a.	n.a.	0.14 [a]	0.87 [a]	2.07 [a]
Building codes of the cantons	Stringent energy consumption standards for new buildings	CO_2	Regulatory	Implemented since 1992	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
Negotiated commitments on energy efficiency	Exemption from electricity network surcharges under the Energy Act	CO_2	Economic	Implemented since 2014	SFOE	n.a.	n.a.	n.a.	n.a.	n.e.	n.e.

Obligation to offset emissions from gas-fired combined-cycle power plants	Avoid new large sources of CO_2 from domestic electricity or heat generation	CO_2	Regulatory	Implemented since 2008	FOEN	n.a.	n.a.	n.a.	n.a.	n.a. [b]	n.a. [b]
Negotiated reduction commitment by MSWI operators	Contribution to emission reduction by MSWI through energy efficiency and metal recuperation	CO_2	Regulatory	Implemented since 2014	FOEN	n.a.	n.a.	n.a.	n.e.	n.e.	0.2 [c]

[a] Including 0.07 Mt from promotional measures taken by the cantons outside of the buildings refurbishment programme.

[b] It is currently uncertain when (and if) new gas-fired combined-cycle power plants will be realized in Switzerland. In any case, the obligation to offset emissions from gas-fired combined-cycle power plants aims at ensuring their climate-neutral operation (partly using foreign carbon credits), thus the net impact of the measure equals zero.

[c] Agreed (net) emission reduction commitment is 0.2 Mt CO_2eq below 2010 emissions by 2020. The recuperation of metals may lead to (indirect) reductions of greenhouse gas emissions outside Switzerland.

n.a., not applicable; n.e., not estimated

3.3.2 SwissEnergy programme

In 2001, the Federal Council launched the 'SwissEnergy' programme, in line with the Energy Act and the CO_2 Act that came into force in 1999 and 2000, respectively. It aims at reducing 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. The SwissEnergy programme represents a major policy instrument for awareness raising and promoting an increase in energy efficiency and the enhanced use of renewable energy. Measures are mostly voluntary in nature, supporting the effect of regulatory measures. Running initially from 2001 to 2010, the programme has been extended to 2020.

SwissEnergy is managed by the Swiss Federal Office of Energy (SFOE). Projects are normally run in close cooperation with cantons, municipalities, and industry, as well as environmental and consumer associations. Programme results are subject to detailed monitoring and verification. To bolster the implementation of the Energy Strategy 2050, Swiss Energy's funding was increased, reaching CHF 45 million in 2014 and CHF 55 million in 2015. Additional funding is to be sourced from third parties (trade and industry, cantons and municipalities).

In recent 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) or codes of conduct (some energy-using products), are now legally mandated and aligned with the standards of the European Union. Hence, the role of SwissEnergy is shifting towards that of a facilitator for the above mentioned regulations and laws.

3.3.3 National buildings refurbishment programme

In order to increase the refurbishment 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 were earmarked for this purpose in the framework of the first CO_2 Act. In 2009 the Swiss Parliament adopted the new buildings programme (operational since 1 January 2010). This programme was collectively developed by the cantons, represented by the Conference of Cantonal Energy Directors (EnDK) and the federal level (SFOE, FOEN). The cantons are responsible for its implementation. The duration of the programme is limited to ten years. A mid-term evaluation will be submitted to the Swiss Parliament in early 2016. Some numbers on the cost-effectiveness of the programme on the basis of the most recent annual reporting (*EnDK*, 2014) are given below under the headings of the two separate tracks of the programme.

With the revision of the CO_2 Act in 2011, the Swiss Parliament increased the maximum amount earmarked for the buildings programme from CHF 200 million to CHF 300 million per year. Available funds are linked to the actual level of the CO_2 levy. With the increases of the CO_2 levy at the beginning of 2014 and 2016, more financial means are available to promote measures to reduce greenhouse gas emissions from buildings. As part of the Energy Strategy 2050, the Federal Council wants to make more funding available to the buildings programme.

The national buildings refurbishment programme contains two distinct parts:

- **Part A – Refurbishment of existing buildings envelope:** Two thirds of the funds for the buildings programme (about CHF 200 million) are dedicated to refurbishing the shell of heated buildings that were constructed before 2000. Subsidies are granted per square meter building envelope or window area if measures comply with defined minimum thermal insulation standards. Promotional measures under Part A of the buildings programme are identical for all of Switzerland. Up to 15% of total investment costs are sponsored by the programme. In 2014, about 5 million square meters of building surface were refurbished with the support of the programme. The main focus was on roofs and facades. On average CHF 66 per tonne of CO_2 reduced were spent by part A of the programme. The cumulative effect of this programme track since its inception in 2010 amount to 8 million tonnes of CO_2 (taking account of the entire lifespan of the measures).
- **Part B – Promotion of renewable energy, energy recuperation and optimization of building technology:** Up to one third of the funds for the buildings programme (about CHF 100 million) are used to subsidize renewable heating systems, use of waste heat, and optimisation of building technology. Federal funds are granted on condition that these are supplemented by cantonal contributions of at least equal size. In 2014, the largest contributions to CO_2 reduction under this programme track came from the installation of wood-based heating systems, including district heating. Other important elements were waste heat utilisation, heat pumps and solar collectors. Average cost per tonne of CO_2 reduced was CHF 54 (combined funds from the federal and the cantonal level). Since 2010, 7.5 million tonnes of CO_2 avoided are attributable to this programme (taking account of the entire lifespan of the measures, i.e. cumulative savings).

Beyond the national buildings refurbishment programme, several cantons provide financial support to measures such as promotion of photovoltaics and consulting of building owners. However, there is no systematic overarching evaluation of the quantitative effect of these measures on CO_2 emissions.

3.3.4 Building codes of the cantons

The cantons are responsible to decree any regulations in the building sector. Under the revised CO_2 Act they are required to define standards for the continuous reduction of CO_2 emissions in new and older buildings (Article 9).

In order to harmonize the building codes throughout Switzerland, the cantons, under the guidance of the Conference of Cantonal Energy Directors (EnDK), agreed on model ordinances (so-called MuKEn). Model ordinances were first established in 1992 and have been updated periodically since (i.e. in 2000, 2008, and 2014, see *MuKEn*, 2014).

According to a declaration of intent issued by the general assembly of EnDK members in 2011, cantons will by 2018 integrate the 2014 version of MuKEn into cantonal legislation in order to become effective by 2020 at the latest. Minimum requirements of this version are: New buildings must be autonomous with regard to their own demand on heat (and produce a reasonable share of their demand on electricity), the use of electricity for heating and warm water production is prohibited, the refurbishment of existing buildings, and the switch to renewables are to be promoted increasingly.

3.3.5 Negotiated commitments on energy efficiency

The Energy Act foresees financial contributions for the promotion of renewable energies. The contributions are financed by means of network surcharges and presently amount to CHF 0.015 per kWh at the most. Energy-intensive companies can be granted a full or partial refund of the network surcharges, provided they comply with certain conditions, inter alia, a commitment to enhancing energy efficiency in a target agreement with the federal government.

3.3.6 Obligation to offset emissions from gas-fired combined-cycle power plants

Currently, no fossil thermal power plants are in operation in Switzerland, and it is unclear whether there will be a need for such power plants to cover future electricity demand. Nevertheless, since 2008, fossil thermal power plants with a capacity larger 100 megawatt obtain planning permission only if their CO_2 emissions are fully compensated. Compared to the first CO_2 Act, the possibility to use the flexible mechanisms of the Kyoto Protocol to compensate for CO_2 emissions has been raised from 30 to 50% under the revised CO_2 Act, i.e. at least half of the compensation has to be achieved domestically.

3.3.7 Negotiated reduction commitment by MSWI operators

Greenhouse gas emissions from waste incineration plants have been increasing to 2.35 million tonnes CO_2eq (roughly 5% of the national total) by 2012, mainly due to the growth of the economy and the population. In the context of national climate mitigation commitments, operators of MSWI are expected to contribute their fair share to emission reduction efforts. In 2014, the DETEC concluded an agreement with the Swiss Association of MSWI. This agreement commits the association to establish a monitoring system and to reduce net CO_2 emissions by 200'000 tonnes by 2020, compared to 2010 levels. Since the potential for direct emission reductions at the incineration plants is limited, improvements in the efficiency of the use of the energy produced and avoided emissions through the recuperation of metals are taken into account (bottom ash of the MSWI containing on average about 10% scrap iron and significant amounts of non-iron metals such as aluminium, copper, brass etc.). Note, however, that the recuperation of metals may also lead to (indirect) reductions of greenhouse gas emissions outside Switzerland, i.e. the direct impact on Switzerland's total greenhouse gas emissions is difficult to estimate. Implementation of the agreement exempts MSWI operators from participation in the emissions trading system.

3.4 Transport

3.4.1 Overview and background information

Switzerland has developed an integrated strategy for transport, seeking better coordination between transport modes, spatial planning, and taking into account environmental and sustainability concerns. While several measures are designed to reduce specific energy consumption or address CO_2 emissions from the transport sector, 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.

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 by developing the Agglomeration Programme (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 December 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). At present, work is progressing on the New Rail Link through the Alps (NRLA). 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.

In the past, financing of the major rail infrastructure projects was secured on the basis of the temporary 'FinÖV', a public transport fund, which drew revenues from the heavy vehicle charges. As from 1 January 2016, subsequent to a popular vote in 2014, operation, maintenance and extension of rail infrastructure are financed through a single, open-ended 'Rail Infrastructure Fund' (Bahninfrastrukturfonds, BIF).

Funding for development and maintenance of road infrastructure is provided through the 'Infrastructure Fund for Agglomeration Transport, the National Road/Motorway Network and Major Roads in Mountain and Peripheral Regions', which was launched in 2007 and is running until 2027. Out of this fund, Switzerland runs an Agglomeration Programme aimed at providing financial resources (CHF 3.44 billion) for infrastructure projects that promote public and non-motorized transport in sub-urban regions and agglomerations.

The two-lane Gotthard road tunnel connecting Northern Switzerland to the Ticino and Italy was opened in 1980. After 35 years of operation it needs major refurbishment. The Federal Council and the Swiss Parliament have proposed to construct a second tunnel. This would allow for closing of the first tunnel during refurbishment works without lengthy interruption of this important traffic link. In addition, two tunnels would lead to safer operating conditions in the future.

A referendum vote on this proposal will be held in February 2016. The referendum is motivated by concerns that the two tunnels will be opened to four-lane traffic once refurbishment of the first tunnel is completed, leading to a conflict with the intention of Article 84 of the Federal Constitution (see section 3.4.6 below).

Tab. 15 gives an overview of the most climate relevant policies and measures in the transport sector, while the following subsections provide more details and background information on each policy and measure.

Tab. 15 > Summary of policies and measures in the transport sector.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (for a particular year, not cumulative, Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
CO_2 emission regulations for new passenger cars	Reduction of average fuel consumption/CO_2 emissions from new cars	CO_2	Regulatory	Implemented since 2012	SFOE, FEDRO	n.a.	n.a.	n.a.	n.a.	0.7	1.7[a]
Energy label for new motor vehicles	Raise visibility of cars with low average fuel consumption/CO_2 emissions	CO_2	Information, regulatory	Implemented since 2003	SFOE	n.a.	n.a.	n.e.	n.e.	i.e.	i.e.
Climate Cent	Compensation of transport emissions by use of Kyoto credits	CO_2, CH_4, N_2O	Voluntary agreement	Implemented 2005–2012, no longer in place	Climate Cent Foundation	n.a.	n.a.	n.a.	3.2[b]	n.a.	n.a.
	Compensation of transport emissions through funding of mitigation projects within Switzerland	Mostly CO_2	Voluntary agreement	Implemented 2005–2012, no longer in place	Climate Cent Foundation	n.a.	n.a.	n.a.	0.4[c]	n.a.[d]	n.a.[d]
Partial compensation of CO_2 emissions from transport fuel use	Domestic mitigation projects as compensatory measure (instead of a CO_2 levy on transport fuel emissions)	All Kyoto gases	Regulatory	Implemented since 2013	Foundation for Climate Protection and Carbon Offset, FOEN	n.a.	n.a.	n.a.	n.a.	0.3	1.5
Heavy vehicle charges	Reduction of transalpine road traffic, increase of transport rates on rail, limit increase in heavy vehicles on the road	CO_2	Fiscal	Implemented since 2001	ARE, FEDRO	n.a.	n.a.	0.11	0.13 – 0.18	0.13 – 0.19	0.15 – 0.20
Mineral oil tax reduction on biofuels and natural gas	Promotion of low carbon motor fuels	CO_2	Economic	Implemented since 2008	FCA in collaboration with FOEN and SECO	n.a.	n.a.	n.a.	0.10	0.10	0.10
Inclusion of aviation in the emissions trading scheme	Limit/offset CO_2 emissions from international aviation	CO_2	Regulatory, economic	Planned	FOCA, FOEN	n.a.	n.a.	n.a.	n.a.	n.a.	n.e.

[a] This estimate presupposes an average fuel consumption of new passenger cars of 95 grams of CO_2 per kilometre.

[b] Annual contribution of carbon credits acquired abroad through the Climate Cent Foundation during the second commitment period (total 2008–2012: 16 Mt CO_2eq).

[c] Annual domestic reductions achieved by the Climate Cent Foundation during the first commitment period (2008–2012, cumulative total: 2 Mt CO_2eq).

[d] The ongoing mitigation impact of Climate Cent Foundation projects after 2012 is contained in the subsequent measure 'Partial compensation of CO_2 emissions from transport fuel use'.

i.e., included elsewhere; n.a., not applicable; n.e., not estimated

3.4.2 CO_2 emission regulations for new passenger cars

Because a voluntary agreement signed in 2002 by the Association of Swiss Automobile Importers to reduce the specific fuel consumption of first-time registration cars was insufficient, the Swiss Parliament amended the CO_2 Act in 2011 to include CO_2 emission targets for newly registered vehicles. The prescriptions came into effect in July 2012 and are based on the European Union regulation. In the first phase, a fleet average of 130 grams of CO_2 per kilometre, as a target for 2015, is set. An intermediate target for 2014 was met at the level of the total car fleet but individual vehicle importers had to pay sanctions totalling CHF 1.7 million due to excess emissions of the individually specified target level. The Federal Council intends to follow the European Union regulation proposals for further decarbonising road traffic.

Targets of 95 grams of CO_2 per kilometre by 2020 for new passenger cars and of 147 grams by 2020 for light commercial vehicles are part of the first package of the Energy Strategy 2050 (see section 3.3.1) which is expected to enter into force in 2017 at the earliest.

3.4.3 Energy label for new motor vehicles

Since 2003, the compulsory energy label for newly sold cars informs customers at the point of sale about fuel consumption and specific CO_2 emissions. The label methodology uses a well-to-wheel perspective for the evaluation. Evaluation criteria are adapted at yearly intervals to follow technological development in the automotive sector. The energy label supports the efforts to lower average CO_2 emissions from newly registered vehicles (see section 3.4.2 above).

3.4.4 Climate Cent

For motor fuels, the Federal Council dispensed with the introduction of a CO_2 levy when implementing the first CO_2 Act. Instead, in 2005 it entered into a voluntary agreement with the Climate Cent Foundation, a private sector initiative. The agreement contained the obligation to make an annual contribution of 3.2 million tonnes of CO_2 through the purchase of foreign emission reduction certificates (CERs, ERUs) and 0.4 million tonnes of CO_2 through investments in domestic emission reduction projects, respectively, during the period 2008–2012. The so-called 'Climate Cent', setting a surcharge of CHF 0.015 per litre on transport fuels, was in effect from 2005 to 2012.

As from 2013, the Climate Cent was replaced by the legally binding obligation for importers of fossil motor fuels to compensate part of the emissions linked to fossil motor fuel use (section 3.4.5). Excess revenues amounting to CHF 150 million, collected by the Climate Cent Foundation until 2012, are to be used by the foundation for the acquisition of foreign emission reduction certificates. The respective credits will be handed over to the government to meet obligations under the international climate regime (for details regarding the agreement between the Climate Cent Foundation and the Swiss Confederation visit *www.klimarappen.ch*[2]).

3.4.5 Partial compensation of CO_2 emissions from transport fuel use

Based on the revised CO_2 Act, as of 2014, fossil fuel importers are bound to offset part (at most 40%) of the CO_2 emissions from transport fuel use through investments in domestic emission reduction projects. The offset is financed by a surcharge on imported fuels which shall not exceed CHF 0.05 per litre of fuel. The Federal Council determined the share of CO_2 emissions from transport fuels to be offset by fuel importers as follows: 2% in 2014–2015, 5% in 2016–2017, 8% in 2018–2019, and 10% in 2020.

The revenues and climate change abatement measures are managed by the follow-up organisation to the Climate Cent Foundation, the Foundation for Climate Protection and Carbon Offset (KliK). By the end of 2014, KliK was budgeting CHF 839 million for the compensation of a cumulative total of 9.28 million tonnes of CO_2 until 2020 (average of CHF 90 per tonne of CO_2) from projects, programmes and the purchase of eligible domestic carbon credits (*KliK*, 2015). The budget estimate corresponds to a surcharge of CHF 0.01–0.02 per litre of fossil transport fuel.

3.4.6 Heavy vehicle charges

Switzerland's freight transport policy is based on Article 84 of the Federal Constitution (as amended in 1994) which requires transalpine freight transport to shift from road to rail. This goal is to be reached by the so-called heavy vehicle charges, in combination with measures to improve competitiveness of international rail transport. The heavy vehicle charges are applied to passenger and freight transport vehicles of more than 3.5 tonnes gross weight. The charge level is calculated according to three criteria: (i) kilometres travelled on Swiss roads, (ii) vehicle specific maximum authorized gross weight, (iii) pollutants according to EURO classes. The heavy vehicle charges have been implemented in three stages between 2001 and 2008, accompanied by increases in the admissible maximum weight for trucks.

The fact that the level of the charge depends on the maximum weight and emission standards of the individual vehicle prompted a significant renewal of the truck fleet in the year before the heavy vehicle charges were introduced. Reduced

[2] Contract: *http://www.klimarappen.ch/resources/UVEK_Vertrag_Verlaengerung_bis_2020_EN.pdf*

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. According to model calculations, air quality has improved by 10% (particle emissions) and 14% (nitrogen oxides) respectively, and CO_2 emissions have decreased by 6% compared to the reference scenario (28 tonnes weight limit, no heavy vehicle charges).

3.4.7 Mineral oil tax reduction on biofuels and natural gas

The amendment of the Mineral Oil Tax Act of 1 July 2008 provides tax incentives for low carbon fuels. A tax reduction of CHF 0.4 per litre of petrol equivalent is granted for natural and liquefied petroleum gas (LPG). Complete tax exemption for biogas and other fuels from renewable sources is granted if certain criteria are met. In March 2014, the Swiss Parliament decided to tighten these criteria by amending the Mineral Oil Tax Act as well as the Environment Protection Act. The ecological criteria are: (i) a minimum of 40% greenhouse gas reduction based on life cycle analysis (LCA), (ii) a net environmental burden not significantly exceeding the one of fossil fuels, (iii) the cultivation of biofuels must not endanger biodiversity, in particular rainforests. Minimum requirements for socially acceptable production conditions are: social legislation applicable at the production location of raw materials and fuels is respected; at least the fundamental conventions of the International Labour Organization (ILO) are complied with; cultivation of biofuels has to be realized on legally acquired soils. Tax revenue losses are compensated by increasing tax rates on liquid fossil transport fuels. In contrast to other countries, Switzerland has no quotas for biofuels.

3.4.8 Inclusion of aviation in the emissions trading scheme

The revised CO_2 Act provides the basis to integrate aviation into Switzerland's emissions trading scheme. However, such an integration is only feasible if the Swiss system is linked to the European system (respective negotiations between the European Union and Switzerland are under way, see section 3.2.5).

3.4.9 Further relevant measures

This section provides a brief overview of measures with limited direct impact on greenhouse gas emission levels, measures that indirectly contribute to climate policy goals (e.g. by reducing precursor gas emissions), measures that have the potential to significantly contribute to greenhouse gas emission reduction in the future as well as measures focussing on non- greenhouse gas emissions that may have favourable side effects on climate change mitigation.

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, inter alia, 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. In recent years, compensation projects have been launched aiming at the enhanced use of biogas for transport purposes. However, the share of biogas as transport fuel is still limited.

