UN Framework Convention on Climate Change

Third National Communication of Switzerland 2001

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This report reflects the state of Swiss climate policy
as of July 2001

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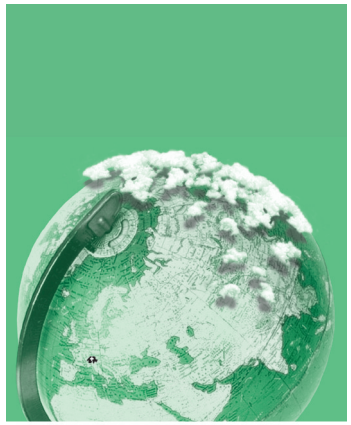

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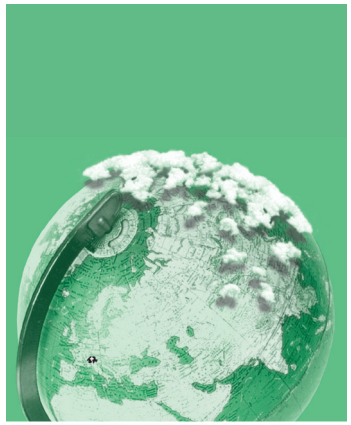

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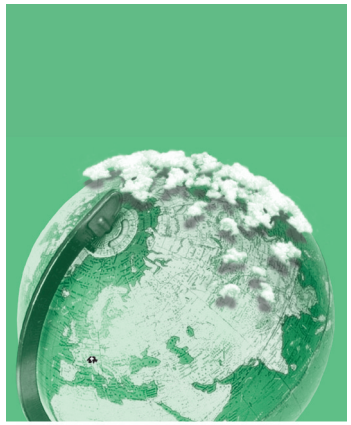
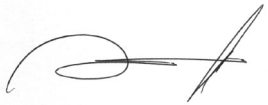


In the course of 2001, the IPCC presented the results of its third assessment. The message of the global climate research community is quite clear: mankind has begun to change the climate of planet Earth. We can no longer deny that with every tonne of greenhouse gas emitted into the atmosphere we are consciously putting at risk all those who are vulnerable to changing climatic conditions. We also know that Switzerland will not be exempted from the list of victims.

From historical records we have learned that the inspiration and ingenuity of human beings alone are not enough to understand the processes that have shaped civilisation over the past centuries. The climate has always been a factor influencing social and economic development. This is another reason why we cannot ignore that we are thoughtlessly playing with fire if we continue to waste the fossil resources offered to us by nature.

The Climate Convention is the appropriate framework to assume our common responsibility, and the Kyoto Protocol to that Convention shows us the way to take the first, challenging steps in the right direction.

At the end of the last decade, the objective of stabilising CO_2 emissions, as set by the Swiss government in 1990, was reached. Through the Law on the Reduction of CO_2 Emissions, which entered into force in spring 2000, the stage is now set to face the challenge of decreasing emissions. In addition, it is gratifying to note that climate policy has become an issue of constructive cooperation, involving a wide range of government agencies, the economic sector, and non-governmental institutions. On this basis, I am confident that Switzerland will continue to be a reliable partner of all nations willing to make progress in the spirit of the Kyoto Protocol.



Philippe Roch, Director
Swiss Agency for the Environment, Forests and Landscape

1. Executive summary

1.1. Introduction and retrospective view

This report is Switzerland's third National Communication under the UN Framework Convention on Climate Change. In accordance with convention guidelines, it documents activities undertaken with a view to meeting commitments under the convention. Switzerland signed the United Nations Framework Convention on Climate Change on 9 May 1992. The second National Communication was submitted on 21 April 1997. The in-depth review of this communication was carried out between January and May 1998.

The most noteworthy recent developments related to climate policy are as follows:

- Switzerland has adopted new CO_2 legislation, providing a framework for a climate change policy focussing on transparent targets that take into account the Swiss commitments under the Kyoto Protocol. The modern approach is based on voluntary agreements as well as economic instruments. If the impact of voluntary action is not sufficient, a CO_2 tax can be introduced. This legislation is based on the ongoing successful energy policy with a new national energy law and related programme activities.
- The national 'Energy 2000' programme ended in 2000. The programme activities have been carefully evaluated building the basis for shaping the 'SwissEnergy' follow-up programme, which started in January 2001.
- The consensus in freight transport policy allows Switzerland to follow its long-term approach of modal shift from road to rail, also considering improvements of efficiency in the road sector. The core element of this strategy is the introduction of the new Heavy Goods Vehicle (HGV) fee on 1 January 2001, which takes into account the external costs of transport.
- No specific new measures were introduced in the areas of policy on air pollution and on waste. Nevertheless, the policies implemented earlier have been strengthened and further developed, following the European approach of reducing air pollution levels.
- At the same time, in the agricultural and forestry sectors, the implementation of sustainability plans has been intensified.
- International activities have been expanded with a view to gaining experience with the new approaches as foreseen by the Kyoto Protocol.

1.2. National circumstances

At the end of 1999, the population of Switzerland was 7.12 million. Two thirds of the Swiss population live in metropolitan areas. The country's area is approximately 41,300 km^2, of which 31 per cent are forests, 37 per cent cropland and permanent pasture, 7 per cent built up and 25 per cent unproductive land. Nominal gross domestic product (GDP) for 1999 was 387 billion CHF, which was a 1.8 per cent increase over the previous year. Real GDP has been rising slightly since 1995. In the nineties, Switzerland, like other European countries, faced economic problems, with increasing unemployment (0.6 per cent in 1990; 4.2 per cent in 1995) and growing deficits in the national budget. However, these problems have now eased, and in 2000 unemployment was down to 1.9 per cent.

Energy use in Switzerland was 855.3 PJ in 2000, which was 0.8 per cent less than in the previous year. 80.1 per cent of final energy consumption was imported from abroad. Oil products made up 60 per cent of final energy consumption, electricity accounted for 22 per cent and gas for 11 per cent. In the last decade, gas and renewable forms of energy together with transport fuels underwent the greatest increases since 1990. Meanwhile, heating oils decreased by 1.3 per cent per year.

Electricity generation is nearly free of fossil fuels (58 per cent hydroelectric power and 38 per cent nuclear power from five plants). Electricity is traded across Swiss borders on a rather large scale. Amongst the factors affecting this trade are hydrological and climatic conditions. Traditionally, Switzerland has been a net exporter of electricity.

Emissions of CO_2 from road transport are based on fuel sold in Switzerland. This includes the so-called 'tank tourism' which occurs because petrol prices in Switzerland are at present significantly lower than in neighbouring countries.

Climatic conditions vary significantly across Switzerland, depending mainly on altitude and latitude (north or south of the Alps). Since there is a considerable yearly variation in weather conditions, heating degree days are an important basis for assessing trends in energy consumption and CO_2 emissions taking account of the effect of seasonal variations in weather.

The Swiss political system is a Confederation with a federal government, parliament and court. The territory consists of 26 cantons (states), each of which has its own government, parliament and cantonal courts. Responsibilities are shared between the federal level and the cantons. Subsidiarity plays an important role. This is reflected in constitutional law which states that unless the legislative power is explicitly attributed to the federal level, the cantons are sovereign, i.e. entitled to legislate in an area of policy.

Co-operation between the different political levels and between the government and the economy is of considerable importance in Switzerland. Formal and informal elements of direct democracy including public participation through initiatives, referenda and consultation procedures play a crucial role and are applied on a regular basis.

Switzerland is a member of several international organisations (e.g. the OECD, the World Bank Group, and all UN specialised agencies). However, it is not a member of

the UN or of the European Union. A governmental proposal to join the European Economic Area, the economic core of the EU, was turned down in 1992 as was a similar proposal, made in 2001. In 2000, Switzerland signed bilateral agreements with the EU on major policy areas such as the free movement of persons, and transport by land and air. A referendum on joining the UN is planned for 2002.

1.3. Greenhouse gas (GHG) inventory information

Switzerland provides standardised technical inventories according to UNFCCC and IPCC guidelines on a yearly basis. The latest submission containing the 1999 inventory dates from April 2001. Summary and trend tables pertaining to that inventory submission may be found in Annex 1 of the present report.

1.3.1. Overview of the Swiss 1999 GHG inventory

Emissions of CO_2

In 1999, gross CO_2 emissions amounted to 44,800 Gg, i.e. 6.25 tonnes per capita. Three quarters of CO_2 emissions were from transportation (34 per cent) and small-scale combustion (41 per cent of which nearly two thirds from the residential sector). Industry (energy and non-energy related emissions) accounted for 20 per cent. Bunker fuel emissions from international aviation are estimated at 4,500 Gg. In line with UNFCCC guidelines, bunker fuel emissions are not included in national inventory figures. At present, the difference between carbon release and carbon uptake by forests indicates an absorption of the order of 4,200 Gg CO_2 per year. Thus, Swiss forests are significant sinks, absorbing a volume corresponding to 9.4 per cent of gross CO_2 emissions.

Emissions of CH_4

Methane emissions were 216 Gg, with nearly two thirds from agriculture, and 29 per cent emitted by the waste sector.

Emissions of N_2O

Total emissions amounted to 11.6 Gg, with slightly over 70 per cent emitted by agriculture. Transport is another important source, with about 18 per cent.

Other greenhouse gases (HFCs, PFCs and SF_6)

These have been of marginal importance in Switzerland and presently account for about 1 per cent of overall gross greenhouse gas emissions. The 1999 emission figures in terms of CO_2 equivalents are 366 Gg for HFCs, 28 Gg for PFCs and 125 Gg for SF_6.

Precursor gases

Out of a total of 99 Gg NO_x emissions, 58 per cent came from the transport sector. Small-scale combustion (19 per cent) was the second most important source.

Of the total of 400 Gg CO emitted, 62 per cent were from the transport sector. About 21 per cent were emitted by small-scale combustion. The category ‚others' (i.e. industrial and construction machinery) emitted another 10 per cent.

In 1999, 165 Gg of non-methane VOCs (NMVOCs) were emitted. The main sources were solvent use in industry (64 per cent) and transport (19 per cent).

Emissions of SO_2

In 1999, 25.5 Gg SO_2 were emitted, with small-scale combustion in the lead at 43 per cent, followed by energy-related emissions from industry with a 21 per cent share.

IPCC source / sink category		CO_2 (1,000 Gg)	CH_4 (Gg)	N_2O (Gg)	HFCs/ PFCs/ SF_6 (Gg CO_2 eq)[1)]	NO_x (Gg)	CO (Gg)	NMVOCs (Gg)	SO_2 (Gg)
1	All energy	41.2	18	2.3	n.o.	93	385	51.8	19.8
	Fuel combustion	(41.1)	(5.7)	(2.3)		(93)	(385)	(44.9)	(19.8)
	Fugitive emissions	(0.07)	(12.4)	(0.0)		(0.06)	(0.01)	(6.9)	(n.o.)
2	Industrial processes	2.2	0.4	0.31	519	0.32	11.3	7.8	3.4
3	Solvent use	n.o.	n.o.	0.39	n.o.	0.04	0.09	104	0.04
4	Agriculture (3 years average)	n.e.	134.5	8.3	n.e.	n.e.	n.e.	n.e.	n.e.
6	Waste	1.3	62.6	0.32	n.o.	5.3	3.3	1.2	2.3
	Total gross emissions	**44.8**	**216**	**11.6**	**519**	**98.7**	**400**	**165**	**25.5**
5	Land use change & forestry	-4.2	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	Total net emissions	**40.6**	**216**	**11.6**	**519**	**98.7**	**400**	**165**	**25.5**
	International bunkers	(4.5)	n.e.	n.e.	n.o.	n.e.	n.e.	n.e.	n.e.

[1)] CO_2 eq = CO_2 equivalents according to IPCC 1995 GWP values for a 100 year horizon
n.o. = not occurring; n.e. = not estimated

Table 1-1: Overview of 1999 emissions and sinks

1.3.2. Recent emission trends

Compared with the 1990 level, CO_2 emissions remained quite stable with a slight oscillation of ± 4 per cent; CH_4 emissions declined. These results can mainly be attributed to the effects of energy-related policies and measures (for CO_2) and stringent prescriptions in the waste sector (in the case of CH_4). In addition, the recessional economic trend led to a slow-down in energy use in all sectors. On the other hand N_2O emissions increased slightly (2 per cent), as a result of the increasing use of catalytic converters.

Due to uncertain data, no clear trend can yet be given for the changes in other greenhouse gas emissions (HFCs, PFCs, SF_6). Generally, with the abolishion of CFCs, HFC emissions have been on the rise.

Precursor gas emissions declined significantly between 1990 and 1999. The most important reason is the effect of stringent emission standards in different sectors (especially transport and small-scale combustion). Emissions of CO and NMVOCs declined by 5 per cent annually and NO_x emissions by 4 per cent per year. Between 1990 and 1999, SO_2 emissions declined by nearly 40 per cent. This reduction is due to the lower sulphur content in light and heavy fuel oil.

1.3.3. Overall emissions balance

On the basis of 1995 IPCC Global Warming Potential (GWP) values for a 100 year time horizon, the gross GHG emissions of Switzerland amounted to 53,500 Gg of CO_2 equivalents in 1999. If removals by sinks are considered, this amount is reduced to a net emission of 49,300 Gg of CO_2 equivalents.

In comparison with 1990 there is no significant change in the proportions of CO_2, CH_4, N_2O and the new gases.

The contribution by sector and by gas is shown in figure 1-1. The largest proportions are from the transport sector with 30 per cent and from the residential sector with 22 per cent.

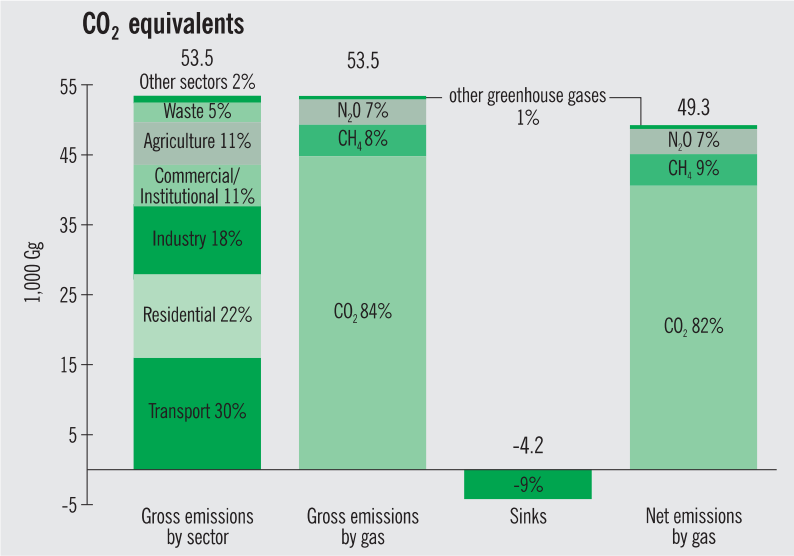


Figure 1-1: CO_2 equivalents by sector and by gas 1999 (not including international bunkers)

1.4. Policies and measures

1.4.1. Climate policy issues

Climate policy in Switzerland is incorporated in the different policies for sectors, which existed before climate change became an important issue. The new CO_2 legislation provides a framework by fixing reduction targets and related instruments:

Federal law on the reduction of CO_2 emissions; in force since 1 May 2000

This recent law is the core element of Swiss climate policy. It was adopted in October 1999 and stipulates an overall target of 10 per cent reduction by 2010 compared to 1990 levels for energy-related CO_2 emissions. Emissions from combustible fuels must be cut by 15 per cent and from petrol/diesel by 8 per cent. The law on CO_2 is being implemented in two stages. The first phase from 2000 to 2004 focuses on voluntary measures taken by industries and households to decrease CO_2 emissions due to energy consumption. This approach is fully compatible with the energy policy and related energy efficiency programmes. Only if the reduction targets seem unlikely to be met, will an incentive tax on fossil fuels (CO_2 tax) be levied in the second phase from 2004 onwards. The maximum rate is fixed at 210 CHF per tonne of CO_2. The tax rates have to be approved by parliament.

The necessity for the tax and the appropriate tax rate depend on the effect of voluntary action, and on the effectiveness of other instruments available, which are relevant to CO_2, e.g., the energy law (see below). The mechanism of the law on the reduction of CO_2 emissions suggests that private initiative is given priority over state intervention. If an incentive tax turns out to be nevertheless necessary, exemption from the tax will be granted to industries entering a legally binding CO_2 reduction commitment, for which energy intensive companies, big emitters and associated groups of emitters are eligible. Net tax revenues will be fully redistributed - without increasing national budgets - to the economy in proportion to the wages paid and to the population on a per capita basis.

Energy policy

The federal energy law of 1998 and the corresponding ordinances shape the legal framework for the federal energy policy. This legislation calls for extensive co-operation with the private sector, reaffirms the principle of subsidiarity, and gives priority to voluntary measures. In addition, the sharing out of competencies between the federal government and the cantons is defined.

The Confederation can provide funds to cantons which have established a programme favouring energy efficiency and renewable forms of energy. In the context of voluntary agreements, co-ordination, evaluation, monitoring and reporting tasks are delegated to private energy agencies in the private sector. The energy consumption of electrical appliances and vehicles may be decreased based on voluntary agreements between producers and purchasers and the Federal Office of Energy. If there is no agreement, or if the agreed target is not met, the government may define criteria for allowing appliances or vehicles on the market.

The most important energy efficiency measures are integrated in the 'Energy 2000' programme, which started in 1990 and is being followed up by the 'SwissEnergy' action plan (from 2001). Between 1990 and 2000 around 560 million CHF were spent on different sub-programmes addressing the most important economic sectors. These activities were accompanied by a stringent evaluation and monitoring programme in order to allocate financial resources properly and to improve knowledge of the impacts and effects of programme activities. Between 1991 and 2000, a total of 9.8 (min.) to 13.7 (max.) million tonnes of CO_2 was saved by measures in the 'Energy 2000' programme. Most of the measures show a favourable cost-effectiveness ratio.

At the same time, Switzerland is discussing fair and efficient ways of liberalising the energy market. The parliament passed the federal law on the electricity market in December 2000. This law is to be challenged by a referendum in 2002. It foresees substantial support for renewable electricity production. However, falling electricity prices might offset incentives to use energy more efficiently. A law on the natural gas market is also being prepared.

Environmental policy

The Swiss federal law on the protection of the environment (revised in 1995) focuses on the precautionary principle and the polluter pays principle. Moreover, a number of ordinances (e.g. those on air pollution control, on waste disposal, and on hazardous substances) are relevant to climate change, and form the basis for reducing emissions. In addition to the ongoing improvement of emission standards (especially in the transport sector), incentive taxes on NMVOCs and on the sulphur content of light fuel oil aim at reducing related emissions from industry and households.

Transport policy

Since the last report, Switzerland has strengthened its approach of promoting environmentally sound transport modes. This is especially true within the freight sector, where a breakthrough has been reached. Freight transport policy is based on the introduction of the distance-related HGV (heavy goods vehicle) fee, accompanied by adjustment of the weight limit to the European average. The revenue will be used mainly to finance investments in public transport infrastructure (alpine tunnels and improvement of passenger relations). Sustainable alpine transit traffic is given very high priority. Additional supporting measures (in particular the promotion of combined transport solutions) are implemented in order to reduce the transit of HGVs through the Alps.

In addition, measures aiming at reducing fuel consumption for passenger cars play an important role in the 'Energy 2000' programme (now 'SwissEnergy'), for example improved driving behaviour, promotion of car sharing and ways of reducing the specific energy consumption of new cars.

Agricultural policy

The Swiss agricultural policy has been undergoing major reform over the last ten years. The changes in the agricultural policy reflect a clear demand by the population as well as the necessity to increase competitiveness and to fulfil international commitments. The tasks of farmers have been reformulated, highlighting competitiveness as well as the protection of the environment (maintenance of the fertility of the soil, conservation and promotion of biological and landscape diversity etc.).

The farmers' response to the new political framework has been very positive. At the end of 2000, environmentally friendly production systems meeting the requirements mentioned above were already applied to over 90 per cent of the agricultural land, and it is expected that the percentage will continue to rise in the next few years, with quality targets and criteria also included in this environmental programme.

Forestry policy

The new forest law, in force since 1993, confirms the long-standing Swiss tradition of preserving the forest area. It protects the forests as close to nature ecosystems. These aims are accompanied by the objective of making better use of the potential of forests for timber production. Thus a timber promotion campaign is being launched in 2001, and financial support is granted for the use of wood as a source of energy.

1.4.2. Measures implemented

Table 1-2 (next page) gives an overview of measures that are most relevant to climate policy, and which have been implemented in the various sectors (situation in July 2001).

1.4.3. Measures adopted or planned

The most important measure adopted is based on the new CO_2 legislation. The CO_2 tax will fill a possible gap between emission trends and predefined targets if voluntary actions do not yield the expected results. In addition, long-term eco-tax proposals are being discussed, with a view to increasing the cost of non-renewable forms of energy, while reducing labour costs.

The most important measures adopted or planned are included in table 1-3 (situation in July 2001).