Further measures to promote rail transport

The ongoing general refurbishment and extension of the rail network, including two new base tunnels (Lötschberg, St Gotthard) will increase capacity and shorten travel times. This will increase competitiveness of rail and thus support the shift from road to rail envisaged as part of Switzerland's transport policy.

To further increase productivity and competitiveness of rail transportation, Switzerland, in accordance with the relevant European Union directive, has been progressively implementing reforms (Railway Reform). This improves inter-operability and the quality of transnational transport. 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 Germany and Italy), Switzerland is subsidizing such services. Thanks to sustained support to truck-on-train transport, a further shift towards combined transport is expected. Total funding for the modal shift from road to rail amounts to more than CHF 1.6 billion from 2009 to 2018.

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

Further measures in the aviation sector

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 European Union and regularly adapts this agreement to new legislation entering into force in the European Union.

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 actively supporting work towards introduction of a new aircraft engine emission certification requirement and a subsequent standard for particulate matter. Switzerland is also advocating the development of a CO_2 standard for airplanes. For more detailed information, see Switzerland's Sixth National Communication under the UNFCCC, p.129f (*Swiss Confederation*, 2013).

Greenhouse gas emissions from marine bunker fuels

As a landlocked country, Switzerland operates only a small fleet of ships at the international level. Consequently, greenhouse gas emissions from marine bunker fuels are negligible in size (see Tab. 1) and only include emissions from fuel sold within the borders of Switzerland for international transport on the Lake Geneva, Lake Constance, and the Rhine. Due to these circumstances, Switzerland is not considering the promotion and/or implementation of decisions by the International Maritime Organization (IMO) a priority field of action.

Air pollution control measures at cantonal and communal level

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

Euro Emission standards

Switzerland is following the European path of reducing air pollutants (NO_x, non-methane hydrocarbons, total hydrocarbons, CO, and particulate matter) by introducing stricter Euro emission standards for new vehicles. With regard to reducing particulate matter 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 (on import taxes or, at the cantonal level, on yearly taxes) for purchasing new or retrofitting old engines.

Gothenburg Protocol

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 emissions of indirect greenhouse gases. The Gothenburg Protocol was revised in 2012. The revised version also addresses particulate matter (PM2.5) and black carbon. It contains national emission reduction commitments for sulphur dioxide, nitrogen oxides, ammonia, volatile organic compounds and particulate matter to be achieved by 2020. The Gothenburg Protocol may also be relevant outside the transport sector.

3.5 Industrial processes and product use

3.5.1 Overview

Most greenhouse gas reduction measures in the sector 'Industrial processes and product use' are implemented under the CO_2 Act and control CO_2 emissions from fossil fuel use. These measures are presented in the section on 'Cross-sectoral policies and measures' (section 3.2). The main instruments affecting greenhouse gas emissions from industry are (i) the CO_2 levy on fossil heating and process fuels (section 3.2.4), (ii) provisions related to participation in the emissions trading scheme (section 3.2.5), and (iii) provisions related to negotiated reduction commitments (section 3.2.6).

In contrast, in the CO_2 Act there are no emissions reduction measures for F-gases and greenhouse gas precursor gases such as (non-methane) volatile organic compounds (NMVOC). For these, policies have been developed on the basis of the Environmental Protection Act and specified in the context of the Ordinance on Chemical Risk Reduction as well as the Ordinance on Air Pollution Control. The respective measures are summarised in Tab. 16 and detailed in the following sections.

Tab. 16 > Summary of policies and measures in the industry sector.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (Mt CO_2eq) [a]			
						Year	HFCs	PFCs	SF_6
Provisions relating to substances stable in the atmosphere	Reduction in use and emissions of F-gases	All F-gases	Regulatory	Implemented since 2003	FOEN, cantons	1995	n.a.	n.a.	n.a.
						2000	n.a.	n.a.	n.a.
						2005	0	0	0.08
						2010	0.28	0.003	(0.23)
						2015	(0.50)	(0.01)	(0.30)
						2020	(0.65)	(0.02)	(0.38)
NMVOC incentive fee	Improvement of air quality due to reduced NMVOC emissions	NMVOC	Economic	Implemented since 2000	FOEN	n.e.			

[a] Values in brackets are subject to a high degree of uncertainty.
n.a., not applicable; n.e., not estimated

3.5.2 Provisions relating to substances stable in the atmosphere

The three main lines of action in the area of F-gases are: (i) to limit the use of these substances to those applications where there is no preferable alternative; (ii) when such substances are used, to reduce emissions as far as possible; (iii) where feasible, to engage in voluntary binding agreements with industry (as implemented in an agreement developed by the industry on SF_6 in high-voltage equipment and other sectors in 2002, revised in 2014).

Under the generic name of 'substances stable in the atmosphere', the Ordinance on Chemical Risk Reduction, in its Annex 1.5, provides for measures to control emissions of persistent substances with high Global Warming Potential (GWP) values (HFCs, PFCs, SF_6, NF_3, HFEs). Section 5 of Annex 1.5 states that containers and switchgear containing such substances must be labelled, inter alia, with the following text in at least two official languages: 'Contains fluorinated greenhouse gases covered by the Kyoto Protocol'.

Because emissions resulting from installations/systems working with refrigerants dominate total F-gas emissions, regulations most importantly aim at reducing emissions from such installations/systems. However, further regulations relating to substances stable in the atmosphere are in place:

Refrigerants

The regulatory system in force since December 2013 contains a partial ban – depending on cooling capacity and sector of use – on marketing of refrigeration, air conditioning and heat pump fixed installations operating with F-gases. To ensure the transparency and proportionality of the relatively complex system, several technical guidelines relating to the relevant technology and to the implementation of the various measures to improve confinement have been developed in collaboration with cantonal authorities and the sector concerned.

Compressed gas containers

In this area, emissions of F-gases (mainly HFCs) can only be limited by restrictions on use. Applications for which exemptions are inevitable are: 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. For other applications where these substances may be required, e.g. for safety reasons, the state of technology is changing rapidly, and it seems more appropriate to use the option of granting temporary exemptions based on individual technically justified requests. Furthermore, the Ordinance on Aerosol Dispensers (*Swiss Confederation*, 2005) prohibits the use of HFCs or PFCs in most spray cans. According to Annex 4 of this ordinance, in spray cans containing cosmetics and household products only the use of HFC-152a as a propellant is allowed.

Plastic foams

The measures currently implemented in Switzerland (restrictions on use, disposal by incineration and recycling) to limit emissions of F-gases from plastic foams on the one hand and the general tendency of this industry sector in Europe on the other hand, have led to the situation where foams without fluorinated gases account for practically the entire Swiss market. F-gases (mainly HFCs) may only be used in plastic insulating foams and under severe restraints: (i) if they offer significant advantages in thermal insulating efficiency in case of spatial constraints, (ii) where non-flammability is required, in agreement with the current state of technology. Rapidly advancing technology requires that the state of technology and application criteria need to be clarified in guidelines developed and updated in collaboration with the producers and professional users, as well as with the cantonal enforcement authorities.

Solvents containing PFC, HFC or HFE

Solvents 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 applicable to professional uses have been slightly modified so that they cover all regulated substances. Consequently, F-gases 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.

Extinguishing agents

Since 1996 the supply and import of extinguishing agents made of F-gases and of appliances or stationary equipment containing such agents are banned. However, temporary exemptions are granted in cases where no viable alternatives are available.

SF_6 in electrical distribution equipment

The use of SF_6 is only authorised in equipment that operates at more than 1 kV and is hermetically sealed or constantly monitored. This is governed by a voluntary agreement established in 2013 by the high-voltage industry[3]. The level and the volume of annual emissions are limited to 1% of the total amount used and 4 tonnes at the most (until 2012, limit is decreasing to 3.6 tonnes in 2020), and recovery of SF_6 from decommissioned equipment must be guaranteed.

Other application sectors

The use of PFCs and SF_6 in tyres, insulating windows and sport shoes is banned since 2003. SF_6 as protecting gas 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 I of the Ordinance on Lists Regarding the Movement of Toxic Waste, waste containing HFCs counts as special waste. Thus, the movement of such waste is controlled, and it must be treated by licensed enterprises in an environmentally sound manner.

[3] *http://www.bafu.admin.ch/klima/13877/14510/14756/index.html?lang=de*

3.5.3 NMVOC incentive fee

Non-methane volatile organic compounds (NMVOCs) are used as solvents in numerous industries, and are contained in many products such as paints, varnishes and various cleaning solutions. If these compounds become airborne, they and nitric oxides contribute to the excessive formation of ground-level ozone (summer smog). Further, NMVOC are indirect greenhouse gases and, finally, also increase the radiative forcing. The NMVOC incentive fee has been levied since 1 January 2000. As a market-based instrument in the field of environmental protection, it creates a financial incentive to further reduce NMVOC emissions.

3.6 Agriculture

3.6.1 Overview and general context

Article 104 of the Federal Constitution forms the basis for agricultural policy in Switzerland. It mentions sustainability as one of the principles guiding production policy. The new Agriculture Act, which came into force in 1999, provides a framework for sustainable development in the agricultural sector. In its Article 2, as amended in 2007, it stipulates that the Confederation shall, inter alia, take measures to promote the sustainable use of natural resources and animal and climate friendly production.

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

With the revision of Switzerland's 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 restrictions on import 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 by 80%.

Tab. 17 > Summary of policies and measures in the agricultural sector.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact ((for a particular year, not cumulative, Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
Proof of ecological performance	Incentives related to ecological goals	CH_4, N_2O, CO_2	Economic	Implemented since the early 1990s	FOAG	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Resource programme	Promotion of efficient use of natural resources	CH_4, N_2O, CO_2	Economic	Implemented since 2008	FOAG	n.a.	n.a.	n.a.	n.e.	n.e.	n.e.
Agricultural policy 2014–2017	Modifications in direct payments system	CH_4, N_2O, CO_2	Economic	Implemented since 2014	FOAG	n.a.	n.a.	n.a.	n.a.	n.e.	n.e.
Climate strategy for agriculture	Long-term mitigation and adaptation in the sector	CH_4, N_2O, CO_2	Information, research	Implemented since 2011	FOAG	n.a.	n.a.	n.a.	n.a.	n.e.	n.e.

n.e., not estimated; n.a., not applicable

Tab. 17 gives an overview of the most climate relevant policies and measures in the agricultural sector, while the following subsections provide more details and background information on each policy and measure. No estimate of mitigation impact is presented since measures are strongly interrelated, their main focus is not on climate policy goals and their impact is evaluated by other indicators than greenhouse gas emissions.

3.6.2 Proof of ecological performance

Direct payments are tied to ecological standards, i.e. farmers are eligible for payments only if they fulfil the so called proof of ecological performance. This is the case when the nutrient balance is maintained, a suitable proportion of farm-

land 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.

3.6.3 Resource programme

On the basis of an amendment to the Agriculture Act, in 2008, a new instrument called resource programme was introduced. Through this programme, the Confederation is subsidizing measures for the more efficient use of natural resources in the agricultural sector. Target areas are resources such as nitrogen, phosphorous and energy, protection and sustainable use of soils, and biodiversity. To qualify for subsidies, measures must go beyond legal requirements or the criteria for other funding programmes. Support is given to measures that need financial support in an introductory phase, but that will run without further payments afterwards. Therefore payments are restricted to 6 years. Up to date, 21 out of 26 cantons are implementing this programme. However, the participation of the farms is generally lower than expected. The current programmes focus mainly on ammonia emission reduction and some deal with soil fertility improvement.

3.6.4 Agricultural policy 2014–2017

In 2013 the Swiss Parliament adopted the present, quadrennial programme for agriculture, the agricultural policy 2014–2017 (AP 2014–2017). The key element of this policy is the further development of the direct payments system. Measures with unspecified aims are replaced by specific tools. Subsidies for livestock are converted to subsidies for ensuring food security, dependent on land use. The funds freed by the abolishment of the general acreage subsidy are used, inter alia, for new direct payment types for environmental-friendly production systems and for the efficient use of resources.

The legal framework of AP 2014–2017 has been designed in a way that enables the promotion of a climate-friendly agriculture. In particular, it allows supporting projects with the goal to improve mitigation or adaptation to climate change. There is no target concerning climate mitigation within AP 2014–2017. However, 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 agricultural greenhouse gas emissions in a positive way. At the same time, the greenhouse gas balance per unit of nutritional energy should improve markedly.

3.6.5 Climate strategy for agriculture

In parallel to the development of the general agricultural policy framework, the Federal Office for Agriculture (FOAG), in 2011, published its climate strategy (*FOAG*, 2011). This strategy is a declaration of intent, guiding 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. 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.

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: (i) emissions by the agricultural sector are to be reduced by at least one-third by 2050 (compared to 1990 levels) through technical and organizational measures, (ii) further reductions are aspired by influencing consumption patterns as well as production structures. These targets are based on the commitment of the international community to prevent an increase in global temperatures of more than 2° C above pre-industrial levels.

Implementing activities in the context of the climate strategy include tools to support farmers and other related stakeholders in the fields of renewable energy, energy efficiency and climate change mitigation. Agricultural research is intensified and different options for the reduction of greenhouse gases are being tested on-farm or on a small regional scale with a view to integrating proven practices into mainstream agricultural policy.

3.7 Land use, land-use change and forestry

3.7.1 Overview

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

Due to the present age structure, large fractions of the Swiss forest are mature for harvesting. Consequently, the levels of harvesting should rise in the near future. On one hand, this contributes to avoiding episodic large quantities of greenhouse gas emissions originating from decay, should the excessive accumulation 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.

Switzerland's forest policy's climate related goal is to adapt forests by increasing resilience to climate change and, taking into account the high growing stock, to reduce CO_2 emissions by substituting for other materials or fossil fuels rather than enhancing sink capacity. The highest possible substitution effect can be achieved through the principle of cascaded use of wood. With the planned step-by-step phasing out of nuclear energy as part of Switzerland's Energy Strategy 2050 (see section 3.3.1), renewable energy sources will play a central role. This is likely to lead to a more intensive use of energy wood and an increase in timber harvesting.

Tab. 18 gives an overview of the most climate relevant policies and measures regarding land use, land-use change and forestry, while the following subsections provide more details and background information on each policy and measure. An estimate of mitigation impact is presented to the extent measures have a main focus on climate policy goals.

Tab. 18 > Summary of policies and measures regarding land use, land-use change and forestry sector.

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (for a particular year, not cumulative, Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
Sustainable forest management and forest area conservation	Limiting harvest to size of growth increment in forests, obligation to compensate for any deforestation	CO_2	Regulatory	First implemented in 1876, main revisions/ extensions in 1902 and 1993	FOEN, cantons	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Measures within Forest Policy 2020	Promote the use of wood and the substitution of carbon intensive resources	CO_2	Information	Implemented since 2011	FOEN, cantons	n.a.	n.a.	n.a.	n.a.	0.80	1.20
Wood Action Plan	Ecologically and economically effective use of wood	CO_2	Information, education, research	Implemented (2009–2012/2012–2016)	FOEN	n.a.	n.a.	n.a.	n.e.[a]	i.e.[a]	i.e.[a]

[a] The respective effects are included under 'Measures within Forest Policy 2020'. Reductions result from substitution of other materials or fossil fuels (and thus impact emissions outside the sector 'LULUCF'). While these indirect reductions are not included in the modelling of emissions (see e.g. section 4.4.4), the figures here do not reflect the corresponding reduction of carbon storage by the forest.
n.e., not estimated; n.a., not applicable; i.e., included elsewhere

3.7.2 Sustainable forest management and forest area conservation

The Forest Act, as revised in 1993, reaffirms the long-standing Swiss tradition of preserving both forest area and forests as natural ecosystems. It prescribes sustainable forest management, prohibits clear-cutting, and bans deforestation unless it is replaced by an equal area of afforested land or an equivalent measure to improve biodiversity. At an average increment of 10.0 million m^3 per year, 1.5 million m^3 remain unlogged annually (values for NFI 3-4b; period 2006–2013) – mainly in forests that are difficult to access and in forest reserves. The federal authorities would like to increase Switzerland's annual wood harvest since the forests' potential for supplying domestic construction and energy wood is

not being exploited to the full. Specific measures aiming, inter alia, at the better exploitation of the existing potential of wood as a renewable resource are described in the sections below.

3.7.3 Measures within Forest Policy 2020

The Forest Policy 2020, which was approved by the Federal Council in 2011, ensures sustainable forest management while creating favourable conditions for an efficient and innovative forestry and wood industry. The policy sets out eleven strategic objectives. It identifies five objectives that pose the greatest challenges: (i) exploiting the potential sustainable wood supply, (ii) contributing to mitigation of, and enhancing resilience to, climate change, (iii) maintaining the protective forest services, (iv) increasing biodiversity by conserving forests as near-natural ecosystems, (v) conservation of the forest area in its spatial distribution. The policy contains a comprehensive set of strategic directions, measures, indicators and target values that go with every objective. Under the Forest Policy 2020, the consumption of sawn timber and timber products should be increased by 20% by 2020 compared to 2006 levels. At the same time, the substitution effect through enhanced use of wood should be increased by 1.2 million tonnes CO_2 per year by 2020 compared to 1990. In the long term, a sustainable equilibrium between forest sink, wood use and wood substitution effects is sought.

3.7.4 Wood Action Plan

Besides the Forest Policy 2020, the Federal Office for the Environment (FOEN) has drawn up a wood resource policy (*FOEN*, 2008, updated in *FOEN/SFOE/SECO*, 2014) which is coordinated with the other relevant sectoral policies (e.g. energy policy, regional development policy). The wood resource policy and the associated wood action plan constitute a direct contribution to the implementation of the Forest Policy 2020, as they aim at exhausting the sustainably harvestable wood potential. The purpose of the wood resource policy is to make the Swiss wood value-added chain internationally competitive in an environmentally friendly manner. Focal areas of the Wood Action Plan comprise state-of-the-art wood burning technologies (reduced pollution) and greater overall efficiency in the chain from harvesting to final consumption. With a view to improving efficiency of wood use, cascade use (first as construction timber, then as chipboard, and only at the end for energy purposes) is prioritized. Between 2009 and 2012, more than 100 projects were supported as part of the first phase of the programme. Upon evaluation of the first phase, the wood resource policy has been updated and the wood action plan extended until 2016.

3.8 Waste

3.8.1 Overview

The disposal of waste is regulated by the Technical Ordinance on Waste (*Swiss Confederation*, 1990). This ordinance is currently being completely revised to take the developments of the last 25 years into account. The revision aims in particular at the sustainable use of renewable and non-renewable raw materials, inter alia by promoting closed-loop material flows. At the same time, the reduction of environmental pollution by means of separation and appropriate treatment of hazardous substances and proper disposal of all kinds of waste is to be improved. The reliability of the waste removal system as a whole is to be strengthened by ensuring adequate structures for collection, transport and treatment of the different types of waste. The revised ordinance will enter into force on 1 January 2016 (under the new name ‘Verordnung über die Vermeidung und die Entsorgung von Abfällen’).

In general, waste disposal in Switzerland is financed on the basis of the polluter-pays principle. In 2011, around 80% of the Swiss population financed their waste disposal entirely or in part through volume-based charges, and the remaining 20% financed it through taxation or payment of a flat fee. As a matter of principle, Swiss waste should undergo material recycling or thermal treatment. If this is technically not possible or economically not viable, the waste is deposited in a landfill following suitable treatment. No untreated municipal solid waste may be deposited in landfills since 2000; the capacity of the waste incineration plants was increased accordingly.

The main strategy to reduce emissions from waste incineration is to increase the recycling quantities. Well-developed recycling services exist for many types of waste. 51% of the total volume of municipal solid waste was collected separately and recycled in 2013. The corresponding figure for 2000 was 45%. Recycling rates are particularly high (> 90%) for glass, aluminium cans, and waste paper.

Regarding waste management, one relevant measure is presented in Tab. 19 and detailed in the following subsection. Furthermore, due to its high relevance for energy-related emissions, a reduction commitment of MSWI operators is presented in detail in the sector 'Energy' (section 3.3.7).

Tab. 19 > Summary of policies and measures regarding waste management. Note: the negotiated reduction commitment by MSWI operators is presented in the sector 'Energy' (section 3.3.7).