Table 1-2: Measures implemented (for further details see the fact sheets in Annex 2)

Name of policy or measure	Objective and/or activity affected	GHGs affected	Type of instrument	Status	Implementing entity or entities	Impact indicators
CO_2 Law	Setting targets and timetables for reduction of CO_2 emissions (combustible fuels and petrol/ diesel, total 10 per cent reduction by 2010 compared with 1990)	CO_2, precursors	Framework legislation: - voluntary, with option for economic incentive tax	In force since 1 May 2000; guideline for voluntary action decreed in July 2001	Swiss Agency for the Environment, Forests and Landscape	Fulfilment of CO_2 requirements according to CO_2 legislation (periodic monitoring of overall emissions; progress reports by players engaged in voluntary agreements)
Energy Law	Ensure safe energy supply, contribute to rational and efficient energy use	CO_2	Framework legislation: - institutional - economic - regulatory	Implemented since 1998	Federal Office of Energy, cantons	Increase in overall energy consumption from 1990 - 2000: 69 PJ Energy savings through legal measures 1990 - 2000: 90.3 PJ
‚SwissEnergy' action plan (follow up programme of former ‚Energy 2000' programme)	10% reduction of fossil fuels from 2000 to 2010	CO_2	Voluntary agreements	Implemented since 1990, the ‚SwissEnergy' action plan is the follow up programme of former ‚Energy 2000'	Federal Office of Energy, cantons and partners in the public and the private sectors	Direct and indirect effects of the programme measured in energy saved and reduction in CO_2 emitted Overall energy savings 1990-2000: 165.5 PJ (9.8 - 13.7 million tonnes of CO_2)
Cantonal and communal energy laws	Adapt the Swiss Energy Law, according to the same goals	CO_2	Framework legislation: - institutional - economic - regulatory	Continuously implemented	Swiss cantons and communal entities; ‚Energy 2000' and ‚SwissEnergy'	Cantonal energy indicators Analysis of the effects of energy policy
Energy efficiency programmes in the building sector	Implementation of Swiss Energy Law (labelling, co-operation, advice)	CO_2	Institutional Regulatory	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, cantons and partners in the public and the private sectors	Energy consumption in new and renovated buildings Energy savings of Energy 2000 in building sector in 2000: 0.8 PJ
Energy efficiency programmes in the commercial and industrial sector	Voluntary agreements, models for large-scale consumers to exhaust technical potentials	CO_2	Voluntary agreements	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, partners in the public and the private sectors	Energy savings of Energy 2000 in commercial and industrial sector in 2000: 12.4 PJ
Energy efficiency programmes in the transport sector	Voluntary agreements (EcoDrive, Car Sharing etc.) to increase efficient use of fossil fuels	CO_2	Voluntary agreements	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, partners in the public and the private sectors	Energy consumption of new passenger cars Energy Savings of Energy 2000 in transport sector in 2000: 2.9 PJ
Energy efficiency programmes in the renewable energy sector	Increase of 3 TWh renewable heat production and 0.5 TWh electricity until 2010 by promotion activities	CO_2	Voluntary agreements Subsidies by cantons	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, Cantons and partners in the public and the private sectors	Change in final consumption of renewable energy from 1990 to 2000: +21.9 PJ (136.8 PJ in total in 2000) Energy saved with energy efficiency measures Energy Savings 2000: 5.5 PJ
Distance-related heavy vehicles fee	Transfer of freight traffic from road to rail, reduction of Transalpine road traffic	CO_2, precursors	Economic measure (Internalisation of external costs)	Implemented since 2001	Federal Office of Customs, Federal Road Administration	Loading factors, change in vehicle-km road - rail Expected reduction in HGV vehicle-km for 2005: from 13.6 per cent up to 17.2 per cent
Modal split measures in freight transport	Transfer of freight traffic from road to rail, reduction of transalpine road traffic (supporting the HGV fee)	CO_2, precursors	Institutional subsidies (combined transport)	Beginning of implementation in 2000	Federal Office of Transport	Reduction in vehicle-km for HGVs, increase in combined transport, traffic volume of transalpine lorries: Expected reduction in HGV vehicle-km in 2005 (with HGV fee: from 18 per cent up to 21.7 per cent)
Sustainability and protection of forest area	Sustainable forest management, no reduction of forest area	CO_2	Regulatory education	Ongoing implementation since 1993	Swiss Agency for the Environment, Forests and Landscape	Number of trees, and their CO_2 absorption
Greenhouse gas mitigation in agriculture	Promotion of ecological practices on farms	CO_2, CH_4, N_2O	Economic voluntary	Ongoing implementation since 1993	Federal Office of Agriculture	Reduction in cattle, and in the use of mineral fertiliser
Ordinances relating to hazardous substances (Annex 4.16) and spray cans	Ban of use of synthetic gases depending on their half life in the air	HFCs, PFCs	Regulatory	In force since 1995 and 1996, respectively	Swiss Agency for the Environment, Forests and Landscape	Absence of certain fluorocarbons in fire extinguishing systems and spray cans
NMVOC charge	Reduction in fugitive fuel emissions	Precursors	Economic	Implemented since 1997, in vigour since 1999	Swiss Agency for the Environment, Forests and Landscape	Expected reduction: 27,000 tonnes of VOCs 100 million CHF in revenue

Table 1-3: Measures adopted or planned

Name of policy or measure	Objective and/or activity affected	GHGs affected	Type of instrument	Status	Implementing entity or entities	Impact indicators
Law on electricity market	Supporting measures to the liberalisation of the electricity markets: consideration of renewable forms of energy	CO_2	Institutional regulatory	Adopted by parliament in 2000; subject to public referendum in 2002	Federal Office of Energy	Percentage of renewable electricity production in 2000: 59.2 per cent (139 PJ)
Ordinance relating to environmentally hazardous substances	Limitation of production, import, sale, use and emission of halogenated gases with a half life in the air of more than 2 years	HFCs, PFCs, SF6	Regulatory Voluntary Agreement Institutional	Possible decision in 2002	Swiss Agency for the Environment, Forests and Landscape	Contribution to Kyoto commitment
CO_2 tax	Reduction of CO_2 emissions according to legal requirements (10 per cent in 2010 compared with 1990)	CO_2, precursors	Economic	Adopted in the law on CO_2 reduction, introduction in 2004 will be discussed if voluntary measures are not sufficient	Swiss Agency for the Environment, Forests and Landscape	Fulfilment of CO_2 requirements according to CO_2 legislation
Ecological tax reform	Shifting tax burden from labour to energy use	CO_2, other emissions	Economic /energy levy and reduction of wage costs	Possible decision in 2004 together with CO_2 tax	Swiss government	Model calculations

1.5. Projections and the total effect of measures

1.5.1. Projections for CO_2, CH_4 and N_2O

The projections for CO_2 are based on scenarios using bottom-up model calculations. These models are applied for long term energy perspectives from 1990 to 2030. The results differ slightly from inventory results, mainly because they consider corrections of data for annual variation in heating degree days.

Non-energy CO_2 emissions are based on production estimates, and carbon sinks are based on the extrapolation of trends. At present, no data are available for carbon fluxes in agricultural soils.

Table 1-4 shows overall emission trends in 2000 and 2010.

	CO_2 (1,000 Gg)		CH_4 (Gg)		N_2O (Gg)	
	2000	2010	2000	2010	2000	2010
Energy[1)]	41.1	40.8	18.7	16.8	2.03	1.29
Industrial processes	2.3	2.3	0.4	0.5	0.31	0.31
Solvent use					0.39	0.41
Agriculture			133.7	129.0	8.04	7.83
Land use change/ forestry	-3.0	-4.5				
Waste	1.4	1.6	61.6	29.3	0.33	0.50
Total (net)	**41.8**	**40.2 (-4%)**	**214.4**	**175.6 (-18%)**	**11.1**	**10.34 (-7%)**

[1)] not including international bunkers (2000 = 4,600 Gg CO_2, 2010 = 5,500 Gg CO_2)

Table 1-4: Projections for emissions of CO_2, CH_4 and N_2O in 2000 and 2010 (measures implemented)

A scenario including the effects of adopted and planned measures (i.e. including a CO_2 tax, as foreseen by the CO_2 law) leads to energy-related CO_2 emissions of 37,800 Gg and 35,900 Gg in 2010 and 2020 respectively.

1.5.2. Other GHG emissions

Table 1-5 presents projections for the most important HFCs and SF_6. The results are mainly based on a substance flow analysis for Switzerland for the years 1997 and 1998.

For PFCs, no trend data are available (actual emissions in 1999 were about 5 per cent of CO_2 equivalent emissions from all synthetic greenhouse gases).

Gg CO_2 equivalent	2000	2010	
HFCs	530	970	(+84%)
SF_6	130	150	(+18%)
Total	**660**	**1'120**	**(+71%)**

Table 1-5: Projections for other GHGs (HFCs and SF_6) 1990 - 2010

1.5.3. Aggregate effects of policies and measures

Table 1-6 shows the expected aggregate effect for the period 1990 to 2020 of measures that are presently under implementation. The projected overall reduction between 1990 and 2020 amounts to 12.3 per cent. Between 1990 and 2010, the overall reduction corresponds to 7.2 per cent.

CO_2 equivalent (Gg)	1990	2000	2005	2010	2015	2020
CO_2	46'430	44'820	44'840	44'700	44'180	43'470
CH_4	5'080	4'480	4'100	3'670	3'610	3'540
N_2O	3'480	3'440	3'350	3'200	3'100	3'030
HFC	0	530	930	970	n.a.	n.a.
PFC	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SF_6	160	130	140	150	n.a.	n.a.
Sinks	-3'190	-3'000	-4'500	-4'500	-4'500	-4'500
Total	**51'960**	**50'400**	**48'860**	**48'190**	**46'390**	**45'540**

n.a. = not available

Table 1-6: Projections for all GHGs in CO_2 equivalent (1990 – 2020)

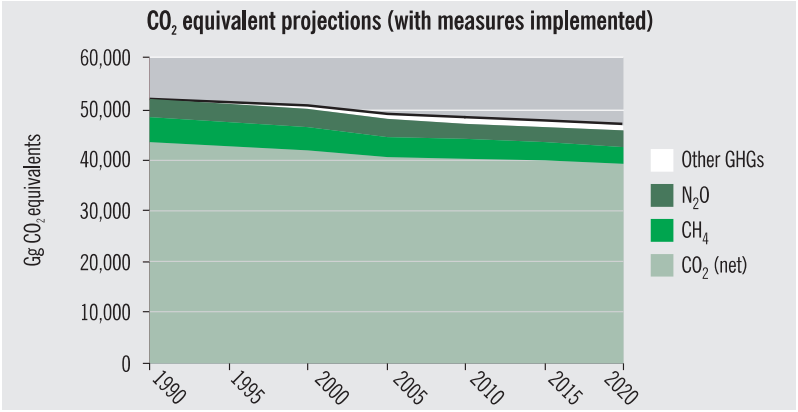


Figure 1-2: Projections of CO_2 equivalent emissions 1990-2020 (based on energy scenario 'with measures implemented'; HFC, PFC, SF_6 emissions kept constant after 2010)

1.5.4. Precursors and SO_2

The estimates are based on long-term perspectives for air pollutants. As a result of measures to reduce air pollution, all emissions tend to decline. Between 1990 and 2010, the following changes are expected.