Name of policy or measure	Objective and/or activity affected	Greenhouse gas affected	Type of instrument	Status	Implementing entity	Estimate of mitigation impact (for a particular year, not cumulative, Mt CO_2eq)					
						1995	2000	2005	2010	2015	2020
Ban on landfilling of combustible waste	Avoid landfill emissions, use waste as an energy source	CH_4	Regulatory	Implemented since 2000	FOEN	n.a.	0.0[a]	0.1[a]	0.2[a]	0.2[a]	0.2[a]

[a] The mitigation impact results from avoided CH_4 emissions due to the ban on landfilling of combustible waste. Additional emissions of CO_2 resulting from MSWI are not considered.

n.a., not applicable

3.8.2 Ban on landfilling of combustible waste

Since 2000, disposal of combustible municipal solid wastes on landfills is banned. All Swiss waste incineration plants use the combustion heat they produce to generate electricity or to supply district heating networks and industrial facilities. Today they cover around 2% of Switzerland's energy consumption. As a consequence of the ban on landfilling, methane emissions from landfill sites have declined substantially.

3.9 Measures affecting longer-term trends in anthropogenic greenhouse gas emissions

The measures described in the sections above generally have the potential to modify longer-term trends in anthropogenic greenhouse gas emissions and removals. In line with Convention objectives, they aim at promoting efficiency in the energy, transport and waste sectors, give preference to the sustainable use of renewable resources in agriculture and forestry and set incentives for the use of climate-friendly substances in the industry sector. Emission trends will be further influenced by measures where no immediate effect on greenhouse gas emission levels is expected but where longer-term contributions to a low-emission economy and society are expected. Examples of particular interest are:

- Cleantech Masterplan (starting in 2011): In 2011, the federal government published the Cleantech Master Plan for Switzerland (*OPET*, 2011). This strategy aims at improving resource efficiency and promoting renewable energies. It encourages cooperation among companies, research centres, cantons and the State. Under its heading, promotional programmes for research and innovation, knowledge and technology transfer, education and advanced training, and export promotion are topics receiving particular attention.
- Technology fund (starting in 2013): In the context of the revised CO_2 Act, a technology fund is established and financed with CHF 25 million per 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.
- Information, training and advisory services (starting in 2013): The CO_2 Act requests the Confederation and the cantons to support measures for the integration of climate change relevant elements in communication, education and professional training programmes at all levels. This includes improving knowledge about mitigation of greenhouse gas emissions and adaptation to climate change.

3.10 Policies and measures no longer in place, changes in the presentation of policies and measures

The climate policy measures 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 targets. Most measures listed in Switzerland's Sixth National Communication are still part of the national portfolio. However, BR CTF Table 3 has been updated to better reflect the nature, status and practical relevance of certain measures.

Two measures are no longer in place: The first CO_2 Act of 1999 has been superseded by the revised CO_2 Act of 2011 (sections 3.2.2 and 3.2.3) and the Climate Cent was replaced by the measure 'Partial compensation of CO_2 emissions from transport fuel use' (sections 3.4.4 and 3.4.5).

Several measures are still in place but no longer listed in the measures tables, due to their nature (legal or strategic frameworks mentioned in the sectoral introductory paragraphs, from which more specific measures emanate) or due to their rather weak link to the achievement of mitigation commitments (measures mainly impacting on precursors gases). These measures are briefly described in textual form at an appropriate place in chapter 3. In the course of these rearrangements, measure names have been harmonized throughout the report to improve clarity. Tab. 20 gives an overview of changes due to this editorial revision.

Tab. 20 > Policies and measures renamed since the last report.

Name of policy or measure in Switzerland's Sixth National Communication and First Biennial Report	Name of policy or measure in Switzerland's Second Biennial Report
CO_2 levy	CO_2 levy on heating and process fuels
Voluntary agreements with trade & industry/Exemption from CO_2 levy without participation in the emissions trading scheme	Negotiated reduction commitments (for exemption from the CO_2 levy)
Obligation for compensation for transport fossil fuel importers	Partial compensation of CO_2 emissions from transport fuel use
Heavy vehicle fee (HVF)	Heavy vehicle charges
Ordinance in Chemical Risk Reduction	Provisions relating to substances stable in the atmosphere
Modifications in direct payments system (AP14–17)	Agricultural policy 2014–2017
MSWI-Climate-Charta [Waste sector]	Negotiated reduction commitment by MSWI operators [Energy sector]
Technical Ordinance on Waste (TOW)	Ban on landfilling of combustible waste

3.11 Policies and measures leading to an increase in greenhouse gas emissions

No changes have occurred compared with the information reported in Switzerland's Sixth National Communication (*Swiss Confederation*, 2013).

3.12 Minimizing adverse effects

Supplementary information under Article 7, paragraph 1 of the Kyoto Protocol, as requested by the guidelines for the preparation of information under Article 7 of the Kyoto Protocol (FCCC/CP/2001/12/Add.3, Annex) is provided on an annual basis in Switzerland's National Inventory Report (*FOEN*, 2015) and made publicly available at the website *www.climatereporting.ch*. Information on minimization of adverse impacts in accordance with Article 3, paragraph 14 of the Kyoto Protocol can be found in chapter 14 of Switzerland's National Inventory Report. This chapter also includes information on Switzerland's approach to minimizing adverse effects of climate change, effects on international trade, and social, environmental and economic impacts on other Parties. Thus, reporting obligations under Article 7, paragraph 2 of the Kyoto Protocol are covered by chapter 14 of Switzerland's National Inventory Report as well. In line with paragraph 24 of the above mentioned guidelines, Switzerland refrains from providing information on these items that is already provided elsewhere.

3.13 Monitoring and evaluation of policies and measures

Article 40 of the revised CO_2 Act obliges the Federal Council to periodically evaluate the effectiveness of the policies and measures required by this 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 have to be reported to the Federal Assembly. However, the periodicity of these evaluations is not further specified. First evaluations of the individual instruments and policies referred to in the revised CO_2 Act have been initiated by FOEN during 2015.

CO_2 levy on thermal fuels

The CO_2 levy on thermal fuels is an essential element contributing to the achievement of Swiss climate policy objectives. In the context of the CO_2 Ordinance (Article 94), the Federal Council has defined intermediate reduction targets for the years 2012, 2014, and 2016 (see also section 3.2.4). If these targets are not met, the CO_2 levy on thermal fuels is increased automatically to the levels set in the Ordinance. The decision for an increase of the levy is taken on the basis

of the national CO_2 statistics which, in turn, rely on the annual official national energy statistics published by the Swiss Federal Office of Energy (SFOE). As the consumption of thermal fuels strongly depends on temperature and solar radiation during the winter season, the corresponding CO_2 emissions are normalized regarding weather conditions before confrontation with the thresholds for the CO_2 levy. However, with regard to the achievement of internationally agreed reduction commitments, emissions are not corrected for weather conditions.

Given that the CO_2 Act envisages numerous (and mutually reinforcing) instruments, interdependencies between these instruments are unavoidable. Sorting out the impacts of the individual policies and their contributions to the observed reductions is very difficult, especially for instruments that have an impact in more than one sector. An example in this context is the CO_2 levy, where it is impossible to determine the exact amount of emissions that have been reduced as a consequence of the levy. With respect to the CO_2 levy, the FOEN has undertaken an evaluation during 2015. The report will be published in 2016.

Emission regulations for motor vehicles

With respect to the effect of emission regulations for motor vehicles, the FOEN has initiated a research project whose goal is to develop an empirical model for estimating 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. Article 37 of the CO_2 Ordinance requests that the DETEC reports to the competent commissions of the Council of States and the National Council on the effectiveness of the emission regulations every three years, starting in 2016.

Compensation of motor fuel emissions

As provided by chapter 7 of the CO_2 Ordinance, fossil fuel importers are bound to offset part of the CO_2 emissions from transport fuel sold in Switzerland. The percentage to be compensated is raised in line with a predefined schedule (see also section 3.4.5). Article 26 of the CO_2 Act gives the Federal Council the competence to raise the compensation rate up to 40% after consulting the sector, should reaching the national reduction target set by the Swiss Parliament be in question.

Sectoral interim targets

In its Article 3, the CO_2 Ordinance stipulates sectoral interim targets for 2015 for three sectors:

- Building sector: no more than 78% of 1990 emissions.
- Transport sector: no more than 100% of 1990 emissions.
- Industry sector: no more than 93% of 1990 emissions.

As soon as data for 2015 are available, FOEN will perform an analysis of achievement of these targets. If a sector-specific interim target is not achieved, the CO_2 Ordinance obliges the DETEC, after hearing the cantons and affected parties, to request the Federal Council for additional measures.

Other monitoring processes

Several other measures require regular reporting of emissions or of compliance with specific commitments. They are therefore closely monitored on a regular basis. This is illustrated by the following examples:

- Firms participating in the emissions trading scheme and firms with an individual (negotiated) 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.
- Operators of fossil thermal power plants and importers/producers of fossil motor fuels are obliged to compensate their emissions. The emission reductions resulting from the projects undertaken for compensation have to be reported on a regular basis.
- Cantons have to report on measures implemented within the buildings refurbishment programme (section 3.3.3) as well as on the development of corresponding CO_2 emissions from buildings. They are obliged to agree on a standardized method for the measurement of the CO_2 emissions from buildings until 2018 the latest.

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

The national CO_2 statistics as well as the annual greenhouse gas inventories submitted to the UNFCCC are the basic tools to assess the overall effect of measures implemented at the national level. They serve to verify whether Switzerland is on track to meet its emission reduction objectives. The most recent available data are regularly published at the FOEN website (*http://www.bafu.admin.ch/Greenhouse-gases*). Details relevant under UNFCCC biennial reporting guidelines are provided in the respective BR CTF tables.

Emission trends and LULUCF sector contribution

Tab. 21 gives an overview of recent trends in total greenhouse gas emissions. A comprehensive overview of emission trends is presented in BR CTF Table 1. Further information can be found in section 1.1.3.

Analysis at the sectoral level (*FOEN*, 2015b) indicates that, in spite of continuous population growth, emissions in the building sector have significantly declined since 1990. On the other hand, strong growth in mobility (strongly coupled to the increase in population) about counterbalances the improving efficiency of the vehicle fleet (Fig. 6). Thus, for the transport sector domestic compensation projects will play an important role in achieving national reduction targets.

Tab. 21 > Summary of gross and net greenhouse gas emissions of Switzerland in the base year (1990) and from 2010–2013.

	Total emissions excluding LULUCF	Contribution from LULUCF
	Mt CO_2eq	
1990 (base year)	53.3	-3.0
2010	54.3	-2.0
2011	50.2	-2.7
2012	51.6	-1.7
2013	52.6	-1.0

FOEN (2015)

Use of units from market-based mechanisms

The use of market-based mechanisms by Switzerland is described in section 2.2.4. Switzerland will account for contributions from the market-based mechanisms at the end of the second commitment period. Thus, no annual numbers are available (see also BR CTF Table 4(b)). As documented in the sections 3.4.4 and 3.4.5, two foundations are mandated with the acquisition of emission reduction certificates through domestic and foreign projects. For the period up to 2020, these foundations dispose of roughly one billion Swiss francs which are collected through a surcharge on fossil transport fuels.

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4 Projections and the total effect of measures

4.1 Introduction

Based on the recommendations raised during the review of Switzerland's Sixth National Communication and First Biennial Report, efforts have been made to develop scenarios with a bifurcation point as early as 1990. Regarding the respective revisions of scenarios for the sector 'Energy', an external study – applying a computable general equilibrium model – has been launched (*EPFL and Infras*, in preparation). Final results are planned for publication in the course of 2016. Therefore, the same scenarios as presented in Switzerland's Sixth National Communication and First Biennial Report are currently used for the sector 'Energy'. In contrast, updated results for the sectors 'Waste' and 'Agriculture' as well as for the emissions of F-gases are presented in the report at hand.

In this chapter emission projections under the following three scenarios are considered:

- 'With existing measures' (WEM) scenario, where currently implemented and adopted measures are encompassed. The WEM scenario thus reflects the current state of legislation.
- 'With additional measures' (WAM) scenario, where implemented, adopted and planned measures are encompassed. The WAM scenario thus reflects the long-term target scenarios of the federal government, taking into account the strengthening of existing policies and measures as well as new policies and measures that have not yet been put in concrete terms but are planned in order to reach the set targets.
- 'Without measures' (WOM) scenario, where all implemented, adopted and planned measures are excluded to the extent possible. However, under the WOM scenario autonomous diffusion of technological advances takes place, leading to a slow gradual improvement of energy efficiency. Furthermore, for the sector 'Energy', many measures are not completely excluded under the WOM scenario, but continued after 2010 as before without any strengthening (see Switzerland's Sixth National Communication and First Biennial Report as well as *Prognos* [2012] for details).

Tab. 22 gives an overview of the measures considered under the different scenarios and details about each measure may be found in chapter 3 'Policies and measures'. General key variables are presented in section 4.1.1. Section 4.2 presents the main results, i.e. Switzerland's total emissions projected under the WEM, WAM and WOM scenarios from 1990 to 2030, disaggregated by gas and by sector. In section 4.3, the resulting total effect of measures is discussed. Finally, information about the methodology applied as well as about underlying assumptions specific to each sector are presented in section 4.4.1 for the sector 'Energy and transport', in section 4.4.2 for the sector 'Industrial processes and product use', in section 4.4.3 for the sector 'Agriculture', in section 4.4.4 for the sector 'LULUCF', and in section 4.4.5 for the sector 'Waste'.

Tab. 22 > Measures considered under the WEM, WAM and WOM scenarios (● = measure considered under the respective scenario). The bifurcation points, which are not necessarily the same for the different sectors, are shown in Tab. 25. The WEM and WAM scenarios are driven by the same policies and measures (i.e. there are no new policies and measures under the WAM scenario), but measures may be strengthened under the WAM scenario compared to the WEM scenario. Under the WOM scenario, many measures are not completely excluded, but rather continued after 2010 as before without any strengthening (see Switzerland's Sixth National Communication and First Biennial Report as well as *Prognos* [2012]).

Measure	Section in chapter 3	Sector	WEM	WAM	WOM	Remark
First CO_2 Act (1999)	3.2.2	Cross-sectoral	●	●	(●)	
Revised CO_2 Act (2011)	3.2.3	Cross-sectoral	●	●	(●)	
CO_2 levy on heating and process fuels	3.2.4	Cross-sectoral	●	●	(●)	
Emissions trading scheme	3.2.5	Cross-sectoral	●	●	(●)	
Negotiated reduction commitments	3.2.6	Cross-sectoral	●	●	(●)	
SwissEnergy programme	3.3.2	Energy	●	●	(●)	
National buildings refurbishment programme	3.3.3	Energy	●	●	(●)	Part A
National buildings refurbishment programme	3.3.3	Energy	●	●	(●)	Part B
Building codes of the cantons	3.3.4	Energy	●	●	(●)	
Negotiated commitments on energy efficiency	3.3.5	Energy	●	●	(●)	
Obligation to offset emissions from gas-fired combined-cycle power plants	3.3.6	Energy	●	●		

Negotiated reduction commitment by MSWI operators	3.3.7	Energy				
CO_2 emission regulations for new passenger cars	3.4.2	Transport	●	●	(●)	
Energy label for new motor vehicles	3.4.3	Transport	●	●	(●)	
Climate Cent	3.4.4	Transport	●	●	(●)	
Partial compensation of CO_2 emissions from transport fuel use	3.4.5	Transport	●	●	(●)	WOM: Rather a continuation of Climate Cent
Heavy vehicle charges	3.4.6	Transport	●	●	(●)	
Mineral oil tax reduction on biofuels and natural gas	3.4.7	Transport	●	●	(●)	
Inclusion of aviation in the emissions trading scheme	3.4.8	Transport				
Provisions relating to substances stable in the atmosphere	3.5.2	IPPU[a]	●	●		
NMVOC incentive fee	3.5.3	IPPU[a]				
Proof of ecological performance	3.6.2	Agriculture	●	●		
Resource programme	3.6.3	Agriculture	●	●		
Agricultural policy 2014–2017	3.6.4	Agriculture	●	●		
Climate strategy for agriculture	3.6.5	LULUCF	●	●		
Sustainable forest management and forest area conservation	3.7.2	LULUCF	●	●		
Measures within Forest Policy 2020	3.7.3	LULUCF	●	●		
Wood Action Plan	3.7.4	LULUCF	●	●		
Ban on landfilling of combustible waste	3.8.2	Waste	●	●		

[a] IPPU, sector 'Industrial processes and product use'

4.1.1 Key variables

To provide a general overview of underlying drivers, Tab. 23 shows key variables and assumptions used for the modelling of the various emission scenarios. Population is assumed to increase considerably. This is also reflected in energy reference area and transport growth. GDP, another parameter influencing energy consumption and greenhouse gas emissions, is also assumed to increase considerably over the coming decades. The stronger policy intervention, in particular under the WAM scenario, is reflected in some key variables, e.g. the international energy prices as well as in the demand on transport and its modal split (road/rail).

Tab. 23 > Key variables used for modelling energy consumption in Switzerland. Unless stated otherwise, the assumptions are identical for all scenarios.

Key variable	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)	464.22	495.38	547	584.2	617.91	645.6	670.5
Oil price (prices 2010, CHF/barrel)	57.8	69.2	79.3	93.7	98.3	101.3	101.7
... WAM scenario	57.8	69.2	79.3	91.1	89.4	86.8	83.2
Gas price (prices 2010, CHF/tonne)	231	339	321	518	561	598	627
... WAM scenario	231	339	321	505	512	517	525
Heating degree days	3081	3518	3586	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)	100.1	106	114.2	122.9	131.1	137.3	141.1
... WAM scenario	100.1	106	114.2	121.4	126.6	130.5	134.8
Passenger transport road/rail split (%)	85/15	84/16	82/18	81/19	80/20		79/21
... WAM scenario	85/15	84/16	82/18	81/19	77/23		73/27
Freight transport (billion tonne km)	23.6	26	26.9	30.4	34.2	37	39.1
… WAM scenario	23.6	26	26.9	30.7	34.5	37	38.7
Freight transport road/rail split (%)	58/42	61/39	63/37	61/39	58/42	57/43	56/44
... WAM scenario	58/42	61/39	63/37	59/41	54/46	51/49	49/51

Prognos (2012)

4.2 Projected emissions

In this section, the projections of Switzerland's greenhouse gas emissions under the WEM, WAM and WOM scenarios are presented. In the general overview in Tab. 24 the scenarios are detailed by sector and gas. Also provided are emissions from international transport, which are, however, not included in the total. Fig. 14 shows the evolution of total emissions under the WEM, WAM and WOM scenarios, while the various panels in Fig. 15 and Fig. 16 present the disaggregation by sector and gas, respectively. To provide more details for the sector 'Energy', the evolutions of the different source categories (1A1, 1A2, 1A3, 1A4, 1A5, and 1B) under the WEM, WAM and WOM scenarios are shown in Fig. 17. However, these scenarios are currently reconsidered using a computable general equilibrium model and the new results are planned for publication in the course of 2016 (*EPFL and Infras*, in preparation).

In brief, the three scenarios are characterised as follows:

- **With existing measures (WEM) scenario:** By 2020, Switzerland's total greenhouse gas emissions under the WEM scenario (including domestic compensation) are projected to decrease to approximately 15% below the emissions in 1990. The national target as set in the revised CO_2 Act would request a reduction of 20% below the emissions in 1990 (section 2.2). However, the WEM scenario depends on various assumptions regarding driving variables, and uncertainties are considerable. While the source category covering residential and commercial/institutional buildings (1A4) dominated total emissions in 1990, its emissions gradually decreased and are projected to continue on a decreasing pathway, reaching a reduction of 27% by 2020 compared to 1990 (Fig. 18). Emissions from transport (1A3), on the other hand, increased considerably (by 14%) between 1990 and 2008, exceeding emissions from residential and commercial/institutional buildings by 2007. Emissions are largely driven by passenger cars. Only recently, efforts to reduce specific vehicle emissions seem to bear fruit. However, with the emission regulations for new passenger cars stipulated in the revised CO_2 Act (section 3.4.2) as well as autonomous technical progress, 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%). In comparison with 1990, emissions in 2020 are approximately 9% lower. Emission reductions from the source categories covering residential and commercial/institutional buildings (1A4) as well as transport (1A3) dominate the projected evolution of total greenhouse gas emissions under the WEM scenario. Emissions from other source categories remain about stable or are of minor importance, with the exception of the emissions of F-gases, which are expected to decrease after about 2015.
- **Without measures (WOM) scenario:** Under the WOM scenario, the measures excluded before 2010, i.e. in particular the ban on landfilling of combustible waste (section 3.8.2) and the provisions relating to substances stable in the atmosphere (section 3.5.2), either have a small influence on total emissions or show their effect in the near future. Measures relevant in the sector 'Energy' are excluded from the WOM scenario as of 2010 only (see Tab. 25). Therefore, the difference between the WOM and the WEM scenarios increases considerably from about 2010–2015 onwards. Emissions under the WOM scenario slowly decrease according to 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 (see Switzerland's Sixth National Communication and First Biennial Report for more details). Emissions under the WOM scenario reach values of 4% and 9% below the emissions in 1990 by 2020 and 2030, respectively. The source categories covering residential and commercial/institutional buildings (1A4) and transport (1A3) are mainly responsible for the general decrease in total greenhouse gas emissions (Fig. 18). In contrast, emissions from energy industries (1A1) strongly increase under the assumption that gas-fired combined-cycle power plants are introduced, reaching a value of about 5.8 Mt CO_2eq above the emission in 1990 by 2030. An increasing trend is also projected for emissions from the sector 'Industrial processes and product use' (sector 2), which, driven by HFC emissions, increase until about 2020 and then flatten out at about 30% above the value in 1990.
- **With additional measures (WAM) scenario:** By 2030, Switzerland's total greenhouse gas emissions under the WAM scenario are projected to decrease to approximately 58% of the emissions in 1990. Compared to the WEM scenario, emissions decrease faster under the WAM scenario, as policies and measures are assumed to be strengthened. While the sector 'Energy' (in particular the source categories covering residential and com-

mercial/institutional buildings as well as transport) is mainly responsible for the additional emission reductions, contributions also come from the sector 'Agriculture' and from the reduction of emissions of F-gases within the sector 'Industrial processes and product use' (Fig. 18).