- NO_x -58 per cent
- CO -57 per cent
- NMVOCs -56 per cent
- SO_2 -56 per cent

1.6. Impacts and adaptation

Recent research has investigated the effects of climate change in Switzerland. Monitoring and model results indicate that there might be significant effects on ecosystems and hydrological cycles due to climate change. Particular effects are expected in alpine regions, where glaciers and permafrost are highly sensitive to changes in surface temperature.

Since the last report, several new research studies have improved our knowledge of vulnerability. Several sectors are seen to be particularly vulnerable, such as mountain, forest and freshwater ecosystems, as a result of the ecological effects of rises in temperature. The increased incidence of storms, and reduced snowfall are specifically important for alpine areas, tourism and forestry. In addition, the insurance sector (an important service sector in Switzerland) is affected by increased payments due to extreme weather events.

Between 1972 and 1998, floods and landslides caused about 200 million CHF per year of direct financial damage, with more than 1,250 observed events. For avalanches, the financial damage covered by insurance was around 6 million CHF per year over the period 1972 to 1993. In February 1999, 1,200 destructive events proved that avalanche damage can be very expensive (620 million CHF of total damage). The financial damage resulting from the storm 'Lothar' in December 1999 reached 1.8 billion CHF, and the floods in May 1999 caused 600 million CHF of damage.

The 1.5 billion CHF spent on avalanche control measures and on land-use planning since the catastrophic winter of 1950-51 have reduced the number of fatalities to about one or two per year. Initial projects to safeguard against the risks of thawing permafrost have recently been implemented.

The legal regulations for adaptation measures are sector-based. Vigorous efforts have been made to apply the same strategy and similar approaches for dealing with all kind of natural hazards. The most important are regulations on flood protection and forest management. The main responsibilities are still at the cantonal level. The emphasis is to an increasing extent placed on preventive measures. Therefore, hazard and risk assessment, the definition of protection targets, the integrated planning of measures (mapping, technical measures and warning systems) and the limitation of residual risk are of central importance.

For actions based on engineering measures, the total financial support from the Confederation between 1988 and 1999 was 65 million CHF per year for flood protection and 80 million CHF per year for protection against avalanches, erosion and landslides. Alarm systems have been installed at various sites, to alert the authorities responsible and those at risk.

1.7. Financial resources and transfer of technology

Switzerland's international involvement consists of the following:

- Swiss **Global Environment Programme (GEP).** Activities give priority to strategic planning, building of institutions and discussions with stakeholders on policy, especially aiming to increase energy efficiency and to promote renewable forms of energy. Between 1997 and 2000, 24.7 million CHF were spent on energy, transport and industry. The evaluation of best practice leads to four main conclusions for future objectives:
  - Build up knowledge-based skills and capacities
  - Facilitate making informed decisions and choices

- Support technology adaptation and ownership
- Build partnerships based on trust and confidence.

- Bilateral measures for **Central and Eastern Europe and the CIS**: Swiss bilateral co-operation is based on three funds (1990, 1992 and 1999). Of the total amount of 2.55 billion CHF, 1.7 billion CHF have already been allocated for financial co-operation.
- Specific support for **transition countries**: Switzerland is supporting the creation of Cleaner production centres (CPC's), with 5.6 million CHF granted between 1998 and 2000. In addition Switzerland joined the pilot phase for activities implemented jointly (AIJ). The Swiss AIJ pilot programme (SWAPP) was launched in April 1997. During the pilot phase, Switzerland aims to provide financial support, to design incentives for private sector investment, to contribute to methodological progress and to build up capacities and institutions.
- **Multilateral activities:** Switzerland is engaged in several multilateral institutions (see table 7-9 on page 65). An important new involvement is the financial support of the World Bank's National JI/CDM Strategy Studies Programme (nearly 8 million CHF granted since 1997).

1.8. Research and systematic observation

The most important topics of **Swiss climate research** are the physical climate system (e.g. studies on atmospheric processes and dynamics, alpine vulnerability, regional climate, the analysis of time series data, the history of the climate, and monitoring). Other important topics are the analysis of biogeochemical processes, the impacts of climate change, and the human dimensions of global change. In the year 2000, a total of 420 research projects were in progress. A major part was dealing with the analysis of earth system processes. Total funding was about 12 million CHF per year, which comes to an average funding per project of nearly 100,000 CHF. More than half of all climate research was funded via grants to individual researchers by the Swiss National Science Foundation. EU projects constituted about 15 per cent of all projects.

A new National Competence Centre of Research on Climate Change was created in April 2001. This centre aims at acquiring a better understanding of climate system processes, adapting and refining scientific tools within an interdisciplinary approach, and transferring knowledge. It was given funding of 8.2 million CHF for the first three years. While the amount of funding for these projects will be only about 15 per cent of total funding, their impact may become substantially more pronounced through positive interactions through the internal co-ordination of these projects.

Swiss energy research is co-ordinated by the Federal Office of Energy. A major part of it is related to the development of renewable energy sources and efficient energy use. The research efforts are linked to international research activities (EUREKA, COST and the EU Framework Programmes). In 1999, a total of 180 million CHF was allocated for energy research.

Systematic observation activities in Switzerland are carried out by different institutions as shown in detail in the separate report on GCOS related activities. The Swiss authorities encourage and support research and systematic observation on the climate system in order to better understand climate changes and their consequences. This support extends to specialised international organisations and programmes. It also takes account of the needs for related capacity building in developing countries. Switzerland is involved in the meteorological land surface and upper air observation systems, in the Global Atmosphere Watch (including associated programmes such as the Baseline Surface Radiation Network), in most of the terrestrial systems of GTOS (glacier, permafrost, snow, hydrology, forest, etc.), and in other international programmes. Capacity building has been developed in relation with the GAW programme and international services (calibration and quality assurance centres, data centres, the Nairobi ozonesonde station), and with the hydrological programme in Asia.

1.9. Education, training and public awareness

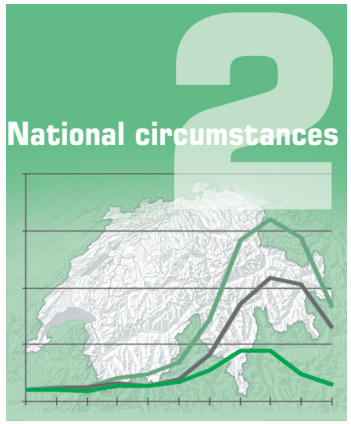
Activities in education, training and public awareness are carried out through the government as well as by the private sector. Information and communication platforms have been built up by the Swiss Agency for the Environment, Forests and Landscape (SAEFL) and by the Federal Office of Meteorology and Climatology (MeteoSwiss). The official climate web site of the SAEFL (www.klima-schweiz.ch) is continuously expanding its services, and has become an important source of information for a broad audience. Publications and sponsoring activities are other means of giving information and raising public awareness.

In the past, a very important source of training has been the 'Energy 2000' programme, where projects and programmes, carried out both by the government and by the private sector, aimed at educating stakeholders through specific courses and information events, by marketing new technologies and by promoting energy efficient behaviour. These activities are being continued through the new 'SwissEnergy' action plan.

Numerous activities concerning information related to climate change are carried out by the Swiss Academy of Sciences' Forum for Climate and Global Change (ProClim). These include an information system with access via the internet (www.proclim.ch) on research in the area of global change, a quarterly newsletter and the organisation of workshops and public forums on global change topics.

At the regional level, several networks exist to promote and discuss energy and climate issues with interested players. In addition, Swiss environmental NGOs are raising awareness through campaigns and projects. The most active are the WWF and Greenpeace.

2. National circumstances



2.1. Geographical and economic context

Location

Switzerland is located between 45°49' and 47°48' north and from 5°57' to 10°30' east. It comprises an area of 41,300 km^2. The location in the heart of Europe and in the centre of the European Union leads to substantial imports and exports of goods and services, and to flows which transit through Switzerland. The main, highest mountain range, the Alps, is a natural barrier to traffic moving in a north-south direction, i.e. between northern Europe and Italy. A number of tunnels enable road and rail traffic to cross the Alps. Two new railway tunnels to facilitate and speed up traffic are currently under construction.

Climatic profile

Climatic conditions vary significantly across Switzerland, depending mainly on altitude and location (north or south of the Alps).

Figure 2-1 shows the index of heating degree days from 1960 to 1999 (1990 = 100). Since there is a considerable yearly variation in weather conditions, heating degree days are an important basis for calculating the effect of weather variability on energy consumption and CO_2 emissions (climate correction). Climate corrected figures are used to adjust base year figures in emission forecasts (see section 5.1) as well as in the retrospective assessment of the effects of the measures.

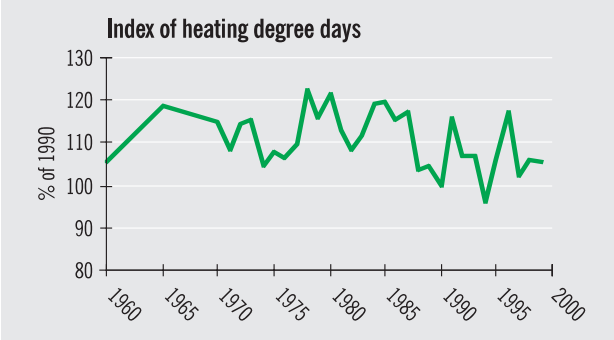


Figure 2-1: Index of heating degree days (1990=100; FOE 2000)

Population

At the end of 1999, the population of Switzerland was 7.12 million. Two thirds of the Swiss population live in cities or metropolitan areas. The population density was 173.5 persons per km^2 in 1999. Figure 2-2 shows the change from 1960 to 1999.