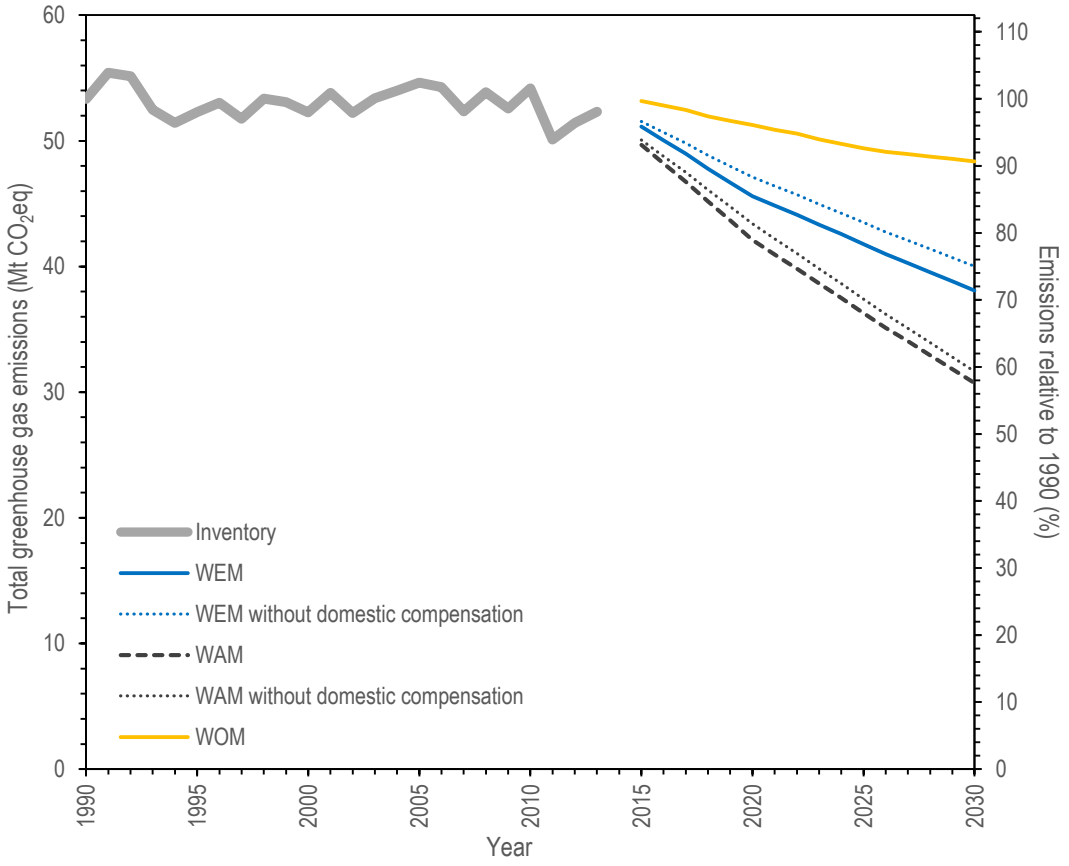
Regarding the sector 'LULUCF', the aggregate effect of policies and measures are not taken into account in the totals presented in this chapter, but emissions from this sector are briefly discussed in the following. The difference between the WEM and the WOM scenarios results from differing forest management practices, because all other parameters are identical for all scenarios (see section 4.4.4). Under the WEM scenario, harvesting is assumed to increase, making the LULUCF sector a net source, with a difference between the WEM and the WOM scenarios of 1.7 to 2.1 Mt CO_2eq in 2020–2030. However, the low harvesting rates assumed under the WOM scenario 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. In more detail, the following emissions and removals are expected from the sector 'LULUCF' under the different scenarios:

- Under the WEM scenario, forest management leads to net emissions in the order of 0.1 Mt CO_2eq per year in 2020–2030. The combined effects of afforestation, deforestation and forest management activities lead to total net emissions in the order of 0.2 to 0.3 Mt CO_2eq in 2020–2030. In total, the sector 'LULUCF' produces net emissions of 0.8 to 0.9 Mt CO_2eq per year in 2020–2030.
- Under the WOM scenario, forest management leads to net removals of -1.5 to -2.0 Mt CO_2eq in 2020–2030. The forest category as a whole (i.e. afforestation, deforestation and forest management activities) acts as a net sink of -1.4 to -1.9 Mt CO_2eq in 2020–2030. In total, the sector 'LULUCF' produces net removals of -0.8 to -1.3 Mt CO_2eq in 2020–2030.
- Under the WAM scenario, forest management leads to net emissions in the order of 1.1 to 1.7 Mt CO_2eq 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 Mt CO_2eq in 2020–2030. In total, the sector 'LULUCF' produces net emissions of 1.8 to 2.4 Mt CO_2eq in 2020–2030.

To ensure consistency with inventory data (chapter 1), emissions from international transport are not included in the totals and reported separately (Tab. 24). For Switzerland, virtually all (more than 99%, see Tab. 1) emissions from international transport stem from aircrafts. Ships are of negligible importance. Emissions from international transport are very similar under the WEM, WAM and WOM scenarios, because the considered national policies and measures do not target these emissions.

The reduction pathways in this chapter represent domestic reductions only and the totals include domestic compensation, which is, however, not attributed to any of the sectors or gases. The target of the revised CO_2 Act is defined as a 20% domestic reduction by 2020 compared to 1990 (section 2.2). In the second commitment period the focus is on domestic measures and not on purchase of carbon credits from abroad, but carbon credits for emission reductions achieved abroad will play a subsidiary role in particular cases, as detailed in section 2.2.4.

Fig. 14 > Total greenhouse gas emissions under the WEM, WAM and WOM scenarios as shown in Tab. 24. The totals presented here do not include emissions from LULUCF, nor from international transport. However, under the WEM and WAM scenarios the totals do include domestic compensation, which is not attributed to any of the sectors or gases. Trends excluding domestic compensation are indicated by the dotted lines. The vertical axis to the right indicates emissions relative to the base year (i.e. emissions of 1990 = 100%).



Tab. 24 > Greenhouse gas emissions under the WEM, WAM and WOM scenarios by sector and gas. Also shown are emission scenarios for international transport (not included in the totals). For the projections a revised approach to estimate fugitive emissions from biogas facilities is used in the sector 'Waste' and small adjustments are included in the sector 'Agriculture', while, in contrast, the emissions presented in chapter 1 rely on the data presented in Switzerland's National Inventory Report 2015. Domestic compensation is included in the total, but not allocated to any of the sectors or gases.

		1990	1995	2000	2005	2010	2013	2015	2020	2025	2030
		Mt CO_2eq									
Total (excluding LULUCF, including domestic compensation)	**WEM**	**53.3**	**52.3**	**52.3**	**54.6**	**54.2**	**52.3**	**51.1**	**45.6**	**41.8**	**38.1**
	WAM	***53.3***	***52.3***	***52.3***	***54.6***	***54.2***	***52.3***	***49.7***	***42.1***	***36.3***	***30.7***
	WOM	***53.3***	***52.3***	***52.3***	***55.0***	***54.9***	***53.4***	***53.2***	***51.2***	***49.4***	***48.4***
1 Energy	WEM	41.7	41.8	42.1	43.9	43.2	41.5	40.6	36.8	33.6	30.7
	WAM	*41.7*	*41.8*	*42.1*	*43.9*	*43.2*	*41.5*	*39.1*	*33.2*	*27.9*	*22.9*
	WOM	*41.7*	*41.8*	*42.1*	*43.9*	*43.2*	*41.5*	*41.2*	*39.4*	*37.7*	*36.8*
1A1 Energy industries	WEM	2.6	2.7	3.2	3.8	3.9	3.7	4.4	4.6	5.4	6.1
	WAM	*2.6*	*2.7*	*3.2*	*3.8*	*3.9*	*3.7*	*4.3*	*4.4*	*4.4*	*4.3*
	WOM	*2.6*	*2.7*	*3.2*	*3.8*	*3.9*	*3.7*	*4.4*	*5.3*	*6.5*	*8.4*
1A2 Manufacturing industries and construction	WEM	6.3	6.1	5.8	5.9	5.7	5.4	5.9	5.6	5.2	4.8
	WAM	*6.3*	*6.1*	*5.8*	*5.9*	*5.7*	*5.4*	*5.6*	*5.1*	*4.4*	*3.8*
	WOM	*6.3*	*6.1*	*5.8*	*5.9*	*5.7*	*5.4*	*5.9*	*5.7*	*5.3*	*4.9*
1A3 Transport	WEM	14.6	14.2	15.9	15.8	16.3	16.2	15.0	13.3	11.8	10.2
	WAM	*14.6*	*14.2*	*15.9*	*15.8*	*16.3*	*16.2*	*14.0*	*11.0*	*8.9*	*6.7*
	WOM	*14.6*	*14.2*	*15.9*	*15.8*	*16.3*	*16.2*	*15.6*	*14.7*	*13.6*	*12.5*
1A4 Other sectors	WEM	17.7	18.2	16.7	17.9	16.9	15.8	14.9	12.9	10.9	9.2
	WAM	*17.7*	*18.2*	*16.7*	*17.9*	*16.9*	*15.8*	*14.8*	*12.4*	*9.8*	*7.7*
	WOM	*17.7*	*18.2*	*16.7*	*17.9*	*16.9*	*15.8*	*15.0*	*13.4*	*11.9*	*10.6*
1A5 Military	WEM	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	WAM	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
	WOM	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
1B Fugitive emissions from oil and natural gas	WEM	0.4	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.2
	WAM	*0.4*	*0.5*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*
	WOM	*0.4*	*0.5*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.2*	*0.2*	*0.2*
2 Industrial processes and product use	WEM	3.5	2.9	3.1	3.8	4.0	4.1	4.1	3.7	3.3	2.8
	WAM	*3.5*	*2.9*	*3.1*	*3.8*	*4.0*	*4.1*	*4.1*	*3.6*	*3.2*	*2.6*
	WOM	*3.5*	*2.9*	*3.1*	*4.0*	*4.5*	*4.7*	*4.8*	*4.8*	*4.7*	*4.6*
3 Agriculture	WEM	6.8	6.5	6.1	6.1	6.2	6.1	6.1	6.0	6.0	6.0
	WAM	*6.8*	*6.5*	*6.1*	*6.1*	*6.2*	*6.1*	*6.1*	*5.9*	*5.7*	*5.5*
	WOM	*6.8*	*6.5*	*6.1*	*6.1*	*6.2*	*6.3*	*6.3*	*6.3*	*6.3*	*6.3*
5 Waste	WEM	1.3	1.1	1.0	0.8	0.7	0.7	0.7	0.6	0.6	0.6
	WAM	*1.3*	*1.1*	*1.0*	*0.8*	*0.7*	*0.7*	*0.7*	*0.6*	*0.6*	*0.6*
	WOM	*1.3*	*1.1*	*1.0*	*0.9*	*0.9*	*0.9*	*0.8*	*0.8*	*0.7*	*0.7*
Domestic compensation	WEM	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.5	-1.7	-1.9
	WAM	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-0.4*	*-1.3*	*-1.1*	*-0.9*
	WOM	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
4 LULUCF	WEM	*-3.0*	*-3.6*	*-0.4*	*-2.4*	*-2.0*	*-1.0*	*1.0*	*1.0*	*1.0*	*0.9*
	WAM	*-3.0*	*-3.6*	*-0.4*	*-2.4*	*-2.0*	*-1.0*	*1.3*	*1.9*	*2.6*	*2.5*
	WOM	*-3.0*	*-3.6*	*-0.4*	*-2.4*	*-2.0*	*-1.0*	*-0.2*	*-0.7*	*-1.1*	*-1.2*
CO_2 (excluding LULUCF)	WEM	44.0	43.3	43.5	45.7	45.0	43.2	42.4	38.5	35.2	32.1
	WAM	*44.0*	*43.3*	*43.5*	*45.7*	*45.0*	*43.2*	*40.9*	*35.0*	*29.5*	*24.4*
	WOM	*44.0*	*43.3*	*43.5*	*45.7*	*45.0*	*43.2*	*43.0*	*41.1*	*39.2*	*38.2*
CH_4 (excluding LULUCF)	WEM	6.2	*5.9*	*5.4*	*5.1*	*5.1*	*4.9*	*4.9*	*4.7*	*4.7*	*4.7*
	WAM	*6.2*	*5.9*	*5.4*	*5.1*	*5.1*	*4.9*	*4.9*	*4.7*	*4.5*	*4.3*
	WOM	*6.2*	*5.9*	*5.4*	*5.2*	*5.2*	*5.2*	*5.2*	*5.1*	*5.0*	*5.0*
N_2O (excluding LULUCF)	WEM	2.9	*2.7*	*2.6*	*2.4*	*2.5*	*2.4*	*2.5*	*2.4*	*2.4*	*2.4*
	WAM	*2.9*	*2.7*	*2.6*	*2.4*	*2.5*	*2.4*	*2.5*	*2.4*	*2.3*	*2.2*
	WOM	*2.9*	*2.7*	*2.6*	*2.4*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*
HFCs	WEM	0.0	*0.2*	*0.6*	*1.1*	*1.3*	*1.5*	*1.5*	*1.3*	*1.1*	*0.7*
	WAM	*0.0*	*0.2*	*0.6*	*1.1*	*1.3*	*1.5*	*1.5*	*1.2*	*1.0*	*0.6*
	WOM	*0.0*	*0.2*	*0.7*	*1.3*	*1.8*	*2.1*	*2.2*	*2.4*	*2.5*	*2.5*
PFCs	WEM	0.1	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*
	WAM	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*
	WOM	*0.1*	*0.0*	*0.1*	*0.0*	*0.1*	*0.1*	*0.0*	*0.0*	*0.0*	*0.1*
SF_6 and NF_3	WEM	0.1	*0.1*	*0.1*	*0.2*	*0.2*	*0.3*	*0.2*	*0.1*	*0.1*	*0.1*
	WAM	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.3*	*0.2*	*0.1*	*0.1*	*0.1*
	WOM	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*	*0.1*	*0.1*	*0.2*
International transport	WEM	3.2	*3.7*	*4.7*	*3.6*	*4.3*	*4.8*	*4.5*	*4.8*	*5.1*	*5.4*
	WAM	*3.2*	*3.7*	*4.7*	*3.6*	*4.3*	*4.8*	*4.5*	*4.7*	*5.0*	*5.3*
	WOM	*3.2*	*3.7*	*4.7*	*3.6*	*4.3*	*4.8*	*4.5*	*4.8*	*5.1*	*5.4*

Fig. 15 > Greenhouse gas emissions under the WEM, WAM and WOM scenarios by sector as shown in Tab. 24. For a more detailed disaggregation within the sector 'Energy' see Fig. 17. For the projections a revised approach to estimate fugitive emissions from biogas facilities is used in the sector 'Waste' and small adjustments are included in the sector 'Agriculture', while, in contrast, the emissions presented in chapter 1 rely on the data presented in Switzerland's National Inventory Report 2015.

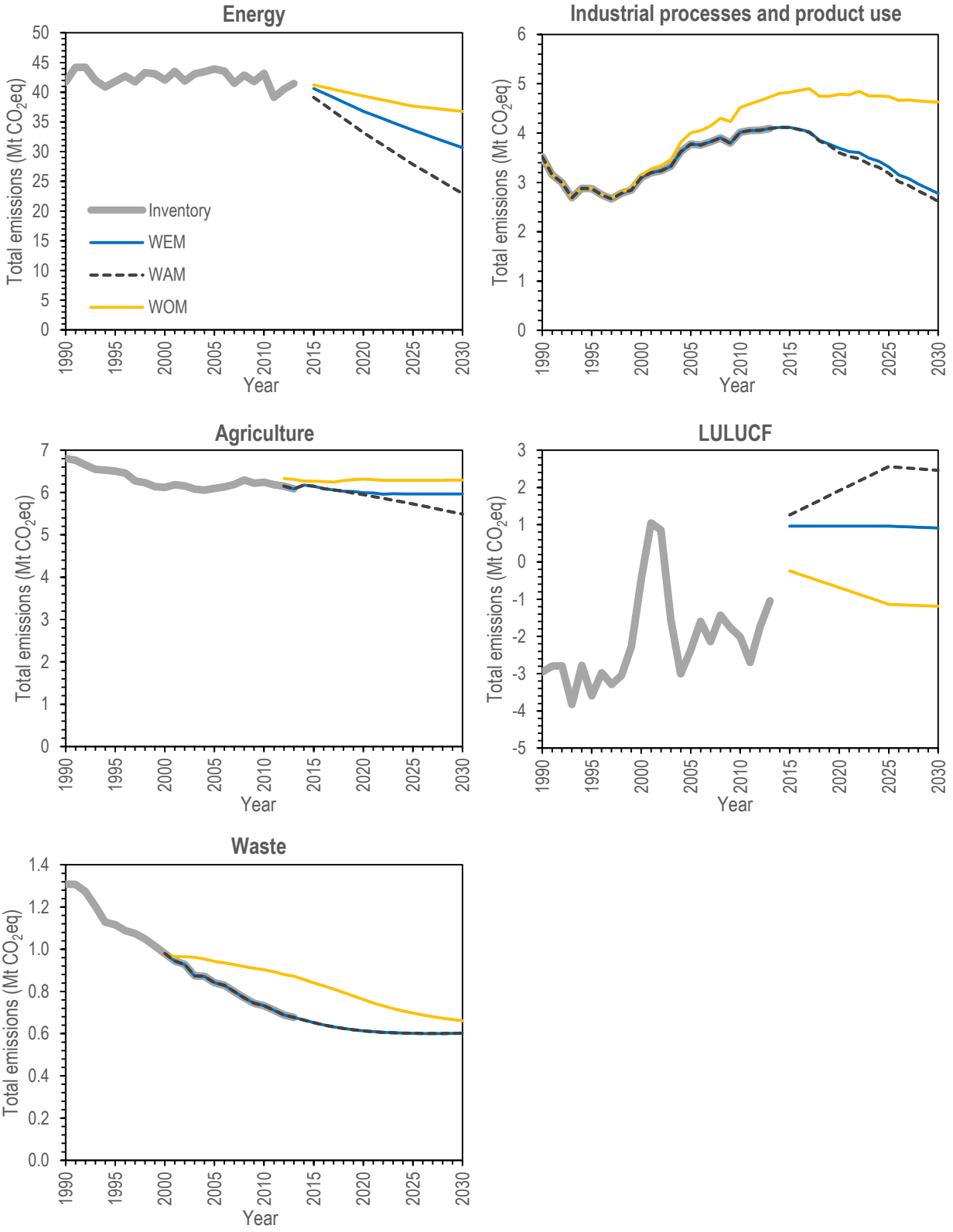


Fig. 16 > Greenhouse gas emissions under the WEM, WAM and WOM scenarios by gas as shown in Tab. 24. For the projections a revised approach to estimate fugitive emissions from biogas facilities is used in the sector 'Waste' and small adjustments are included in the sector 'Agriculture', while, in contrast, the emissions presented in chapter 1 rely on the data presented in Switzerland's National Inventory Report 2015.

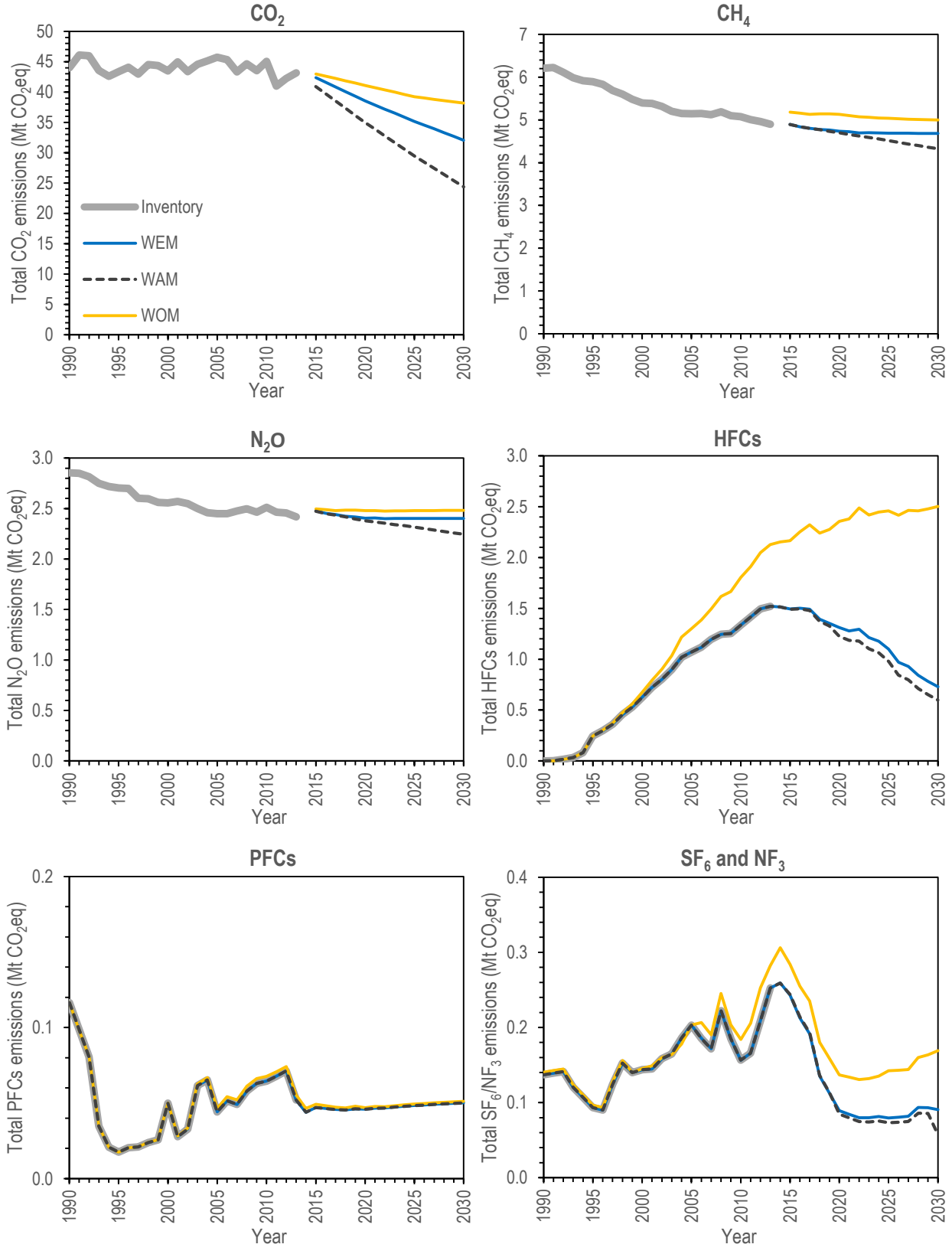


Fig. 17 > Greenhouse gas emissions in the source categories of the sector 'Energy' under the WEM, WAM and WOM scenarios as shown in Tab. 24. Source category 1A4 'Other sectors' is dominated by emissions from residential and commercial use of fossil fuels, while source category 1A5 'Other' covers emissions from off-road military vehicles including military aviation (see section 1.1.3 for more details). The scenarios for the sector 'Energy' are currently reconsidered using a computable general equilibrium model and the new results are planned for publication in the course of 2016 (*EPFL and Infras*, in preparation).

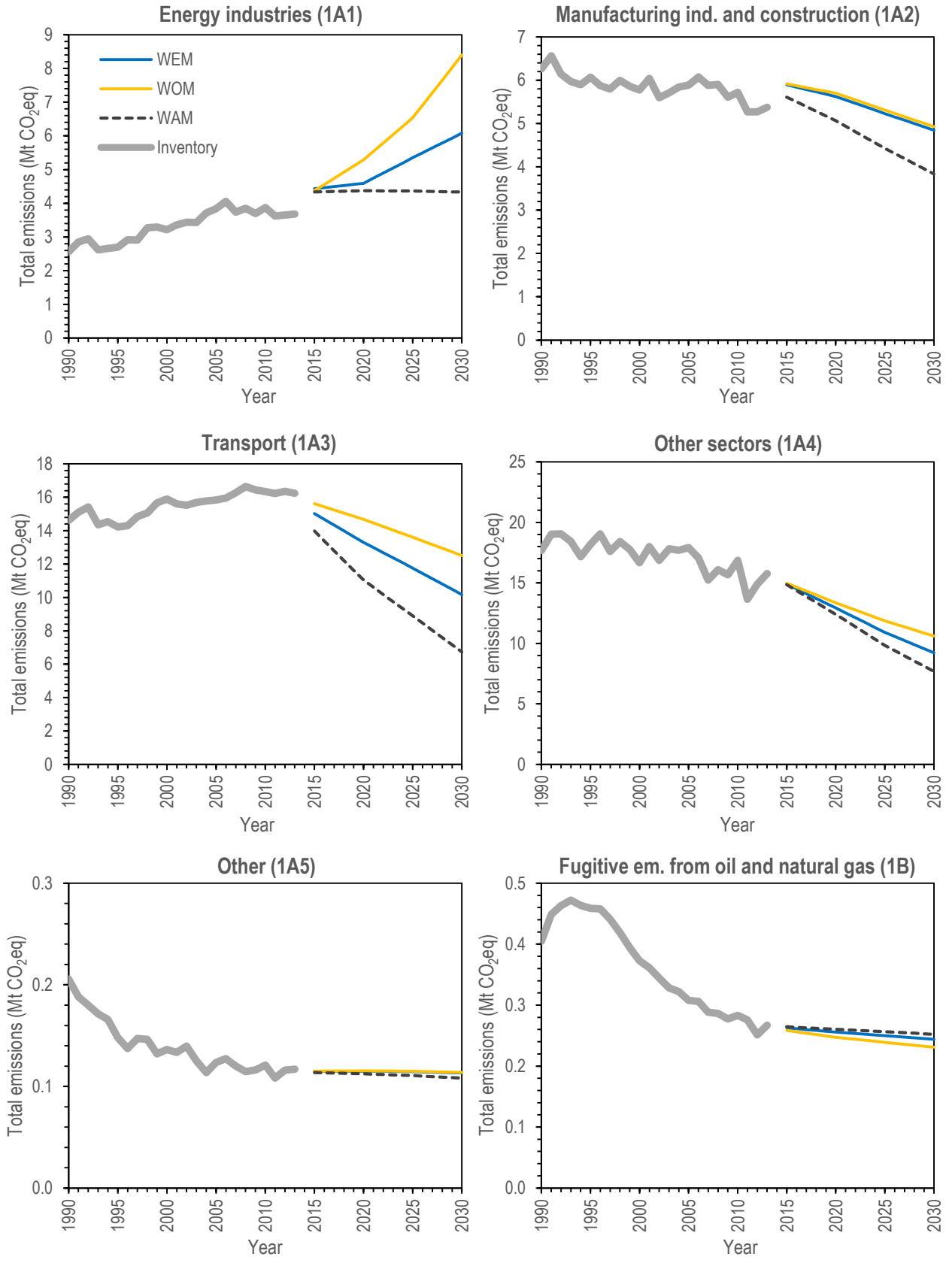
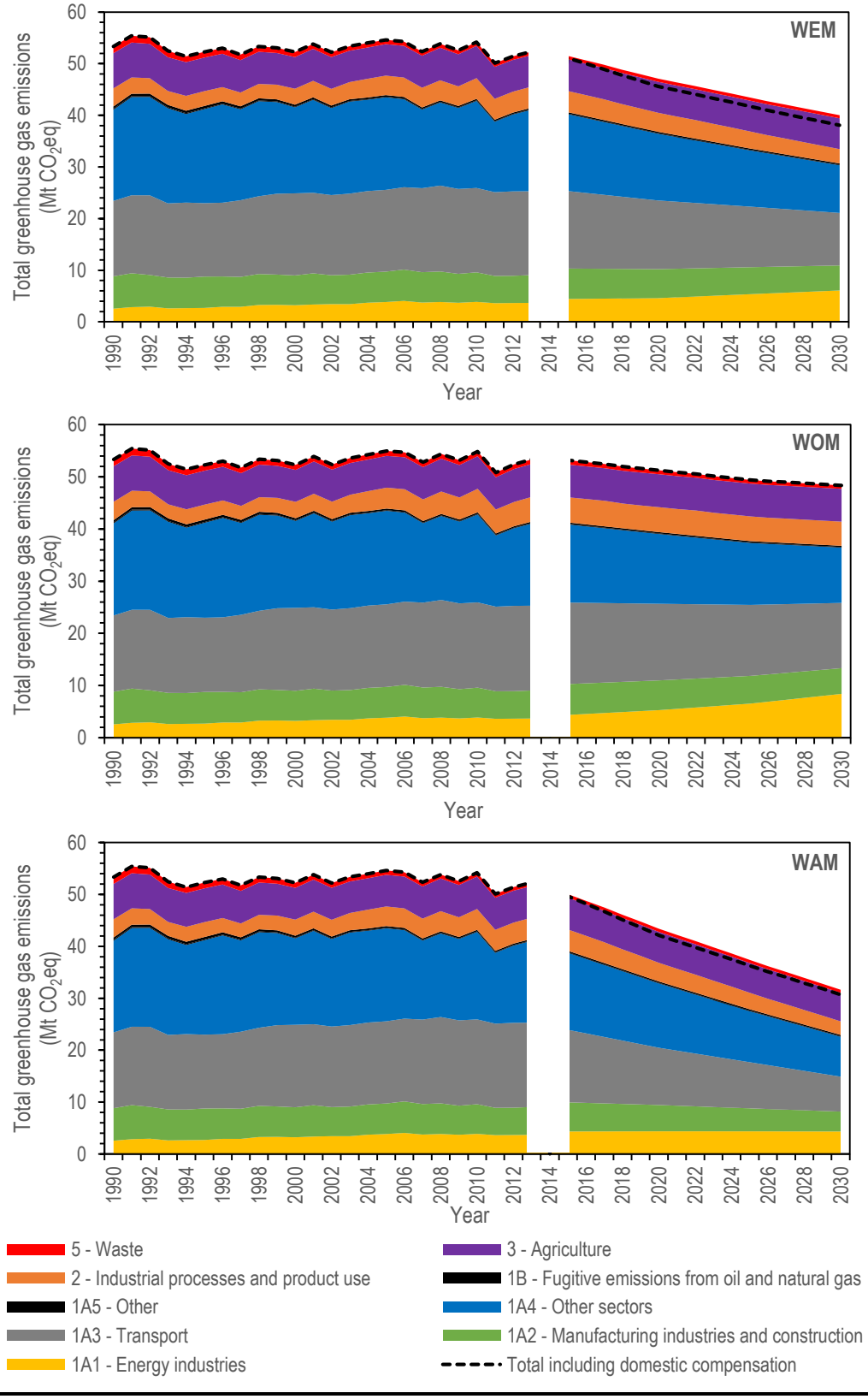


Fig. 18 > Contribution of the different sectors to the evolution of total greenhouse gas emissions under the WEM (top), WOM (middle) and WAM (bottom) scenarios. Contributions from the sector 'Energy' are further disaggregated to illustrate the most important source categories (1A1, 1A2, 1A3, 1A4, 1A4, and 1B). The totals (including domestic compensation, which is not attributed to any of the sectors) are indicated by the dashed black lines.



4.3 Total effect of measures

The aggregate effect of measures presented here is calculated based on the difference between emissions under the WEM and WOM scenarios. In contrast to Switzerland's Sixth National Communication and First Biennial Report, the bifurcation points of the scenarios for some sectors have shifted and are now as indicated in Tab. 25.

Tab. 25 > Bifurcation points of the scenarios for the individual sectors.

Sector	Bifurcation point
Sector 'Energy'	The bifurcation point is 2010 as in Switzerland's Sixth National Communication and First Biennial Report; an ongoing study will shift it to 1990 (*EPFL and Infras*, in preparation).
Sector 'Industrial processes and product use'	No measures specifically targeting process emissions are considered under any of the scenarios. Regarding F-gases, the bifurcation point of the scenarios is 1990.
Sector 'Agriculture'	The bifurcation point is 2011.
Sector 'LULUCF'	The bifurcation point is 2015 (first calculation with different assumptions for the WEM, WAM and WOM scenarios).
Sector 'Waste'	The bifurcation point is 1990; however, no measures are in place until the year 2000.

By 2020, the total effect of existing measures including domestic compensation is estimated at a reduction of 5.7 Mt CO_2eq (annual reduction, not cumulative). This estimate depends on the assumptions for the evolution of the underlying drivers and contains considerable uncertainties. Tab. 26 provides an overview of the resulting total effect of measures by gas. The contribution of each sector is shortly discussed below.

Tab. 26 > Total effect of policies and measures by gas (excluding LULUCF, including domestic compensation, which is not attributed to any of the gases). Shown are the differences between the WEM and WOM scenarios as presented in Tab. 24.

	1990	1995	2000	2005	2010	2013	2015	2020	2025	2030
	Mt CO_2eq									
CO_2	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	-2.6	-4.1	-6.1
CH_4	0.0	0.0	0.0	-0.1	-0.2	-0.3	-0.3	-0.4	-0.3	-0.3
N_2O	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1
HFCs/PFCs/SF_6/NF_3	0.0	0.0	0.0	-0.2	-0.5	-0.6	-0.7	-1.1	-1.4	-1.9
Domestic compensation	0.0	0.0	0.0	0.0	0.0	0.0	-0.4	-1.5	-1.7	-1.9
Total (excluding LULUCF, including domestic compensation)	0.0	0.0	0.0	-0.3	-0.7	-1.1	-2.1	-5.7	-7.6	-10.3

Energy and transport

The aggregate effect of policies and measures in the energy sector is strongly influenced by the future electricity generation and electricity demand. The projection rely on the assumption that with the phase-out of nuclear power plants, gas-fired combined-cycle power plants and electricity imports will be required to maintain electricity supply. Overall, efforts to reduce emissions from the sector 'Energy' under the WEM scenario lead to emission reductions of about 2.6 Mt CO_2eq in 2020 and 6.1 Mt CO_2eq in 2030 compared to the WOM scenario, which already includes most measures without strengthening. Thereby, energy industries contribute emissions reductions of about 0.7 and 2.3 Mt CO_2eq in 2020 and 2030, respectively. Improved energy efficiency of buildings entails reductions of 0.4 Mt CO_2eq in 2020 and 1.4 Mt CO_2eq in 2030. Energy efficiency measures in industry are estimated to contribute about 0.1 Mt CO_2eq annually over the period 2020–2030. Finally, substantial emission reductions are assigned to the sector 'Transport', with 1.4 Mt CO_2eq in 2020 up to 2.3 Mt CO_2eq in 2030.

Industrial processes and product use

As no policies and measures affecting process emissions of CO_2, CH_4 and N_2O from industry are considered, all scenarios are identical and, thus, no aggregate effects of policies and measures are expected for these gases. However, policies and measures with regard to F-gases substantially influence emissions of HFCs, PFCs, SF_6, and NF_3 from the sector 'Industrial processes and product use'. In particular, the phase-out of fluorinated refrigerants assumed under the WEM scenario leads to a substantial reduction of total greenhouse gas emissions in the order of 1.1 Mt CO_2eq in 2020 and 1.9 Mt CO_2eq in 2030 compared to the WOM scenario (Tab. 24).

Agriculture

The aggregate effect of policies and measures in the agriculture sector is calculated by comparing the WEM and WOM scenarios. The measures implemented under the WEM scenario lead to reduced emissions of the order of 0.3 Mt CO_2eq annually over the period 2020–2030 (Tab. 24). Both CH_4 and N_2O emission reductions contribute about equally to the overall reduction.

Waste

The total effect of policies and measures can almost completely be attributed to the ban on landfilling of combustible waste (section 3.8.2), which is considered for the WEM and the WAM scenario, but not for the WOM scenario (section 4.4.5). The effect of the ban on landfilling of combustible waste is slightly reduced due to incentives for increasing biogas production, which lead to somewhat increased fugitive CH_4 emission under the WEM and WAM scenarios, compared to the WOM scenario. Overall, emissions under the WOM scenario exceed emissions under the WEM scenario by 148 kt CO_2eq in 2020 and by 60 kt CO_2eq in 2030 (Tab. 24).

4.4 Methodology: Bottom-up estimates

The projections are developed along the same methodology as the greenhouse gas inventory (bottom-up estimates). This means that the same processes and gases are considered in a way that is as consistent as possible with the greenhouse gas inventory. This approach is similar to the approach used for the projections in Switzerland's Sixth National Communication and First Biennial Report. Tab. 27 provides a general overview of important assumptions, while the following sections present details relevant for each sector.

Tab. 27 > Overview of sectoral background scenarios. Sectoral greenhouse gas emissions are based on the various sectoral scenarios used to calculate emissions according to the methodology used for the greenhouse gas inventory.

Sector	Scenario	Sectoral scenario	Reference
1 Energy	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)
2 Industrial processes and product use: Process emissions	All	Scenario based on key parameters related to industrial production as used in the energy scenarios	*Prognos* (2012)
2 Industrial processes and product use: F-gases	WEM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	*Carbotech* (2015)
	WAM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	*Carbotech* (2015)
	WOM	Individual scenario based on assumptions regarding use/replacement of HFCs and SF_6	*Carbotech* (2015)
2 Industrial processes and product use: Solvents	All	Scenario based on key parameters (e.g. population) as used in the energy scenarios	*Prognos* (2012)
3 Agriculture	WEM	Agricultural policy 2014–2017	*Swiss Federal Council* (2012), *Möhring et al.* (2015)
	WAM	Climate strategy for agriculture	*FOAG* (2011)
	WOM	Agricultural policy 2011	*Peter et al.* (2010)
4 LULUCF	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)
5 Waste	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)

4.4.1 Energy

For the sector 'Energy', apart from updated Global Warming Potential (GWP) values, the same scenarios as in Switzerland's Sixth National Communication and First Biennial Report are used (please refer to the respective report for details). As mentioned above, an external study applying a computable general equilibrium model has been launched (*EPFL and Infras*, in preparation), which will provide updated scenarios and, in particular, a WOM scenario with a bifurcation point as early as 1990. The final results are planned for publication in the course of 2016.

4.4.2 Industrial processes and product use

In Switzerland, there are few industrial branches that release relevant amounts of process-related greenhouse gases. The major emitter of the sector is the cement industry contributing about half of process-related greenhouse gas emissions, followed by emissions from the use of F-gases as refrigerants and emissions from steel production. With the exception of F-gases, measures in the industry sector are primarily targeting energy-related emissions (section 3.3). Nevertheless, for companies that are included in the emissions trading scheme (section 3.2.5), there is a gradual reduction of the emissions allocation, which also includes process emissions and gases other than CO_2. In view of the subordinate importance of remaining process emissions, further efforts in this field will have a small effect and are therefore not differentiated between the scenarios. As the NMVOC incentive fee (section 3.5.3) is not considered either, provisions relating to substances stable in the atmosphere (section 3.5.2) represent the only policy leading to differences between the WEM, WAM and WOM scenarios for the sector 'Industrial processes and product use'.