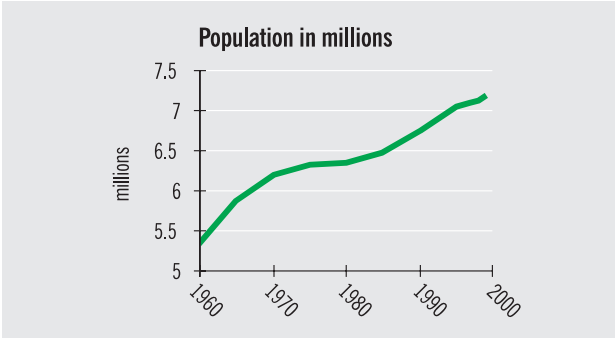


Figure 2-2: Population between 1960 and 1999 (FOS 2000a)

Land use

The area of the country is approximately 41,300 km^2, of which 31 per cent are forest and woodland, 37 per cent cropland and permanent pasture, 7 per cent built up, and 25 per cent unproductive land. The size of the built-up area more than doubled between 1950 and 1990, with continued increase after 1990. Transport infrastructure takes up 2.3 per cent of the overall area. The number of farms, of livestock and of people employed in primary agricultural production have decreased over recent decades, while the average size and productivity per farm have increased.

Economy: GDP, public debt and balance of payments

Nominal GDP was 387 billion CHF in 1999 which is a 1.8 per cent increase over the previous year. In real terms, GDP remained level in the early nineties, but has been increasing since 1995. Figure 2-3 shows the changes in nominal and real GDP between 1970 and 1999.

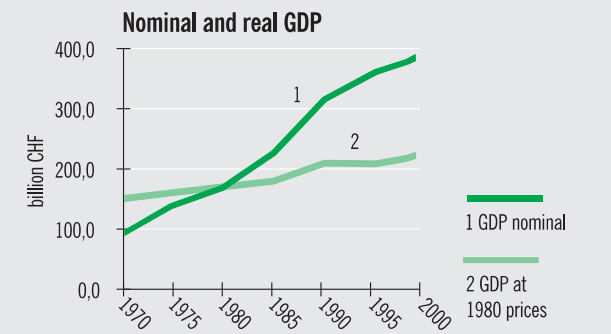


Figure 2-3: Nominal and real GDP (at 1980 prices) between 1970 and 1999 (FOS 2000a)

Over the period from 1990 to 1997, real GDP 'per capita', i.e. per fulltime job, increased continuously (see figure 2-4).

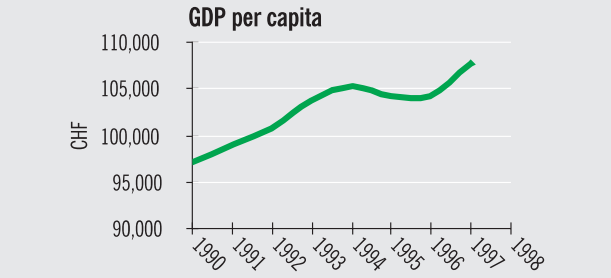


Figure 2-4: Real GDP per capita (at 1990 prices expressed as per fulltime job) between 1990 and 1997 (FOS 2000a)

Unemployment was 1.9 per cent in 2000. In parallel with rising unemployment, government spending of all three administrative levels together has exceeded revenues since 1990, which has led to increasing debt. However, over the past few years the gap between expenditure and income has been closing rapidly.

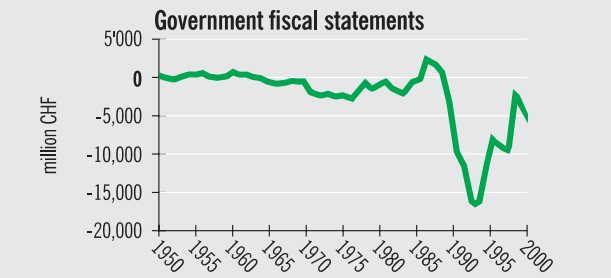


Figure 2-5: Government fiscal statements (in million CHF, nominal) between 1950 and 1998 (all administrative levels; FOS 2000b)

Typically, the elements of the Swiss balance of payments can be characterised as follows:

- the balance of trade with goods is negative
- the balance of services is positive
- the balance of labour and capital incomes is positive
- the balance of transfers is negative.

Energy supply

Switzerland does not have any fossil energy resources of its own. In 2000, 59.7 per cent of total final energy consumption was oil, 22.0 per cent electricity and 11.1 per cent natural gas. The rest comprised wood, waste, district heating, coal and several renewable forms of energy. Over 80 per cent of energy consumption was imported. 16.3 per cent of final energy use was from renewable sources, most of it hydroelectricity. Almost two thirds (57.9 per cent in 2000) of electricity generation was hydroelectric, 38.2 per cent was produced in the five domestic nuclear power plants, and the rest in thermal power plants or from other renewable sources (solar energy, wind, biomass). The contribution of the renewable sources wind and solar energy to electricity generation is still small (below 1 per cent), but, supported by the 'Energy 2000' programme, it increased markedly between 1990 and 2000 (wind energy: 1991 0.1 GWh; 1999 3.3 GWh; solar energy (electricity): 1991 2.0 GWh; 1999 9.0 GWh, FOE 2000).

Energy end use by sector

Between 1980 and 1999, aggregate end use of energy increased by 25.1 per cent. The largest increase was in the transport sector (+52.5 per cent), whereas energy consumption in industry increased by 26.8 per cent, 4 per cent more than the service sector. The household sector had an increase of 8.9 per cent. In 1999, transport accounted for 32.2 per cent of energy end use, whereas in 1950 its share was only 15 per cent.

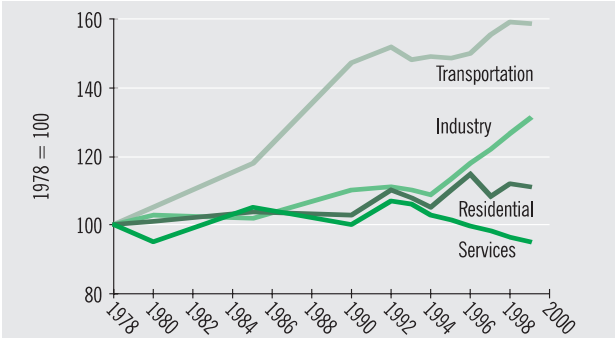


Figure 2-6: Indices for energy end use by sector between 1978 and 1999 (1978=100; total: 861,770 TJ; FOE 2000)

Energy productivity has remained the same in recent decades, in other words the index of per capita energy consumption and the index of per capita GDP increased steadily.

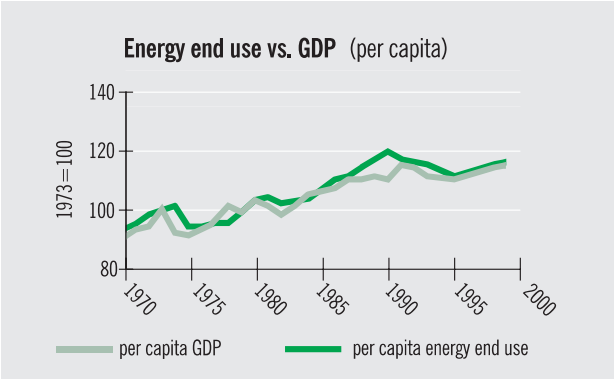


Figure 2-7: Indices of per capita energy end use and per capita GDP between 1970 and 1998 (1973 = 100; FOS 2000)

Energy prices

Between 1970 and 1993, the real prices of energy sources decreased in general, and reached a historic low.

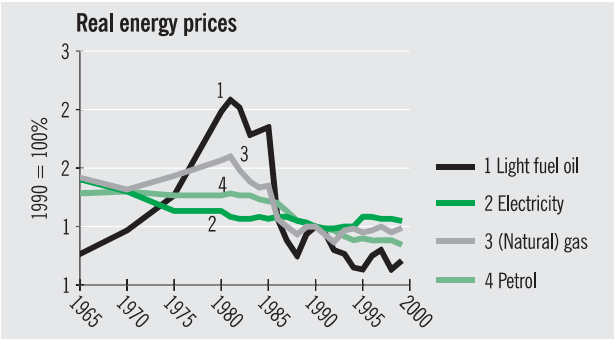


Figure 2-8: Indices of real energy prices of major energy sources at retail and household levels between 1965 and 1999 (1990=100; FOE 2000)

Electricity trade

Electricity is traded across Swiss borders on rather a large scale. Amongst the factors affecting the volume traded are hydrological and climatic conditions. Traditionally, Switzerland has been a net exporter of electricity. Exchanges take place with several western and central European countries. Figure 2-9 shows electricity exchanges with neighbouring countries for the year 1999, when exports by Switzerland exceeded imports by some 9,300 GWh.

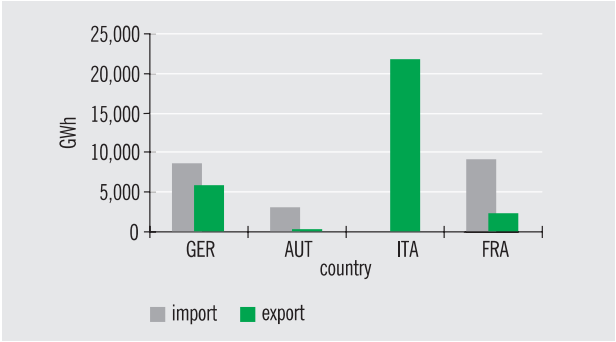


Figure 2-9: Electricity imports and exports by Switzerland to and from neighbouring countries (UCTE 2001)

Transport sector

Unlike the road network, Swiss rail infrastructure has not been significantly expanded over the past 50 years. Nevertheless, by international comparison, Swiss railways play an important role in the transport market, especially in passenger transport. Figure 2-10 shows the demand for passenger transport by road, rail, and air & water.

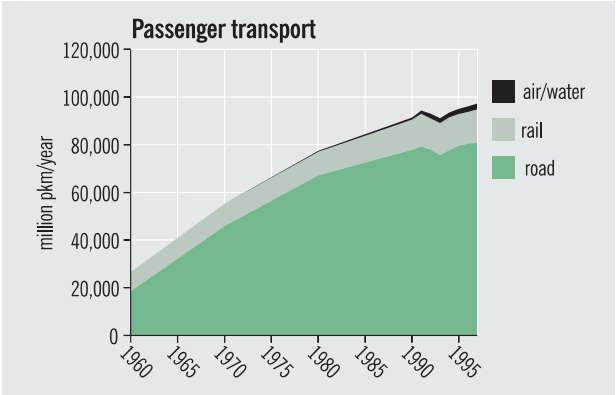


Figure 2-10: Passenger transport 1960 - 1997 (FOS 2000a)

As in most European countries, rail has been losing market share to road in freight transport. Figure 2-11 shows the market shares of road, rail and air & water freight transport in Switzerland.

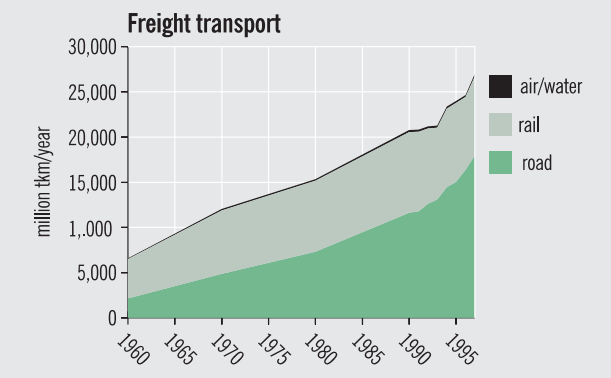


Figure 2-11: Freight transport 1960 - 1997 (FOS 2000a)

Rail has suffered a similar setback in transalpine freight transport, although Swiss rail transport has traditionally had a particularly strong position compared with that in neighbouring alpine countries, because of significant restrictions on road freight transport in Switzerland (28 tonne weight limit until 2001, and a ban on lorries at night and on Sundays).

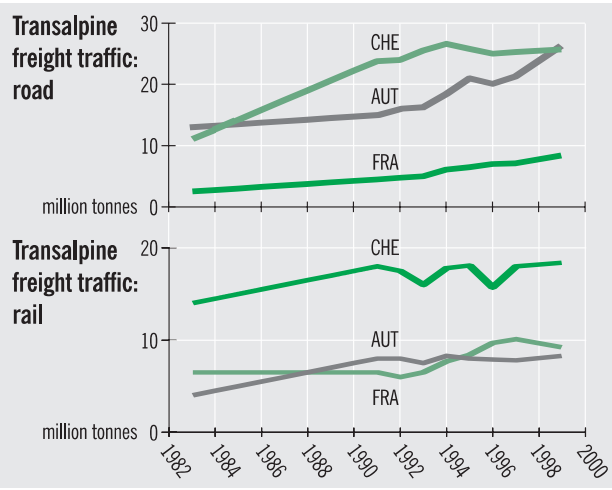


Figure 2-12: Transalpine freight traffic (goods in million tonnes; FOS 2000a)

Car ownership (including minibuses) increased from 510,000 vehicles in 1950 to 3.55 million in 2000 (FOS 2001), so half the inhabitants of Switzerland own a car.

2.2. GHG emissions from 1900 to 1999

In most sectors the quality of data is only satisfactory from about 1950 on, when emissions started to soar. Consequently, emission data from the period 1900 to 1950 are rough estimates, and are based on a number of assumptions.

2.2.1. CO_2

Anthropogenic gross CO_2 emissions have increased markedly since 1950. This has mainly been due to a large increase in fossil fuel consumption. From 1980 on the emissions have remained fairly stable.

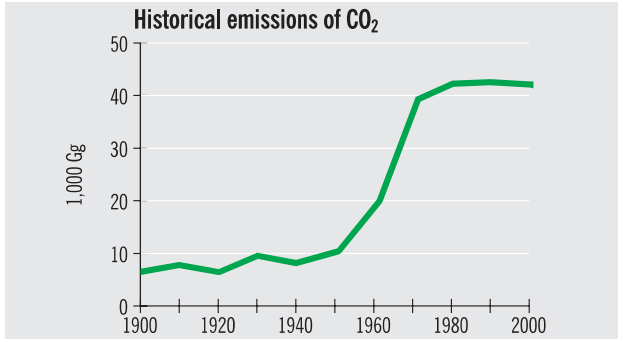


Figure 2-13: Gross CO_2 emissions from 1900 to 1999; (SAEFL 1995; 2000a, 2001)

Per capita CO_2 emissions peaked in 1980 and have decreased since then. This partly reflects increased energy efficiency.

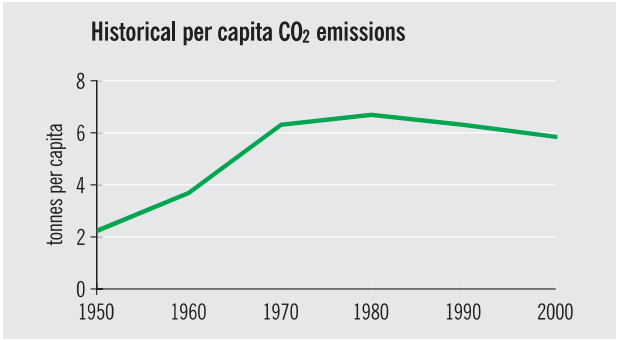


Figure 2-14: Per capita gross CO_2 emissions from 1950 to 1999; (SAEFL 1995; 2000a; 2001)

When interpreting Swiss CO_2 emissions a few points should be borne in mind.

- Switzerland has very little heavy industry, which would tend to be particularly emission-intensive.

- Electricity generation in Switzerland (hydroelectric and nuclear) causes relatively little CO_2 emissions. This leads to lower per capita emissions compared with other countries.
- Since the emissions inventory relates to the Swiss territory, energy embodied in products consumed in Switzerland, but produced abroad, is not included. A recent study indicates that the CO_2 emissions corresponding to energy embodied in the energy and foodstuffs sectors alone amount to about one third of domestic emissions (SAEFL, 2000b).
- Possible CO_2 emissions from net electricity trade are not included.
- Emissions of CO_2 from road transport are based on fuel sold in Switzerland. This includes the so-called 'tank tourism' which takes place because petrol prices in Switzerland are at present significantly lower than in neighbouring countries. However, diesel prices are relatively higher in Switzerland.

The ratio of gross CO_2 emissions per unit of real GDP increased until around 1970, but has decreased since then.

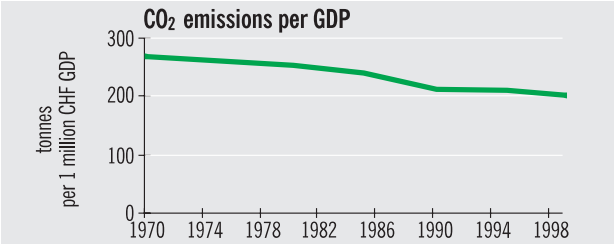


Figure 2-15: Ratio of gross CO_2 emissions per unit of real GDP (at 1980 prices) between 1970 and 1998 (SAEFL 1995; 2000a; 2001; FOS 2000a)

2.2.2. CH_4

Total methane emissions increased steadily from 1950, peaked around 1970 and have since decreased. In 1990 most of the emissions (62 per cent) were caused by the agricultural sector (mainly cattle), the second most important source was the waste sector (28 per cent), where most emissions stem from landfills. Quantities from all sources have decreased in recent years (decreasing number of livestock and improved feed quality; technical improvements).

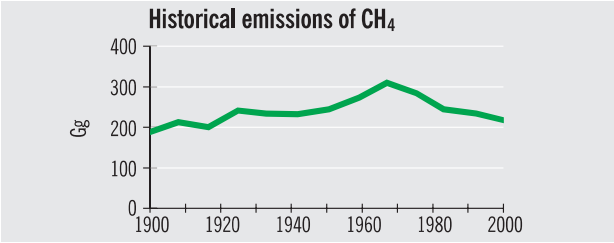


Figure 2-16: CH_4 emissions from 1900 to 1999; (SAEFL 1995; 2000a; 2001)

2.2.3. N_2O

Emissions of N_2O were already substantial in 1910 (6,250 tonnes) and have increased steadily until the present. The main source is agriculture (81 per cent in 1990, decreasing to 71 per cent in 1999). The contribution of the transport sector has increased rapidly (9 per cent in 1990, rising to 18 per cent in 1999).

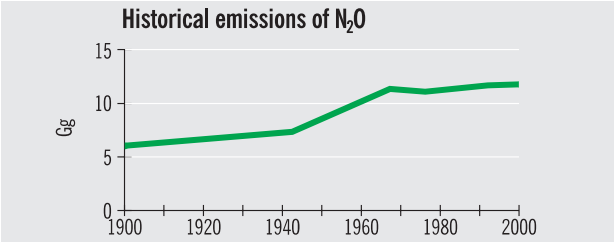


Figure 2-17: N_2O emissions from 1900 to 1999; (SAEFL 1995; 2000a, 2001)

2.2.4. Precursors (NO_X, NMVOCs, CO)

Emissions of NO_X increased gradually between 1900 and 1950. After 1950, they rose more rapidly and reached a peak in around 1980, when they were six times as high as in 1950. The rapid increase was due to road transport. The decrease from 1985 on has been due to the market penetration of the catalytic converter for passenger cars which has been mandatory for new cars since 1987, and which reduces specific NO_X emissions (emissions per km driven) by 80 to 90 per cent.

Emissions of NMVOCs increased by a factor of 3.5 between 1900 and 1950. Between 1950 and 1980 they increased almost fivefold, mainly due to the increased use of solvents in industry, in the small-scale service sector and in private households. A further reason is the rapid growth in transport. During the last two decades the emissions returned to their 1960 level.

Emissions of CO increased by a factor of 2.8 between 1950 and 1975. Until the 1950s, coal and wood-fired heating were the main sources. Since then, transport has taken the leading role. In 1999, CO emissions were slightly below their 1950 level. Figure 2-18 shows emissions of the three precursor gases between 1900 and 1999.

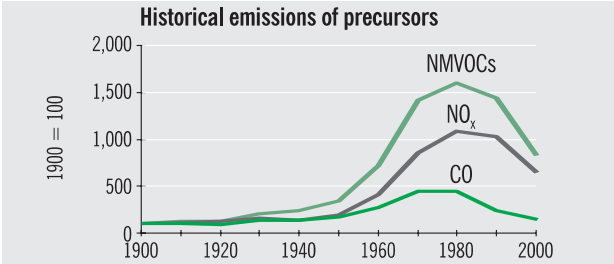


Figure 2-18: Emissions of precursors 1900 to 1999 (1900=100; SAEFL 1995; 2000a, 2001)

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Relevant internet sites:

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http://www.statistik.admin.ch (Swiss Federal Office of Statistics)

http://www.swiss-energy.ch (Swiss Federal Office of Energy)

http://www.ucte.org/Statistik/English/Default_Stat_E.htm (Union for the Co-ordination of Transmission of Electricity, UCTE)

3. GHG inventory information

Standardised, technical inventory information, as required by the Guidelines for the Preparation of National Communications by Annex 1 Parties and the revised IPCC Guidelines for National Greenhouse Gas Inventories, is provided in the annex of this report. In this chapter, inventory data will be presented and commented on more comprehensively, illustrating main sources and sinks (see section 3.1), trends in emissions since 1990 (see section 3.2), and the contributions of CO_2, CH_4 and N_2O to the present Swiss emissions balance based on 100 year GWP values (see section 3.3).