Regarding process-related emissions, the relevant activity data for industrial production are inferred from the energy perspectives report of *Prognos* (2012). Production of mineral products (cement, bricks and tiles) and metal production are assumed to decline over the coming decades. For other processes, for which detailed production projections are unavailable, it is assumed that activity remains at the level of recent years. Emissions from solvent and other product use are scaled with population growth or production indices as appropriate. As no policies and measures specifically targeting process-related emissions are in place, equal activity data and, thus, emissions are assumed for the WEM, WAM and WOM scenarios.

Regarding emissions of F-gases, which strongly depend on the scenario, projections are based on a bottom-up model which covers the period from 1990 to 2050 (*Carbotech*, 2015). This model is also used to derive emission estimates for the annual greenhouse gas inventory and has been applied to project emissions of F-gases in Switzerland's Sixth National Communication and First Biennial Report. Up to the most recent inventory year, i.e. currently from 1990 to 2013, the model is based on import statistics and supplemented by available information from the branch associations and companies concerned. The model makes assumptions about product life time and emission factors for assembly, operation and disposal. For the projections, the two most important applications of fluorinated gases, refrigeration and electrical equipment, are considered in detail, while other categories in the model are left unchanged. The main factors defining the scenarios are the phase-out of HFCs, decreasing emission factors in refrigeration and the limit set on SF_6 emissions in the agreements with the relevant industries. With regard to the current submission, the model calculations have been updated, taking into account the new Global Warming Potentials (GWP) values (section 2.2.2). Further, adjustments have been made regarding the time horizons for the phase-out of refrigerants with high Global Warming Potential (GWP) values as well as regarding the growth of the market for heat pumps. Finally, the model now takes into account emissions of NF_3.

Tab. 28 provides an overview of assumptions in the sector 'Industrial processes and product use' with regard to the WEM, WAM and WOM scenarios. Please refer to *Carbotech* (2015) for further details about assumptions and methodologies.

Tab. 28 > Assumptions used for the projections of emissions from the sector 'Industrial processes and product use' under the WEM, WAM and WOM scenarios.

	WEM	WAM	WOM
Industrial production	In close correspondence with the assumptions on industrial production used in the energy perspectives of *Prognos* (2012), the cement and steel production are assumed to decline over the coming decades. For other	As there are no policies and measures affecting the production rates, the evolution is identical for all three scenarios.	As there are no policies and measures affecting the production rates, the evolution is identical for all three scenarios.

	processes, it is assumed that activity remained at the level of the recent years.		
HFC as refrigerants	Increasing restriction of exceptions to use F-gases (in concert with technical progress). This leads to an almost complete replacement of HFCs used as refrigerants (*Carbotech*, 2015). Measures to reduce leakage (secure handling of refrigerant, monitoring etc.).	Similar but faster replacement of HFCs as refrigerants compared to the WEM scenario. Optimization of disposal leads to additional prevention of emissions to the atmosphere. (*Carbotech*, 2015).	The WOM scenario assumes no forced phase-out and replacement of fluorinated gases and therefore HFC emissions keep increasing (*Carbotech*, 2015).
SF_6	Agreements with relevant sectors, leading to reduction of emissions.	Stepwise prohibition of SF_6, leading to a replacement for use in electrical equipment.	Constant use of SF_6 and higher emission factors compared to the WEM and WAM scenarios.
Gases from other industrial processes	Other industrial process emissions (e.g. ammonia/ethylene production, nitric acid production) are assumed to maintain the current production levels.	Identical evolution for all three scenarios.	Identical evolution for all three scenarios.

4.4.3 Agriculture

Scenarios for agriculture are based on projected activity data, e.g. livestock numbers, crop production data (amount of crops harvested, areas of crop cultures, meadows and pastures) and fertilizer use (synthetic fertilizers and recycling fertilizers) from different agricultural policy evaluation models. Most other model parameters for emission calculation (e.g. nitrogen excretion rates, emission factors) have been kept constant at the value of 2013. 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 2013 have been extended by continuing the trends according to the development in the models used relative to a base year period. As base year period the mean of the years 2008–2010 (WEM and WAM scenarios) respectively 2008–2011 (WOM scenario) 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 behaviour of the time series, another base year period has been chosen.

Note that the new calculations performed while updating the projections for the sector ‘Agriculture’ also require small adjustments in estimated emissions under the WEM scenario between 1990 and 2030. These recalculations, which will be integrated in Switzerland’s greenhouse gas inventory in conjunction with the next inventory submission, are considered in this chapter in order to get consistent scenarios for the full period from 1990 to 2030. In contrast, the emissions presented in chapter 1 agree with Switzerland’s National Inventory Report 2015.

The following considerations regarding different aspects are relevant under the WEM, WAM and WOM scenarios.

Animal livestock population

The development of livestock population numbers is dependent on price scenarios and consequently on policies concerning market price support and free trade agreements with the European Union (*Peter et al.*, 2009; *Peter et al.*, 2010; *Zimmermann et al.*, 2011; *Möhring et al.*, 2015). 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 mainly influenced by requirements for animal friendly livestock husbandry and the respective incentives. Furthermore, the need for low-emission stable and manure management systems might have a certain influence in the future.

Nitrogen excretion by animals

Nitrogen excretion rates determine the amount of manure nitrogen managed and applied to soils and hence govern N_2O emissions. N-excretion rates varied in the past due to changing production modes and particularly due to the feeding of protein reduced animal feeds. It is most likely that excretion rates will continue to change in the future although there are no clear indications of directions of future trends.

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 particularly related to possible free trade agreements as well as the need for animal fodder will determine the portfolio of crop cultures in the future.

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 fulfil the proof of ecological performance 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 allowances. Furthermore, the rigour of the enforcement of the standards defined in the Suisse-Bilanz can have substantial effects 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). Parameters determining the nitrogen surplus and hence the nitrogen use efficiency are primarily the ammonia emission factors and the share of nitrogen lost as nitrate (leaching and runoff). Nitrogen use efficiency will be affected by the programmes for resource-efficiency (Ressourcenprogramme, Ressourceneffizienzbeiträge; e.g. *Swiss Confederation*, 2009), the programme 'QuNaV' (Förderung von Qualität und Nachhaltigkeit in der Land- und Ernährungswirtschaft) as well as by the general requirements under the proof of ecological performance (e.g. Suisse-Bilanz).

The following circumstances and sources of information are relevant under the specific scenarios.

WEM scenario

The basis of the WEM scenario is the agricultural policy 2014–2017 (section 3.6). Direct payments were decoupled to a certain degree from cropping area and particularly from the amount of animals living on the farms, reducing incentives for intensification that would lead to negative environmental impacts (*Swiss Confederation*, 2009). *Möhring et al.* (2015) investigated the repercussions of the agricultural policy 2014–2017 with the multi-agent model SWISSland. Projections are based on data and information available by January 2015 on the economic development in the European Union and the world markets, the macroeconomical forecast for Switzerland as well as the currently applicable agricultural policy. Development of animal populations, productivity of dairy cows, development of cropping areas and fertilizer use have been projected until the year 2024. For the subsequent years, all values have been kept constant at the levels projected for 2024.

WAM scenario

Up to 2018, emissions follow the same course as under the WEM scenario i.e. the development according to the agricultural policy 2014–2017 (*Möhring et al.*, 2015). After 2018, emissions are projected to decline according to the target scenario in the climate strategy for agriculture (*FOAG*, 2011). 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 the respective production structures further reductions of similar scale are aspired (*FOAG*, 2011). The envisaged decrease of emissions is in line with the roadmap of the European Commission for moving to a competitive low carbon economy in 2050 (*EC*, 2011). 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, tools 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 Zurich (e.g. *Kreuzer*, 2012) or the IP-Suisse programme (*Mieleitner et al.*, 2011; *Alig et al.*, 2015) list various potential mitigation measures that will be pursued in such a context. Two programmes intended to financially support relevant projects by agricultural stakeholders, namely the resource programme (section 3.6.3) and the 'QuNaV' (Förderung von Qualität und Nachhaltigkeit in der Land- und Ernährungswirtschaft), have been implemented by the Federal Office for Agriculture (FOAG).

WOM scenario

The WOM scenario for agriculture is based on the continuation of the agricultural policy 2011. The fundamental assumption is that the scheme of the direct payments and the requirements under the proof of ecological performance would not have been adjusted and will not be adjusted in the future. Projections are calculated according to *Peter et al.* (2010) as expected after the implementation of the agricultural policy 2011. *Peter et al.* (2010) projected the future development of the agricultural portfolio 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 et al.*, 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) develops according to the macroeconomic development that was given exogenously as model input. Technical, organizational and structural framework conditions were 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.

Tab. 29 provides an overview of assumptions in the sector 'Agriculture' with regard to the WEM, WAM and WOM scenarios.

Tab. 29 > Assumptions used for the projections of emissions from the sector 'Agriculture' under the WEM, WAM and WOM scenarios.

	WEM	WAM	WOM
Animal livestock population	The agricultural policy 2014–2017 influences animal population as predicted by *Möhring et al.* (2015). Direct payments were decoupled to a certain degree from cropping area and particularly from the amount 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 2024 (the time horizon of *Möhring et al.*, 2015) constant population numbers have been assumed for all animal categories due to the lack of further projections.	Generally, livestock populations are projected to decrease after 2018 until overall agricultural greenhouse gas emissions reach the minimum reduction target set in the climate strategy for agriculture in 2050 (*FOAG*, 2011), i.e. 1/3 of the level of 1990. This means that livestock populations fall by more than 27% between 2018 and 2050. In the logic of this scenario, a reduction of the consumption of animal products should accompany the reduction of the livestock populations in order to prevent the imports of greenhouse gas intensive animal products.	Overall, *Peter et al.* (2010) expected rather constant livestock populations until 2022. Beyond 2022, constant population numbers have been assumed for most animal categories due to the lack of further projections.
Feeding regime	With the exception of mature dairy cows, energy intake and methane rates remain constant at the value of 2013, i.e. no technical measures concerning animal diets are implemented. Milk yield and hence gross energy intake of mature dairy cattle is assumed to further increase until 2024 (*Möhring et al.*, 2015). Accordingly, the CH_4 emission factor for both enteric fermentation and manure management increases proportionally. An important political measure could be the promotion of extensive milk and meat production based on a grassland diet (*Swiss Federal Council*, 2012). Some respective incentives have already been implemented in the agricultural policy 2014–2017, although it is not yet known to what degree feed intake and milk yield will be influenced in the future by this policy.	Energy intake as well as all other related feeding parameters are assumed to be equal to those under the WEM scenario. The findings of the Animal Nutrition Group of the Swiss Federal Institute of Technology in Zurich (e.g. *Kreuzer*, 2012) might help to define alternative feeding strategies with low emission intensities in the future. However, scientific results are not yet in the state to allow widespread implementation. Accordingly, the respective emission reductions are not yet included in the inventory model scenario.	With the exception of mature dairy cows, energy intake and methane rates remain constant at the value of 2011, i.e. no technical measures concerning animal diets are implemented. Milk production and hence gross energy intake of mature dairy cattle level off approximately around 2011 (*Peter et al.*, 2010). Accordingly, the CH_4 emission factors for both enteric fermentation and manure management remain more or less at the level of 2011.
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 programme 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	The same assumptions are implemented as under the WEM scenario.	Manure management system distribution is assumed to remain constant (distribution of 2011).

	systems cannot be predicted satisfactorily and are thus left constant at the level of 2013.		
Nitrogen excretion by animals	All nitrogen excretion rates are assumed to remain constant at the level of 2013 with the exception of mature dairy cows. Nitrogen excretion of mature dairy cows is projected to increase until 2024 due to the higher milk production projected by *Möhring et al.* (2015), which is related with higher feed intake rates.	The same assumptions are implemented as under the WEM scenario.	Nitrogen excretion rates of all animal except mature dairy cattle are assumed to remain constant at the level of 2011. Nitrogen excretion rates of mature dairy cattle are dependent on milk production and are assumed to level off around 2011 as no further increase of milk yield is projected (*Peter et al.*, 2010).
Crop cultures	Targeting of direct payments is improved, particularly for the promotion of common goods and the securing of a socially acceptable development (*Swiss Confederation*, 2009, *FOAG*, 2010). Direct payments are 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 determine the portfolio of crop cultures in the future. Taking into account these aspects, *Möhring et al.* (2015) projected the future development of the individual crop cultures. Overall, agricultural area is projected to slightly decrease. Beyond 2024, constant yields and areas have been assumed due to the lack of further projections.	For crop yields the same projections are used as under the WEM scenario. In Switzerland an increase of the agricultural area is not possible and a decrease is very unlikely because inland food supply security is an important target of agricultural policy.	Development of crop cultures between 2011 and 2022 is calculated according to *Peter et al.* (2010). Areas of arable crops are slightly declining while land use for meadows and pasture is slightly increasing. Between 2022 and 2050, areas and yields are assumed to remain constant.
Fertilizers and fertilizer management	Use of commercial fertilizers is projected to decrease by 4% between the baseline period (2008–2010) and 2024 (*Möhring et al.*, 2015). Beyond 2024, constant fertilizer use has been assumed.	The same projections are used as under the WEM scenario until 2024. Afterwards, consumption of commercial fertilizers is projected to further decline by 15% until 2050 due to further promotion of nitrogen use efficiency.	After 2011, 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.
Nitrogen use efficiency	Further development of the scheme of direct payments (with adjustments in the proof of ecological performance, *Swiss Confederation*, 2009) as well as programmes for resource efficiency in agriculture are designed to increase nutrient use efficiency in order to fulfil 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 ammonia emission factors and nitrogen loss rates are projected to remain constant in the inventory model.	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 available (*Kupper and Menzi*, 2011). The respective findings might be used to refine the projections under the WAM scenario in the future.	Since total amount of applied commercial fertilizer as well as total nitrogen available from animal manure are assumed to remain constant, no increase in nitrogen use efficiency is achieved. This is compatible with the WOM scenario.

4.4.4 LULUCF

To project emissions from the LULUCF sector the stochastic empirical single tree forest management scenario model MASSIMO3, which was derived using data from the three successive Swiss National Forest Inventories (NFI), is used. The model is perfectly designed to reflect the specific characteristics of Swiss forests, but direct comparability with other countries is not possible. MASSIMO3 is also used for the calculation of the Swiss Forest Management Reference Level for accounting for forest management under the Kyoto Protocol for the second commitment period (2013–2020). The model mainly consists of a single tree growth component, a wood harvesting component, and a component on natural regeneration. These model components as well as in-growth and mortality rates are empirically derived from the NFI data (Kaufmann 2011), as detailed in the following:

- **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. In-growth rates are considered as well.

- **Wood harvesting component**: 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 the NFI data.
- Information for plots with **natural regeneration** is extracted from a database containing NFI-regeneration plots.
- **Mortality rates and management strategies** are considered as observed in the last few years, since MASSIMO3 is based on data of the three NFIs covering the time period 1985–2005, comprising all management activities with significant impact on that period.

MASSIMO3 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. Changes in emissions or removals from non-CO_2 gases are not calculated by the model. Accordingly, it is assumed that between 2014 and 2030 the non-CO_2 gases stay at the mean value of the emissions between 1990 and 2007 since no changes are expected in the occurrence of wildfires nor in afforestation and deforestation. As greenhouse gas emissions in the LULUCF sector are dominated by activities in source category 4A1 'Forest land remaining forest land', projections are focussing on this source category, assuming that all other source categories remain at their current levels. Source category 4A1 is closely related with the KP activity forest management. Using MASSIMO3 and defining future harvesting rates to derive forest management scenarios, greenhouse gas balances under the WEM, WAM and WOM scenarios were calculated. 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 characteristic of the WEM, WAM and WOM scenarios, which correspond to the scenarios presented in Switzerland's Sixth National Communication and First Biennial Report, are detailed in Tab. 30.

Tab. 30 > Assumptions used for the projections of emissions from the sector 'LULUCF' under the WEM, WAM and WOM scenarios.

	WEM	WAM	WOM
Forest area, afforestation, deforestation	The forest area as well as the changes in forest area (afforestation, deforestation) are calculated using an extrapolation of the trend 1990–2009 (values derived from the Swiss land use statistics AREA, *SFSO*, 2012).	Afforestation and deforestation activities are identical for all scenarios.	Afforestation and deforestation activities are identical for all scenarios.
Forest management, political measures	In order to reach the optimal combination of the objectives identified in the Switzerland's Forest Policy 2020 (section 3.7), it is important that Swiss forests are stable and managed in a sustainable way. The WEM scenario, in accordance with the 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.	Compared to the WEM scenario, a different approach for forest management is taken into account. Switzerland's wood resource policy (*FOEN*, 2008; section 3.7) 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.	No political measures considered.
Harvesting rates	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. After 2025, harvesting rates are assumed to stay at this level.	As the aim of Switzerland's wood policy under the WAM scenario is to increase wood production by 2025 in the interest of harvesting the potential sustainable wood supply, harvesting rates have to increase by up to 30% compared to 1995–2006 (harvesting rate for period NFI2-3; *Kaufmann*, 2011). After 2025, 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 is used for accounting under the Kyoto Protocol.	Without political measures, Swiss forests would act as a considerable CO_2 sink because growing stock in Swiss forests would further increase, thereby leading to an unsustainable forest structure. Under the WOM scenario, harvesting rates stay at the level of 1995–2006 (NFI2-3; *Kaufmann*, 2011) until 2030.

Other source categories and greenhouse gases	As greenhouse gas emissions in the LULUCF sector are dominated by activities in source category 4A1 'Forest land remaining forest land', projections are focussing on this source category, assuming that emissions from all other source (including all emissions of CH_4 and N_2O) remain constant.	Identical assumptions for all scenarios.	Identical assumptions for all scenarios.

4.4.5 Waste

As policies and measures are very limited in the sector 'Waste', the WEM, WAM and WOM scenarios are largely based on the same underlying assumptions, with differences for the WOM scenario regarding waste disposal and emissions from biogas production (Tab. 31). For the latter, a revised approach to estimate fugitive emissions from biogas facilities, based on on-site measurements, was used. However, the revised approach is only applied with regard to the values presented in this chapter, while the emissions presented in chapter 1 rely on the previous approach and agree with Switzerland's National Inventory Report 2015. This recalculation, which affects all emissions from 1990 to 2030, will be integrated in Switzerland's greenhouse gas inventory in conjunction with the next inventory submission. For all scenarios, it is assumed that waste generation per capita remains the same.

Tab. 31 > Assumptions used for the projections of emissions from the sector 'Waste' under the WEM, WAM and WOM scenarios. In agreement with the greenhouse gas inventory, emissions from waste incineration facilities are reported under public heat and electricity generation in the sector 'Energy'.

	WEM	WAM	WOM
Waste disposal	As landfilling of combustible waste was only of secondary importance and is prohibited completely since 2000 (section 3.8.2), emissions from solid waste disposal sites are small and further decreasing in the coming decades.	Same as for the WEM scenario.	It is assumed that landfilling was not prohibited. Consequently, the amount of waste disposed at waste disposal sites decreases slowly from its value in 1999 to 10% of this value by 2020, and remains constant thereafter. The reasoning for this assumption is a decreasing public acceptance of waste disposal sites (odour, need of space, pollution, etc.), leading to the closing of waste disposal sites (where practicable) even without an official ban. It is further assumed that the share of CH_4 recovered for power production (on total CH_4 produced) is the same under the WOM scenario as under the WEM and WAM scenarios (the share decreases disproportionately as the cost-income ratio is changing for the worse with decreasing CH_4 production of the waste disposal site).
Waste water handling	Emissions from waste water handling are assumed to scale with the evolution of population.	Same as for the WEM scenario.	Same as for the WEM scenario.
Biogas production	It is assumed that increased demand for biogas leads to the construction of 336 additional biogas facilities (*Prognos*, 2012). Accordingly, fugitive emissions from digestion of solid waste are assumed to increase over the coming decade.	Same as for the WEM scenario.	Under the WOM scenario, lower end use of biogas is projected compared to the WEM and WAM scenarios. Therefore, only 51 additional biogas facilities are need, which reduces fugitive emissions from digestion of solid waste.

4.4.6 International transport

The latest energy scenarios (*Prognos*, 2012) serve as the basis for the projections of emissions from international transport. In consistency with the greenhouse gas inventory, emissions of CO_2, CH_4, and N_2O are then calculated by bottom-up estimates. The different scenarios (WEM, WAM and WOM) are very similar regarding emissions from international transport, as policies and measures aim at reducing greenhouse gas emissions within Switzerland.

4.5 Changes since the last National Communication

The general approach to derive emissions scenarios is fairly similar to the one used in the Sixth National Communication and First Biennial Report. Minor changes regarding methodology and assumptions have occurred in the following sectors:

- In the sector 'Industrial processes and product use', the calculation of emissions of F-gases has been updated.
- In the sector 'Agriculture', the projections under the WEM scenario were updated based on new model evaluations (*Möhring et al.*, 2015). Emission reductions under the WAM scenario are lower than in the Sixth National Communication and First Biennial Report due to a less ambitious interpretation of the target in the climate strategy for agriculture (*FOAG*, 2011). The inventory model used for the projection in this report is substantially different to the model used in the Sixth National Communication and First Biennial Report. Due to the introduction of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (*IPCC*, 2006) and the shift to the second commitment period under the UNFCCC, model structure and parameters were changed fundamentally. The bifurcation point for the WOM scenario in the sector 'Agriculture' is 2011.
- In the sector 'Waste', a revised approach to estimate fugitive emissions from biogas facilities was used under all scenarios (section 4.4.5). Further, the ban on landfilling of combustible waste is now, for the first time, excluded under the WOM scenario.

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5 Financial resources and transfer of technology

5.1 Introduction

The Swiss Federal Constitution stipulates that Switzerland be 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 global 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 programmes and projects, as well as integrating low-carbon development and climate resilience into Switzerland's development assistance – has thus been a cornerstone of Switzerland's international engagement since the early 1990s. 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 agencies coordinate their activities through a joint platform named PLAFICO, which associates other entities of the federal government as needed. All matters related to international environment finance and development cooperation are coordinated through this platform. In addition, all three institutions were subject to considerable structural adjustments to better respond to the increasing challenges posed by climate change, and further expanded their cooperation with non-government stakeholders in recent years.

Building on decades of climate-relevant work in developing countries in different areas such as energy efficiency, renewable energy, agriculture and forestry, land-use planning, disaster risk management and technology transfer, Switzerland has played an active role since the early days of international climate policy. In the international climate change arena, Switzerland systematically emphasizes the relevance of a fair and equitable burden sharing among Parties, while stressing the importance of a sound regulatory and political framework conducive to low-carbon and climate-resilient development. Through its multilateral and bilateral cooperation and its membership in the governing bodies of various multilateral institutions (inter alia MDBs, GEF, GCF, AF, UN agencies) Switzerland attaches great importance to increased coherence and effectiveness in the design and implementation of climate-relevant policies, strategies and actions. Furthermore, the establishment of strategic partnerships at all levels and the strengthening of dialogue among all stakeholders are key principles guiding Switzerland's international climate change engagement.

In February 2011, the Swiss Parliament decided to increase the level of Official Development Assistance (ODA) to 0.5% of gross national income (GNI) by 2015. This decision took into consideration the need for Switzerland to honour its UNFCCC Fast-Start Financing commitment for the period 2010–2012. Consequently, new and additional resources of USD 150 million were made available and used by SDC, SECO and FOEN to expand their respective climate change portfolio (*SDC/SECO/FOEN*, 2013). As witnessed by the report on effectiveness about the Swiss international cooperation on climate change, commissioned jointly by SDC and SECO in 2014 (*SDC/SECO*, 2014), the additional public funds were allocated primarily to well-performing existing projects and multilateral initiatives, while placing an even focus between mitigation and adaptation. Switzerland was able to significantly increase its ODA in 2013 and 2014 by lifting it from USD 3'100 million 0.45% of GNI) in 2012 to USD 3'200 million (0.45% of GNI) in 2013, and to USD 3'550 million (0.49% of GNI) in 2014.

Climate finance followed this trend and was steadily increased since the ratification of the Convention in 1992. Since the last Biennial Report Switzerland further increased its public climate finance from USD 175 million in 2012 to USD 287 million in 2014[4]. Therefore, Switzerland considers its climate finance as new and additional.

[4] The strong increase is due to the increased mainstreaming and climate focus in Swiss development cooperation as well as the increased availability of imputed shares from OECD DAC for the calculation of the climate specific share of multilateral core contributions. The climate relevant bilateral public climate finance increased 29% from CHF 143 Million in 2012 to CHF 184 Million in 2014.

The decision adopted by the Conference of the Parties to the UNFCCC in 2010 in Cancun refers to a variety of sources including the private sector. The financial resources reported in this chapter relate to financing from public sources attributable to ODA. The current Swiss public investments for climate change adaptation and mitigation measures can be found in Tab. 34 and Tab. 35. All public funding was provided in the form of grants (no loans).

This Biennial Report does not include mobilized private climate finance. Switzerland has added its data to the OECD-CPI report on Climate Finance 2013–2014 and the USD 100 billion goal (*OECD*, 2015) and was part of the donor group, which provided significant methodological input to the report[5] to measure and report mobilized private climate finance for the first time in a transparent, comparable and aggregate manner. Switzerland, together with the other donors, followed a robust methodology for the assessment of the mobilized private sector investments[6]. In developing the methodology, the donor group was guided by the following principles: (i) to ensure that only finance mobilized by developed country governments is counted towards the USD 100 billion goal, (ii) and that, where multiple actors are involved, the resulting finance is only counted once in tracking the progress, (iii) to ensure that the reporting framework encourages and incentivizes the most effective use of climate finance. The report came to the conclusion that all developed countries have jointly mobilized USD 12.8 billion in 2013 and USD 16.7 billion in 2014 from private sources. Switzerland is working on increasing its share of mobilized private finance.

5.2 Multilateral activities

Switzerland has made financial contributions to the UNFCCC Secretariat, to the operating entities of the financial mechanism of the Convention, to other multilateral institutions and to international financial institutions (IFIs) such as the World Bank and other multilateral development banks (MDBs) that fund climate change adaptation, mitigation, disaster risk management, capacity building and technology cooperation programmes in developing countries. 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 CGIAR, whose operations are co-funded by Swiss core contributions, are increasingly generating important climate benefits.

Tab. 34 indicates Switzerland's contributions to these multilateral institutions, organizations and associated programmes. Where possible, Switzerland calculated the climate relevant part of the Swiss multilateral ODA contributions using the climate relevant share of the portfolio for the respective organization according to the OECD DAC methodology. For the MDBs the relevant numbers are drawn from the latest MDBs' joint report on climate finance (*World Bank*, 2015). Switzerland also cooperates with a number of multilateral institutions as implementing agencies of bilateral and regional programmes and projects. The funds invested in those specific programmes are included in Tab. 35.

5.2.1 Green Climate Fund

As an operating entity of the financial mechanism of the Convention the Green Climate Fund's (GCF) purpose is to make a significant and ambitious contribution to the global efforts towards attaining the goal agreed by the international community to keep global warming below two degrees Celsius. In the context of sustainable development, the Fund promotes a paradigm shift towards low-emission technologies and climate-resilient development (adaptation and mitigation) with a focus on the most vulnerable countries. The GCF Board has decided to take financing decisions on the Fund's first project proposals at its third meeting in 2015. It will use grants and other financial instruments to support mitigation and adaptation activities in developing countries, while actively engaging the private sector through its private sector facility. During the reporting period, Switzerland contributed USD 0.5 million to support the secretariat to achieve the requirements leading to the first capitalization of the GCF end of 2014. Switzerland has made a pledge of USD 100 million for the Fund's Initial Resource Mobilization in November 2014. The pledge of the first tranche was formalized and disbursed in 2015.

5.2.2 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,

[5] http://www.news.admin.ch/NSBSubscriber/message/attachments/41225.pdf
[6] http://www.news.admin.ch/NSBSubscriber/message/attachments/40866.pdf

biodiversity, land degradation, forests, the ozone layer, persistent organic pollutants and international waters. Switzerland has been contributing to the Fund since its inception in 1991. To the GEF's Fifth Replenishment (2010–2014) Switzerland contributed roughly USD 114 million. 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 considerations into broader programmes, which address the cross-cutting challenges of land degradation, biodiversity, chemicals management and international waters. For the Fund's Sixth Replenishment (2014–2018) Switzerland pledged roughly USD 133 million in May 2014, with subsequent parliamentary approval.

5.2.3 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 (LDCs) with regard to the negative impacts of climate change. The LDCs identified adaptation as their top priority, which is why the LDCF is thus far the only existing fund under the Climate Convention tasked specifically with financing the preparation and implementation of National Adaptation Programmes of Action (NAPAs). Unlike the LDCF, the SCCF is open to all developing country parties to the UNFCCC by supporting adaptation and technology transfer. Switzerland committed itself to payments to the LDCF and the SCCF due to an emissions-based burden sharing formula. Between 2013 and 2014, Switzerland's contributions to both funds amounted totally to roughly USD 5 million.

5.2.4 Adaptation Fund

The Adaptation Fund (AF) was established to finance concrete adaptation projects and programmes in developing countries that are parties to the Kyoto Protocol and are particularly vulnerable to the adverse effects of climate change. Financing for the AF 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. In 2013 Switzerland provided a supplemental contribution of USD 9 million to the AF in line with Article 12 of the Kyoto Protocol.

5.2.5 Climate Investment Funds

The Climate Investment Funds (CIFs) support transformational, scaled-up climate action in developing countries that has the potential to leverage significant co-financing from the private sector and MDBs and achieve strong 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 targeted programmes: the Forest Investment Programme, the Pilot Programme for Climate Resilience and the Scaling Up Renewable Energy in Low Income Countries Programme.

Switzerland contributed up to now USD 26 million to the Scaling Up Renewable Energy in Low Income Countries Programme (SREP). The SREP's mandate is to scale-up the deployment of renewable energy solutions in the world's poorest countries to increase energy access and economic opportunities. It currently supports 27 pilot countries, including one regional programme.

5.2.6 Global Facility for Disaster Reduction and Recovery

The Global Facility for Disaster Reduction and Recovery (GFDRR) is a growing global 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: (i) risk identification, (ii) risk reduction, (iii) preparedness, (iv) financial protection, (v) 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). Switzerland contributed USD 10 million to the GFDRR from 2013 to 2014 with a particular focus on resilience to climate change.

5.3 Bilateral activities

Next to the important multilateral engagement, the bilateral programmes and projects build a key element of Switzerland's climate change cooperation. Switzerland works closely with bilateral partners to deliver effective global responses to climate change and tangible results on the ground. All activities 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. Switzerland's bilateral and regional climate-relevant activities are driven by the goal to generate new and relevant knowledge, harness and replicate successful practices and develop the skills and capacities of partner countries and their engagement in the international debate on climate change issues. A special emphasis is placed on helping civil society better access climate-sensitive information and participate in national and international decision-making processes.

In order to effectively tackle the double challenge of addressing climate change mitigation and climate change adaptation in a complementary manner and to consequently respond to the global context, the climate change activities of SDC consists of four main components: (i) climate change processes and funds, (ii) climate change mitigation, (iii) climate change adaptation, (iv) knowledge management. In total SDC spent USD 237 million between 2013 and 2014 for bilateral climate change programmes. Additional USD 11 million were provided for humanitarian aid interventions as direct adaptation response measures to natural disasters (further details see Tab. 35).

With the aim to foster climate-friendly growth in developing countries, SECO's climate change portfolio is structured mainly along three areas of intervention: (i) energy efficiency and renewable energy sources, (ii) sustainable management of natural resources, (iii) framework conditions and new market and financing mechanisms. SECO provided USD 135 million between 2013 and 2014 for its global, regional and bilateral programmes and projects in climate change. In addition, it mobilized roughly USD 3.7 million from the private sector through the Swiss Investment Fund for Emerging Markets (SIFEM)[7], which was reported to the OECD and CPI for their aggregate report.

5.4 Adaptation

Climate change presents a major global challenge and a potential threat to human welfare and to economic and social development. Yet people in developing countries are much more affected by the impacts of climate change due to widespread poverty and lower resilience and coping capacities. Switzerland has undertaken a broad range of activities to support developing countries in reducing their vulnerability to the unavoidable consequences of climate change while minimizing the social and economic costs by:

- Maintaining or increasing productive capital of land (forest, agriculture) at local level.
- Reducing vulnerability to natural hazards in highly endangered areas at the local/regional level.
- Supporting countries in defining their national and sub-national adaptation strategies and plans.
- Increasing capacity-building, technology transfer and innovation in the field of adaptation in developing and middle-income countries.
- Increasing understanding and awareness about adaptation at different levels and promoting south-south learning processes.

Besides supporting developing countries in adapting to the impacts of climate change, Switzerland has been active for many years in the prevention and reduction of disaster risks. For instance, it developed methods and tools to better integrate disaster risk reduction into project planning and project management[8].

In total Switzerland provided USD 112 million in 2013 and USD 115 million in 2014 specifically for bilateral adaptation activities on different levels (local, regional, global).

[7] The Swiss Investment Fund for Emerging Markets (SIFEM) is Switzerland's development finance institution and a cornerstone of Swiss development cooperation (see http://www.sifem.ch/).

[8] http://www.sdc.admin.ch/en/Home/Themes/Disaster_risk_reduction_emergency_relief_and_reconstruction/Disaster_Risk_Reduction

Through its bilateral and multi-bilateral development cooperation, Switzerland supported multiple climate change adaptation related projects, such as the Climate Change Adaptation Programme in semi-arid areas in India (Tab. 32) and:

- Climate Change Adaptation and Disaster Risk Reduction resulting from glacial retreat in the Andes: The accelerated retreat of tropical glaciers in the Andes has the potential to significantly change the overall risk exposure of upland communities – as it is frequently associated with increased possibilities for landslides, avalanches and floods related to glacier lake outbursts. This, in turn, alters social conditions, and further increases the vulnerability of populations living in these remote mountainous areas. Peru and Switzerland established an extensive collaboration aimed at improving local capacities for adaptation and disaster risk management that is concurrently working at different levels: At the institutional level, the objective is strengthening the glaciology and water resources unit of the National Water Authority (ANA). At the academic level, the twinning of Peruvian and Swiss universities permitted setting up revised curricula and the implementation of a number of post-graduate courses in glaciology and climate change. And finally at the local level, baseline and feasibility studies provided a solid basis for the installation of early warning systems and the implementation of suitable adaptation measures.
- Environmental Programme for Disaster Risk Management and Climate Change: Climate change will strongly affect Nicaragua and this programme provides support to rural smallholders to cope with climate change in two selected watersheds. The smallholders will improve their practices in agriculture and forestry to reduce water run-off and soil erosion. In addition, protection works will prevent or reduce losses of lives and damage to infrastructure. The outcomes of this programme are i) to increase the resilience to climate change of smallholders by promoting profitable agricultural practices of soil management, erosion control and landslide reduction, ii) to reduce disaster damage to basic infrastructure and productive land at key sites, through sustainable investments in minor protection works; iii)and capacity building in smallholders, municipal technicians and institutions.
- Adaptation for Smallholder Agriculture Programme (ASAP): SDC has disbursed CHF 10 million in 2013 and 2014 to support this programme. It has been launched by IFAD in 2012 and aims at improving the resilience to climate change of 8 million people (of whom 4 million should be women and girls) who are living in poor smallholder farming communities by 2020. Indigenous people are also an important target group, because they face economic, social, political and cultural marginalization in the society in which they live, resulting in extreme poverty and vulnerability for a disproportionate number of them. ASAP is also expected to deliver co-benefits in terms of carbon sequestration and reduction in net emissions from agriculture, and to reduce the pressure on conversion of forests to agriculture use.
- 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 programmes. It reduces the occurrence of moral hazard and adverse selection.
- Technical assistance for Disaster Risk Financing and Insurance (DRFI): The programme implemented by the World Bank aims at reducing the financial vulnerability of states to natural disasters by improving their financial response capacities in the aftermath of natural disasters while protecting their long-term fiscal balances. Most developing countries still rely heavily on post-disaster financing through budget reallocation, post disaster borrowing, or tax increases. These funds may take time to mobilize, causing potential delays in disaster response and impacting long term economic development. Sovereign disaster risk financing and insurance can help countries secure adequate funds ex-ante and execute those funds efficiently and transparently post disaster.

Tab. 32 > Promotion of Climate Change Adaptation in semi-arid and rainfed regions of India.

Project/programme title:
Promotion of Climate Change Adaptation in semi-arid and rainfed regions of Maharashtra, Madhya Pradesh and Andhra Pradesh, India.

Goal:
Develop capacities of the local communities to better handle the effects of climate change in semi-arid and rainfed regions of Maharashtra, Madhya Pradesh and Andhra Pradesh.

Recipient country	Sector	Total funding	Years in operation
India	Adaptation	CHF 5.5 million, thereof fast-start financing: CHF 1.7 million	2009–2015

Description:
The project aimed at developing capacities of the local communities to better handle the effects of climate change. It sought to develop replicable strategies, approaches, measures and processes that would help vulnerable communities cope with, and wherever possible, adapt to climate change. The project had four key objectives:

- Communities manage sustainably enhanced ecosystems in project area.
- Productivity of natural and other resources that contribute to improved quality of life of the communities is increased.
- Local institutions have in place effective governance mechanisms to sustainably manage regenerated ecosystems.
- Awareness and understanding of climate change issues amongst people, children and policy makers is increased.

The project was implemented by Watershed Organisation Trust (WOTR) in 25 villages of Maharashtra and further extended to 24 villages in Maharashtra, Madhya Pradesh and Andhra Pradesh.

Key achievements:

- 30–80% increase in crop yields in semi-arid Maharashtra.
- 20–40% cost reductions due to climate-resilient natural resources management practices.
- 38 villages adopted water budgeting plans.
- 4–12 feet increase in groundwater level in Maharashtra even in drought years, leading to supply of drinking water to neighbouring villages.
- 29% reduction in distress migration.
- 37% reduction in malnutrition in children.
- 13% reduction in anaemia among women.
- Interest by states of Andhra Pradesh and Meghalaya in scaling up.
- Innovative adaptation approaches and measures.

Technology transferred:
A key focus of the CCA project has been on local level interventions in village clusters as a means to learn about the social, political and technical innovations required for effective CCA. Building on the established WOTR portfolio of community-based mobilisation and ecosystem-based development practices, the CCA project selected a broad portfolio of local interventions for testing such as Weather based agro-advisories, Adaptive Sustainable Agriculture, Water-budgeting, People's biodiversity registers (PBRs) and clean energy campaigns among others.

Impact on government targets:
WOTR collaborated with Indian Meteorology Department (IMD) for place-specific agro-advisories. Based on its experience under the CCA project, IMD is now planning to extend the block level weather advisories to other parts of the country. WOTR's tool for vulnerability assessment, Community Driven Vulnerability Evaluation (CoDRiVE)-Programme Designer (PD), was pilot-tested in 2 districts of Andra Pradesh. The state level nodal agency (SLNA) for implementation of IWMP in Andhra Pradesh, Telengana and Maharashtra have expressed interest to pilot the use of CoDriVE –PD into 3 IWMP projects that are just being initiated. Group Micro-Irrigation model (experience of the Israipalli hamlet) is now approved for 1 more group under the Telangana State Micro-Irrigation Project (TSMIP). Sanction is awaited for another 4 groups. The manual for the People's Biodiversity Register is to be promoted by the State Biodiversity Board of Maharashtra.

As the National Implementing Entity (NIE), project partner NABARD is now able to take forward the learning of the CCA project through its Watershed Development Fund and projects supported through the Adaptation Fund and the Green Climate Fund.

SDC

5.5 Mitigation

Greenhouse gas emissions responsible for warming the planet originate from multiple sources. Therefore Switzerland's support of climate change mitigation activities in developing countries is cross-cutting building on a variety of sectors and actors. Switzerland focuses its activities on access to modern energy infrastructure, including renewable energies, rural electrification, energy efficiency in the industry and in the building/construction sector, cleaner industrial production, and sustainable use of natural resources, namely forests and grassland. In addition, Switzerland supports its partner countries in the development and use of innovative financing and market mechanisms in climate protection such as emissions trading schemes or carbon taxes. Switzerland also assists selected partner countries in developing a scientific basis for planning mitigation activities (Mitigation Action Plans and Scenarios – MAPS) and supports developing countries in the design and implementation of ambitious policies to mitigate climate change such as clean air policies or policies to mitigate black carbon emissions. Overall Switzerland provided USD 72 million in 2013 and USD 85 million in 2014 for bilateral climate change mitigation activities.