3.1. Overview of sources and sinks (Swiss Greenhouse Gas Inventory 1999)

3.1.1. CO_2

In 1999, national gross CO_2 emissions amounted to 44,800 Gg or 6.25 tonnes per capita. Three quarters of these emissions came from transport (34 per cent) and small-scale combustion (26 per cent from residential, 13 per cent from commercial / institutional). Industry accounts for 20 per cent of CO_2 emissions (15 per cent energy-related emissions; 5 per cent not energy-related). Other sources are of minor importance.

The allocation of emissions from aircraft to domestic and international flights has been revised since the last report. For 1999, bunker fuel emissions from international aviation are estimated at 4,500 Gg. They are not included in the national emission figures.

At present, the net result of carbon harvest versus carbon uptake yields an absorption of the order of 4,200 Gg CO_2. Thus, Swiss forests are significant sinks, with an absorption corresponding to 9.4 per cent of gross CO_2 emissions.

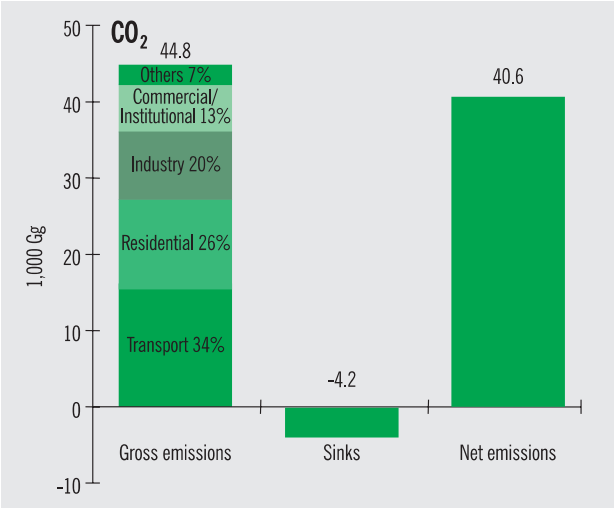

Figure 3-1: 1999 CO_2 emissions and removals by sector (not including international bunkers)

3.1.2. CH_4

In total, 216 Gg of CH_4 were emitted in 1999. Nearly two thirds of this came from the agricultural sector. About 86 per cent of agricultural emissions were released by enteric fermentation in ruminants. The second most important source of CH_4 emissions was the waste sector, with 29 per cent of the total. Taken together, these two sectors account for over 90 per cent of Swiss CH_4 emissions.

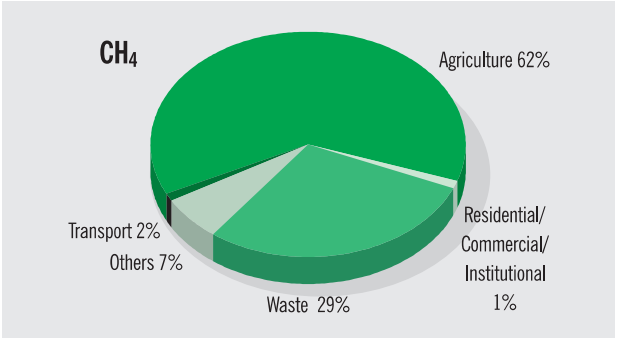

Figure 3-2: 1999 CH_4 emissions by sector

3.1.3. N_2O

About 70 per cent of the 11.6 Gg of N_2O emitted in 1999 came from agriculture. A source of increasing significance was transport, which contributed about 18 per cent.

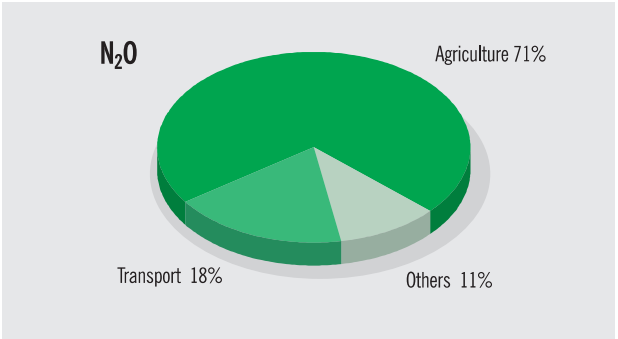

Figure 3-3: 1999 N_2O emissions by sector

3.1.4. Other greenhouse gases (HFCs, PFCs, SF_6)

Until the present, emissions of HFCs, PFCs and SF_6 have been of marginal importance in Switzerland (about one per cent of overall gross GHG emissions). Reliable and complete emission statistics are still being developed. The first systematic survey, conducted during the period 2000 to 2001, and based on the IPCC guidelines, gave the following figures for 1999 (in CO_2 equivalents): 366 Gg HFCs; 28 Gg PFCs; and 125 Gg SF_6.

3.1.5. Precursor gases

NO_X

Of a total of 99 Gg emitted, 58 per cent came from the transport sector. Secondary sources for NO_X emissions were small-scale combustion (residential / commercial / institutional / agriculture) (19 per cent), industry (11 per cent) and waste (5 per cent).

CO

Of the total of 400 Gg emitted, 62 per cent originated in the transport sector. About 21 per cent were contributed by small-scale combustion while the category 'others' (industrial and construction machinery) emitted another 10 per cent.

NMVOCs

In 1999, 165 Gg of NMVOCs were emitted. The main sources of emission were solvent use in industry (64 per cent) and the transport sector (19 per cent). Industrial processes accounted for 5 per cent of NMVOC emissions.

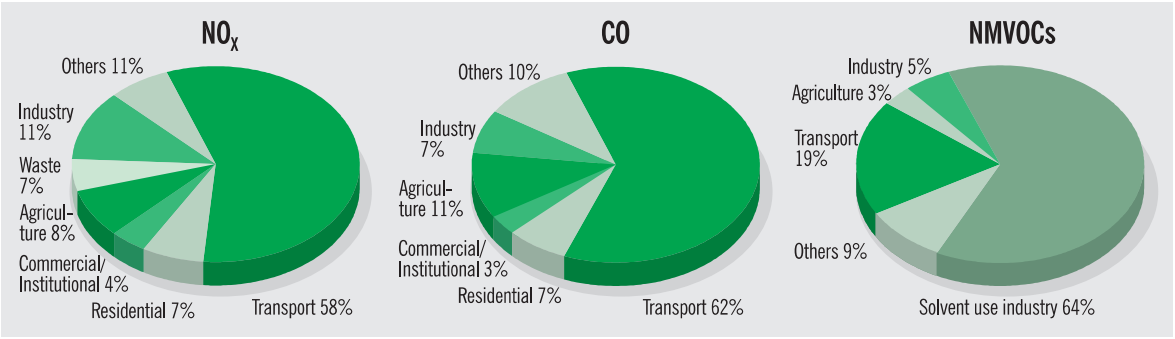

Figure 3-4: 1999 precursor emissions by sector

3.1.6. SO_2

Contrary to the above gases, SO_2 is not a greenhouse gas. In fact SO_2 emissions counteract the process of global warming and may mask warming effects at the local to regional scale. Emissions of SO_2 amounted to 25.5 Gg in 1999. Small-scale combustion took the lead with a 43 per cent share, followed by energy-related emissions from industry (21 per cent) and non energy-related industrial processes (14 per cent). 'Agriculture' means agricultural machinery.

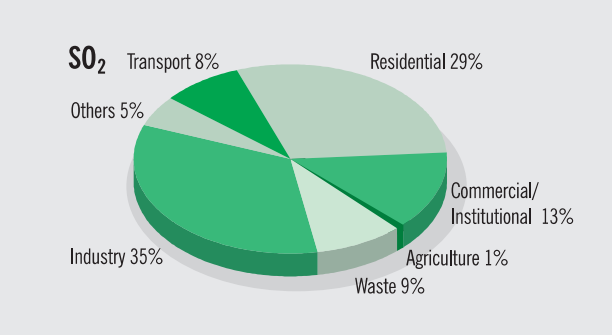

Figure 3-5: 1999 SO_2 emissions by sector

3.1.7. Summary 1999

IPCC source / sink category		CO_2 (1,000 Gg)	CH_4 (Gg)	N_2O (Gg)	HFCs/ PFCs/ SF_6 (Gg CO_2 eq)[1]	NO_X (Gg)	CO (Gg)	NMVOCs (Gg)	SO_2 (Gg)
1	All energy	41.2	18	2.3	n.o.	93	385	51.8	19.8
	Fuel combustion	(41.1)	(5.7)	(2.3)		(93)	(385)	(44.9)	(19.8)
	Fugitive emissions	(0.07)	(12.4)	(0.0)		(0.06)	(0.01)	(6.9)	(n.o.)
2	Industrial processes	2.2	0.4	0.31	519	0.32	11.3	7.8	3.4
3	Solvent use	n.o.	n.o.	0.39	n.o.	0.04	0.09	104	0.04
4	Agriculture								
	(3 years average)	n.e.	134.5	8.3	n.e.	n.e.	n.e.	n.e.	n.e.
6	Waste	1.3	62.6	0.32	n.o.	5.3	3.3	1.2	2.3
	Total gross emissions	**44.8**	**216**	**11.6**	**519**	**98.7**	**400**	**165**	**25.5**
5	Land use change								
	& forestry	-4.2	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
	Total net emissions	**40.6**	**216**	**11.6**	**519**	**98.7**	**400**	**165**	**25.5**
	International bunkers	(4.5)	n.e.	n.e.	n.o.	n.e.	n.e.	n.e.	n.e.

[1] CO_2 eq = CO_2 equivalents according to IPCC 1995 GWP values for a 100 year horizon
n.o. = not occurring; n.e. = not estimated

Table 3-1: Overview of 1999 emissions and sinks

3.2. Recent trends in emissions

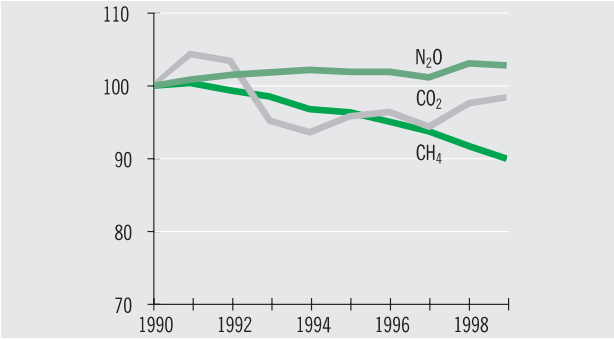

Figure 3-6: Indices of total emissions of CO_2 (net), CH_4 and N_2O between 1990 and 1999 (1990=100)

3.2.1. CO_2

In 1990, gross CO_2 emissions reached the level of 44,400 Gg. Subsequently, emissions oscillated around this level within a margin of ± 4 per cent. The yearly variation can largely be attributed to changing seasonal weather conditions (number of heating degree days per year) as well as changes in the price difference for petrol and diesel compared with neighbouring countries ('fuel tourism'). These natural or intangible factors have to be taken into consideration when assessing emission trends against emission targets.