Switzerland has deepened its interministerial coordination through a number of institutional arrangements. Besides PLAFICO (see introductory chapter), the one specifically targeting the energy sector is the interdepartmental platform

on Renewable Energy and Energy Efficiency Promotion in International Cooperation (REPIC)[9]. Apart from enhancing knowledge and coherence, REPIC offers seed money, capacity building and technical advice for promising climate change initiatives, during the pre-competitive phases of project development, for technology and market testing. In Tanzania for example, REPIC funded solar thermal demonstration units on a university campus to show their simple handling and reliable operation. The positive results lead to the installation of additional 40 solar thermal systems for the overall 500 students. Based on the positive experience gained within this project, a further goal is the distribution of this technology in the region.

Through its bilateral development cooperation Switzerland supports multiple climate change mitigation projects, such as the Green Building Code Colombia (Tab. 33) and the following:

- The Energising Development Partnership (EnDev) is a joint impact-oriented global programme of six donor countries. EnDev supports the provision of energy for household applications such as the provision of modern energy for lighting and small electrical appliances (e.g. information and communication technologies). It also supports energy for cooking and heating through the promotion of efficient and clean cooking, baking and space heating devices. The programme promotes the provision of energy for social infrastructures such as schools, hospitals and community centres; and energy for small and medium-sized enterprises, cooperatives and craftsmen through the provision of modern energy services for productive use, for income generation.
- Sino-Swiss Cooperation on Clean Air and Climate Change Legislation and Policy (CCLP): China and Switzerland have established an intensive cooperation on Clean Air policy improvements, based on practical piloting actions and exchange of experts from policy and practice. The project culminated in the publication of the Revised Air Pollution Prevention and Control Act in China in September 2014, with significant contributions by Swiss Experts based on our long-standing experience, notably regarding the chapters on the multi-pollutant co-control, the VOC Emissions, vehicle emission control, and the long-term vision on air pollution control among others. In several pilot cities, standards and measures for enforcing of the law were tested. The regulations and implementation at the local level remain a top priority and need to be further developed.

Tab. 33 > 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 1.7 million	2011–2015

Description:
The programme consists of the following three components:

- The design of a national Green Building Code that will establish sustainable standards to be applied by developers and municipalities nationwide as well as adapted regulation for all four climate zones in Colombia in representative cities.
- Capacity building within the construction related public and private sector.
- 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 (approved in June 2015)
- Strengthen implementation capacities of national stakeholders
- Strengthen awareness raising on green building issues

Technology transferred:
Not applicable.

Impact on greenhouse gas emissions/sinks:
Reduction of greenhouse gas emission will only be measurable after the implementation of the code, but it is expected to be 189,753 metric tons/year.

SECO

[9] http://repic.ch/repic-en/

5.6 Multiple benefits of forestry

At a global scale, deforestation is responsible for about 8% of global greenhouse gas emissions in 2014[10]. By absorbing and storing CO_2 from the atmosphere, tropical forests are therefore of critical importance in mitigating climate change. In addition, stronger ecosystems often provide important climate adaptation benefits for livelihoods and hazard protection. However, Switzerland's activities in the field of sustainable management of forests, grasslands and soil do not only focus on mitigation and adaptation effects, but are also geared towards yielding multiple environmental, economic and social benefits. By making sure that these areas are both protected and used as a sustainable source of income for local communities, natural resources are in fact at the heart of the fight against poverty.

Through its bilateral, regional and multilateral development cooperation Switzerland supports 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 the development and piloting of REDD+ and thus preparations for a results-based payment scheme to sustainably manage and protect forests as important carbon stocks and sinks.
- Sustainability standards: Switzerland supports initiatives involving sustainability standards for renewable commodities (e.g. tropical timber, cocoa, cotton), some of which are important drivers of deforestation.
- Participatory Forest Management Project in Bhutan: Community forestry contributes to improved livelihoods, sustainably managed forests and democratic governance in Bhutan. Being the largest community-based organisation in Bhutan it has the potential of providing role models for grassroots organisations and developing leadership capacities of women contributing to the increased representation of women in local governments. Community forestry stands for the ongoing shift in paradigm in Bhutan's forestry sector from strict protection towards a sustainable use of resources.
- ASEAN-Swiss Partnership on Social Forestry & Climate Change: South-East Asia is one of the world's most vulnerable regions to climate change and environmental degradation, due to high population growth, growth in consumption and economic activities in coastal and mountain areas. More than 100 million poor people in the region heavily rely on the forests that cover about 50% of the total land area. Deforestation significantly contributes to greenhouse gas emissions, but forests also help to mitigate global warming and contribute to reduce vulnerability of the rural poor. The overall goal of the project is to contribute to food security through sustainable, efficient and effective use of land, forest, water and aquatic resources by minimizing the risks and impacts of, and the contributions to climate change. It addresses two specific objectives: (i) social forestry approaches integrated into the climate change adaptation and mitigation strategies, (ii) socio-economic benefits derived from the inclusion of communities, women and vulnerable groups in forestry and climate change adaptation and mitigation measures.

5.7 Provision of financial resources (including under Article 11 KP)

Switzerland's development cooperation has steadily increased over the last years. Tab. 34 and Tab. 35 give an overview on multilateral and bilateral climate-related public contributions of Switzerland. Overall, Switzerland disbursed USD 299 million in the form of grants through bilateral, multi-bilateral and multilateral channels in 2014 (up from USD 281 million in 2013) as public climate finance. Of the bilateral climate finance USD 115 million or 57% went to adaptation and USD 87 million or 43% went to mitigation (compared to USD 112 million and 61% for adaptation and USD 72 million and 39% for mitigation in 2013). More details are provided in the BR CTF Tables.

The data in Tab. 34 is based on support provided and the climate-specific part of the inflows is calculated based on the climate-specific imputed shares published on a year-by-year basis by the OECD DAC.

[10] http://www.globalcarbonproject.org

Tab. 34 > Switzerland's financial contributions to multilateral institutions and programmes 2013 and 2014.

	2013		2014		2013-14
	Core contribution	Climate-specific contribution	Core contribution	Climate-specific contribution	Average imputed share
	USD				
Multilateral climate change funds					
1 Global Environment Facility	30'743'789	16'909'084	31'714'211	17'442'816	55%
2 Least Developed Countries Fund	1'078'729	1'078'729	1'092'840	1'092'840	100%
3 Special Climate Change Fund	1'348'412	1'348'412	1'366'050	1'366'050	100%
4 Adaptation Fund	10'787'295	10'787'295	0	0	100%
5 Green Climate Fund	0	0	546'420	546'420	100%
6 UNFCCC Trust Fund for Supplementary Activities	214'513	214'513	211'776	211'776	100%
7 IPCC	107'873	107'873	174'854	174'854	100%
Sub-total	**44'280'611**	**30'445'906**	**35'106'151**	**20'834'756**	**64%**
Multilateral financial institutions, including regional development banks					
1 World Bank (including IDA and IBRD)	227'224'264	42'803'862	230'196'477	43'363'759	IDA: 20%; IBDF: n/a
2 International Finance Corporation	0	0	0	0	n.a.
3 African Development Bank	56'870'007	18'767'103	83'878'134	27'679'784	33%
4 Asian Development Bank	12'944'753	3'236'188	13'114'078	3'278'519	25%
5 European Bank for Reconstruction and Development	0	0	0	0	n.a.
6 Inter-American Development Bank	1'300'705	0	1'454'944	0	n.a.
Sub-total	**298'339'729**	**64'807'153**	**328'643'633**	**74'322'062**	**22%**
Specialized United Nations bodies					
1 United Nations Development Programme	64'723'767	0	65'570'388	0	n.a.
2 United Nations Environment Programme	4'483'955	0	4'610'800	0	n.a.
Sub-total	**69'207'722**	**0**	**70'181'188**	**0**	**0%**
Other					
1 UNCCD	647'238	0	1'004'468	0	n.a.
2 IFAD	10'247'930	0	10'381'978	0	n.a.
3 UNISDR	606'785	0	1'229'445	0	n.a.
4 CGIAR	16'720'306	0	16'939'017	0	n.a.
5 Multilateral Fund for the Implementation of the Montreal Protocol	1'893'820	1'893'820	1'918'592	1'918'592	100%
Sub-total	**30'116'079**	**1'893'820**	**31'473'500**	**1'918'592**	**6%**
Total	**441'944'141**	**97'146'879**	**465'404'472**	**97'075'410**	**21%**

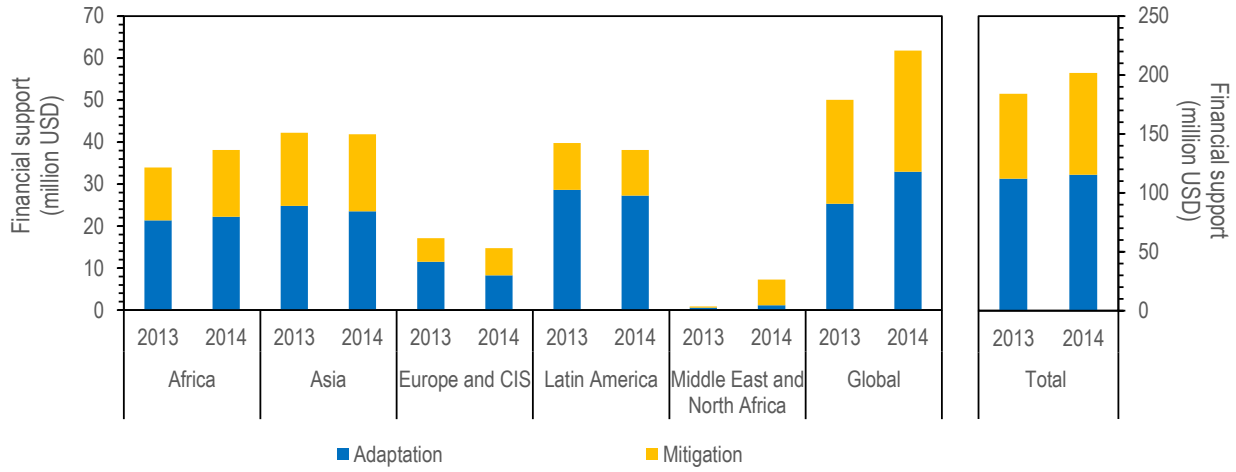
n.a., not applicable

Tab. 35 > Switzerland's public financial contributions through bilateral and multi-bilateral channels 2013 and 2014.

	2013		2014	
	CHF	USD	CHF	USD
Adaptation activities of SDC				
Programmes and projects in Africa	17'071'266	18'415'277	18'077'726	19'756'058
Programmes and projects in Asia	20'134'740	21'719'937	19'752'427	21'586'238
Programmes and projects in Europe and CIS	3'268'174	3'525'476	4'068'190	4'445'880
Programmes and projects in Latin America	23'620'287	25'479'900	20'686'114	22'606'609
Programmes and projects in the Middle East and North Africa	393'378	424'348	337'117	368'415
Global programmes and projects	11'867'894	12'802'247	16'226'445	17'732'905
Humanitarian aid adaptation programmes and projects	3'765'788	4'062'266	6'248'389	6'828'488
Sub-total	**80'121'527**	**86'429'451**	**85'396'408**	**93'324'593**
Mitigation activities of SDC				
Programmes and projects in Africa	6'567'791	7'084'870	8'904'831	9'731'554
Programmes and projects in Asia	8'755'229	9'444'523	9'753'662	10'659'190
Programmes and projects in Europe and CIS	505'561	545'364	545'744	596'411
Programmes and projects in Latin America	8'278'760	8'930'542	6'710'533	7'333'537
Programmes and projects in the Middle East and North Africa	200'000	215'746	0	0
Global programmes and projects	5'902'976	6'367'714	7'004'514	7'654'812
Humanitarian aid mitigation programmes and projects	0	0	39'688	43'373
Sub-total	**30'210'317**	**32'588'759**	**32'958'972**	**36'018'877**
Adaptation activities of SECO				
Programmes and projects in Africa	2'726'194	2'940'826	2'243'748	2'452'058
Programmes and projects in Asia/Oceania	2'849'874	3'074'243	1'740'483	1'902'069
Programmes and projects in Europe and CIS	7'383'615	7'964'923	3'475'077	3'797'702
Programmes and projects in Latin America	2'948'971	3'181'142	4'257'261	4'652'504
Programmes and projects in the Middle East and North Africa	155'206	167'425	752'875	822'772
Global programmes and projects	7'299'020	7'873'668	7'150'397	7'814'238
SIFEM adaptation programmes and projects	0	0	0	0
Sub-total	**23'362'880**	**25'202'227**	**19'619'841**	**21'441'343**
Mitigation activities of SECO				
Programmes and projects in Africa	5'140'862	5'545'596	5'686'586	6'214'527
Programmes and projects in Asia/Oceania	7'411'992	7'995'534	7'078'551	7'735'722
Programmes and projects in Europe and CIS	4'731'186	5'103'670	5'399'862	5'901'184
Programmes and projects in Latin America	1'999'497	2'156'916	3'209'131	3'507'066
Programmes and projects in the Middle East and North Africa	29'268	31'572	5'588'475	6'107'308
Global programmes and projects	11'895'393	12'831'911	11'213'358	12'254'404
SIFEM mitigation programmes and projects	4'667'821	5'035'316	7'667'789	8'379'665
Sub-total	**35'876'019**	**38'700'515**	**45'843'752**	**50'099'877**
Adaptation activities of FOEN (Global)				
Sub-total	**432'368**	**466'408**	**379'202**	**414'407**
Mitigation activities of FOEN (Global)				
Sub-total	**306'365**	**330'485**	**416'066**	**454'693**
Adaptation activities through other government entities (Global)				
Sub-total	**80'000**	**86'298**	**128'000**	**139'883**
Mitigation activities through other government entities (Global)				
Sub-total	**200'000**	**215'746**	**32'000**	**34'971**
Sub-total public bilateral adaptation	**103'996'775**	**112'184'384**	**105'523'451**	**115'320'226**
Sub-total public bilateral mitigation	**66'592'701**	**71'835'505**	**79'250'790**	**86'608'418**
Total	**170'589'476**	**184'019'889**	**184'774'241**	**201'928'644**

All contributions included in Tab. 35 are public provided climate-specific and grant-based financial contributions from Switzerland. The climate-specific share of each activity is assessed based on the Rio-marker methodology and project specific reduction factors are applied. A reduction factor of 1–50% will be applied for activities with an indirect impact on climate change adaptation or mitigation (significant marker) and a reduction factor of 51–100% will be applied for activities with a direct impact on climate change adaptation or mitigation (principal marker). Double counting between adaptation and mitigation specific activities is excluded. Table Tab. 35 includes aggregate data per region. The BR CTF Tables contain more disaggregated data.

Fig. 19 > Trend of Swiss bilateral and multi-bilateral disbursed public support for climate change mitigation and adaptation activities in developing countries, 2013 and 2014.



5.8 Technology transfer and capacity building for mitigation and adaptation in developing countries

Most Swiss programmes and projects, which support developing countries in their endeavours to mitigate and adapt to climate change, contain a technology transfer and a capacity-building component. Technology transfer and capacity-building are critical means of implementation to ensure the sustainability of a project or programme, in particular in the area of infrastructure financing and the development of local markets and products.

Due to the integrated character of technology transfer and capacity-building, it is hardly possible to single out the respective components. In addition, it would not do justice to the integrated approach underpinning Switzerland's climate change interventions. Therefore, technology transfer and capacity-building components of Swiss-funded projects are not systematically identified in this report. However, for illustrative purposes, various project examples given below showcase how the integrated approach plays out.

- Since the beginning, Switzerland has been an active member of the World Bank programme Partnership for Market Readiness (PMR). The PMR is a forum for collective innovation and action and a fund to support capacity building to scale up climate change mitigation, including carbon pricing instruments such as an emissions trading scheme, a carbon tax or a crediting Nationally Appropriate Mitigation Actions (NAMA).
- In Burkina-Faso, the interdepartmental platform on Renewable Energy and Energy Efficiency Promotion in International Cooperation (REPIC) supports the establishment of a local production of energy efficient heat pump fruit dryers. In a first phase in 2011, a Swiss NGO in cooperation with a Swiss University developed a dryer specifically for subtropical conditions. Thanks to the new drying system with heat pump technology, operating costs and CO_2 emissions can be reduced by more than 50%. Through the Swiss know-how and technology transfer, resident refrigeration specialists are enabled to create and market the dryer locally. The dryer dissemination will strengthen local small businesses, as well as the livelihoods of fruit dryer producers and their employees.

- African Forests, People and Climate Change: The impacts of climate change are posing a major threat to the future development in Sub-Saharan Africa. Improved capacities and knowledge about the forest-climate change nexus is crucial to make sure that the full potential of African forests and trees is mobilized for adapting to climate change and mitigating the adverse effects. The overall goal of the project is to build capacities of stakeholders to strengthen the role of Africa's forests and trees to adapt to climate change and mitigate its adverse effects in various landscapes in ways that will enhance livelihoods, sustain biodiversity and improve the quality of the environment. This will be achieved through programmatic and institutional strengthening of the African Forest Forum (AFF) in ways that foster an independent and objective analysis of related issues, promote advocacy and offer advice on all relevant policy and technical issues in forests and climate change.
- Since 2012, SECO has been one of the main partners of UNIDO's global Resource Efficient and Cleaner Production (RECP) Programme that applies and disseminates cleaner production methods in order to support developing and transition countries on their way toward green growth. The RECP programme aims to increase the efficiency of energy and resources use in industrial production and to improve companies' environmental performance.

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Abbreviations and acronyms

AAU	Assigned Amount Units
AF	Adaptation Funds
ARE	Federal Office for Spatial Development
ART	Agroscope Reckenholz-Tänikon Research Station
CER	Certified Emission Reduction
CFCs	Chlorofluorocarbons
CH_4	Methane
CHF	Swiss francs
CIS	Commonwealth of Independent States
CMP	Meeting of the Parties to the Kyoto Protocol
CO	Carbon monoxide
CO_2	Carbon dioxide
CORINAIR	CORe INventory of AIR emissions
CRF	Common Reporting Format
CRMG	Commodity Risk Management Group
CRT	Continuously Regenerating Trap
DES	Data Exchange Standard
DETEC	Federal Department of Environment, Transport, Energy and Communications
EASA	European Aviation Safety Agency
ECAC	European Civil Aviation Conference
EMEP	European Monitoring and Evaluation Programme
EMIS	Swiss National Air Pollution Database
EPA	Environmental Protection Act
EPFL	Swiss Federal Institute of Technology Lausanne
ETH/ETHZ	Swiss Federal Institute of Technology Zurich
ERU	Emission Reduction Units
FAL	Swiss Federal Research Station for Agroecology and Agriculture
FCA	Swiss Federal Customs Administration
FCPF	Forest Carbon Partnership Facility
FDFA	Federal Department of Foreign Affairs
FEDRO	Federal Roads Office
FOAG	Federal Office for Agriculture
FOCA	Federal Office of Civil Aviation
FOEN	Federal Office for the Environment
FOITT	Federal Office of Information Technology, Systems and Telecommunication
SFSO	Federal Office of Statistics
GCF	Green Climate Fund's
GDP	Gross Domestic Product
GEF	Global Environment Facility
GWP	Global Warming Potential
HFCs	Hydrofluorocarbons
ICAO	International Civil Aviation Organization
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change

IPPU	Industrial Processes and Product Use
ISDC	Interdepartmental Sustainable Development Committee
ITL	International Transaction Log
LCA	Life cycle analysis
lCER	Long-term Certified Emissions Reduction
LDC	Least Developed Countries
LPG	Liquefied petroleum gas
LULUCF	Land Use, Land-Use Change and Forestry
MDB	Multilateral Development Banks
MSWI	Swiss municipal solid waste incineration plants
NFI	National Forest Inventory
NGO	Non-governmental organization
NH_3	Ammonia
NIS	National Inventory System
NMVOC	Non-methane volatile organic compound
NOx	Nitrogen oxides
N_2O	Nitrous oxide
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PFCs	Perfluorocarbons
PMR	Partnership for Market Readiness
QA	Quality assurance
QC	Quality control
QMS	Quality Management System
REDD	Reducing Emissions from Deforestation and Forest Degradation
REPIC	Renewable Energy and Energy Efficiency Promotion in International Cooperation
RMU	Carbon Removal Unit
SBSTA	Subsidiary Body for Scientific and Technological Advice
SDC	Swiss Agency for Development and Cooperation
SECO	State Secretariat for Economic Affairs
SEF	Standard Electronic Format
SF_6	Sulphur hexafluoride
SFOE	Swiss Federal Office of Energy
SO_2	Sulphur dioxide
tCER	Temporary Certified Emissions Reduction
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
VOC	Volatile organic compounds
WAM	With additional measures
WEM	With existing measures
WOM	Without measures