The 1999 level of 44,830 Gg was very close to the 1990 value. Thus, Switzerland reached its stabilisation goal over the 1990 to 2000 period. This situation can be seen as the combination of two effects: policy measures which are relevant to climate (see chapter 4) and the weak economic development in the nineties.

In 1990, excessive damage to certain forest areas through windthrow led to increased yield, temporarily reducing the net CO_2 absorption of forests by almost 20 per cent. Under regular conditions, such as in 1999, forests absorbed CO_2 at a rate of 10 per cent of total CO_2 emissions.

3.2.2. CH_4

The calculations show that CH_4 emissions have declined from 242 Gg in 1990 to 216 Gg in 1999, with an intermediate peak at 243 Gg in 1991. This trend is above all a reflection of changes in the agricultural sector, because CH_4 emissions are closely correlated to the number of livestock. Other sectors also show a tendency towards a decline in emissions, giving an overall decrease of 10 per cent between 1990 and 1999.

3.2.3. N_2O

The data show a very slight increase in emissions from 11.5 Gg in 1990 to 11.6 Gg in 1999. This relative stability is the result of two opposing trends: whereas agricultural emissions showed a decline of 10 per cent between 1990 and 1999, the transport and waste sectors tended to emit increasing amounts of N_2O as a consequence of the increased use of catalytic converters in passenger cars and waste incineration plants.

3.2.4. Other greenhouse gases

Historical data on emissions of HFCs, PFCs and SF_6 are difficult to obtain, and related studies are still in progress. Accordingly, assessments of trends are not very reliable. A clear trend towards the increased use of HFCs as cooling agents can be observed since the beginning of the nineties. SF_6 emissions show both increasing (electrical equipment) and decreasing (window filling gas) tendencies in the main fields of application. Due to the pattern of production and consumption in Switzerland, PFCs are of minor importance.

3.2.5. Precursor gases

NO_X

An almost constant decline of about 4 per cent per year has taken place over the period from 1990 to 1999. This decline was mainly due to the increased use of catalytic converters in passenger cars.

CO

Decreasing by about 5 per cent per year, CO emissions showed a very marked decline between 1990 and 1999. Again, the main reason for this change was the increased use of catalytic converters in passenger cars.

NMVOCs

These substances showed the same tendency as CO, with an average yearly reduction in emissions of about 5 per cent. This reflects the increased use of catalytic converters in passenger cars, as well as more stringent measures to limit emissions from the use of solvents.

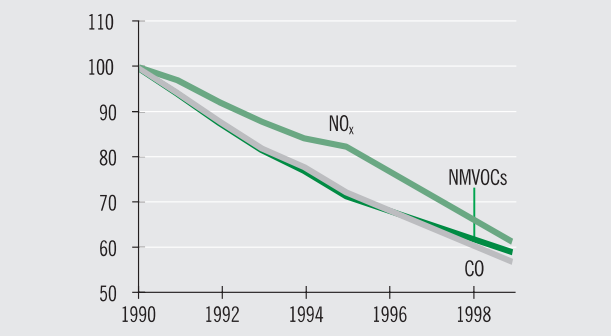

Figure 3-7: Total emissions of precursors between 1990 and 1999 (1990=100) (to the right)

3.2.6. SO_2

Data on SO_2 emissions are not available on a yearly basis. Overall emissions have declined by nearly 40 per cent over the period from 1990 to 1999. This reduction is due to the effects of lower sulphur content in light and heavy fuel oil.

3.3. Overall emissions

3.3.1. CO_2 equivalents by gas

On the basis of 1995 GWP values for a 100 year horizon, in 1999 the gross greenhouse gas emissions of Switzerland amounted to 53,500 Gg of CO_2 equivalents. If removals by sinks are considered, this amount is reduced to a net emission of 49,300 Gg of CO_2 equivalents.

In comparison with 1990 data, there were no significant changes in the proportions of CO_2, CH_4 and N_2O in terms of total CO_2 equivalents.

1'000 Gg CO_2 equivalents	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	Total
Gross emissions	44.83	4.57	3.62	0.37	0.03	0.13	**53.53**
percentage share of total	*83.75*	*8.54*	*6.76*	*0.69*	*0.06*	*0.24*	***100.00***
Net emissions	40.60	4.57	3.62	0.37	0.03	0.13	**49.30**
percentage share of total	*82.35*	*9.27*	*7.34*	*0.75*	*0.06*	*0.26*	***100.00***

Table 3-2: 1999 emissions in CO_2 equivalents by gas

3.3.2. CO_2 equivalents by sector

The following sectors were of major importance for their contributions to CO_2 equivalents: transport (30 per cent, including 0.5 per cent domestic civil aviation); residential sector (22 per cent); industry (18 per cent, including 4.5 per cent non energy-related emissions); agriculture (11 per cent); commercial & institutional sector (11 per cent); waste (5 per cent).

Of the total CO_2 equivalents emitted 79 per cent were energy-related.

Forests were sinks, since the difference between carbon uptake and carbon removal was positive (net absorption of 4,200 Gg of CO_2 equivalents).

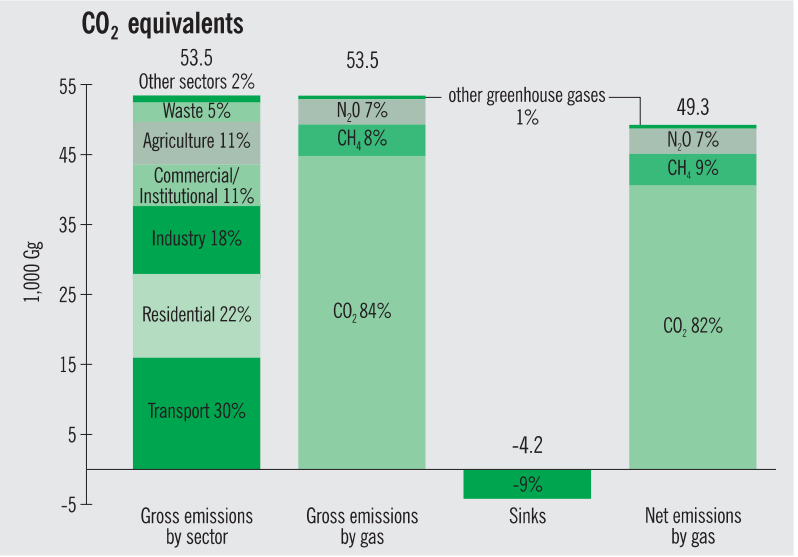

Figure 3-8: CO_2 equivalents by sector and by gas (not including international bunkers)

References:

SAEFL, 2001, Swiss Greenhouse Gas Inventory 1999
UNEP / WMO / IPCC, 1996, Revised IPCC Guidelines for National Greenhouse Gas Inventories, Vols 1-3

4. Policies and measures

4.1. Policy-making in Switzerland

4.1.1. Organisation

Switzerland is a Confederation with a Federal Government, two chambers of parliament and a Federal Court. The territory consists of 26 cantons (states), each of which has its own government, parliament and cantonal courts. Responsibilities are shared between the federal level and the cantons.

4.1.2. Decentralisation and subsidiarity

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

4.1.3. Co-operation

Co-operation is an important principle, both vertically and horizontally. In matters where the federal level legislates, the role of the cantons is to implement (execute) the federal legislation. Very often, the cantons have substantial freedom in this endeavour, allowing them to take local or regional conditions into account. At a lower level, an analogous autonomy is granted to the municipalities by the cantons.

On the other hand, cantons co-operate horizontally and have, in a number of policy areas, concluded treaties that facilitate harmonised, effective implementation.

4.1.4. Legislative hierarchy at the federal level

The legislative system comprises several levels of hierarchy. All legislation must ultimately be based on the (written) Constitution. Laws of different kinds (federal laws and federal decrees) implement constitutional matters. Regulation at both levels is subject to the influence of the people, which is not the case for ordinances, through which the government alone implements the contents of laws.

4.1.5. Direct democratic rights

Switzerland is a representative democracy with strong formal and informal elements of direct democracy. By means of a popular initiative, citizens can ask for an amendment to the Constitution (or, at the cantonal level, also an amendment to a law). Popular initiatives may comprise a general suggestion or contain detailed regulations. In most cases a majority of the electorate and of the cantons must accept the proposal to make it part of the Constitution. This "double" majority (population and cantons) mainly implies the protection of the interests of less populated rural cantons.

The second formal instrument of direct democracy is the referendum. This allows citizens to veto decisions made by parliament. The referendum may be mandatory or optional. It is possible to have a referendum concerning regulations at the level of the Constitution, formal laws, international treaties and federal decrees that are generally-binding and urgent. Both popular initiatives and referenda also exist at the cantonal level. The petition is an informal instrument of public participation and is non-binding.

4.1.6. Public consultation

The cantons and other interested parties (e.g. business, trade unions, NGOs etc.) are included in a consultation process whenever government (the Federal Council) proposes a change in the Constitution, in a law or an ordinance, which is of significance to those involved. Although the outcome of this process is formally non-binding, it is of great importance and reflects an established principle of consensus typical of policy-making and of political culture in Switzerland.

4.1.7. Switzerland and the EU

Switzerland is a member of several international organisations (e.g. the OECD, the World Bank Group, and all UN specialised agencies); however, it is not member of the UN or of the European Union. In the case of the UN, membership was proposed by the government and parliament, but was turned down in a referendum in 1986. A new proposal is being discussed at the moment, with a referendum planned for 2002.

Membership of the EU remains a strategic aim of the Federal Council, although a majority of the Swiss voters turned down membership of the European Economic Area (the economic core of the EU treaty) in 1992. A similar vote in 2001 had the same outcome. Since 1992, Switzerland has been in bilateral negotiations with the EU on major policy areas (e.g. free movement of persons, land and air transport, public procurement, and research). These negotiations were very important in shaping the Swiss policy on freight transport (see section 4.2.3).

Although Switzerland is not a member of the EU, most new Swiss laws or changes in existing Swiss laws have been made compatible with EU law. The aim is to facilitate possible subsequent membership of the European Economic Area or of the EU. As a result of Switzerland's strong economic ties with many EU countries (notably Germany), a "virtual" dependency exists, despite the formal political absence of Switzerland from the EU.

In 1999, bilateral treaties were agreed upon between Switzerland and the European Union. These contain measures regarding the free movement of persons, air transport, overland transport, agriculture, technical barriers to trade and public procurement markets. Further topics are currently under discussion (education and security amongst others). The bilateral agreements have yet to be ratified by the EU Member States.

4.2. General policy context

Climate policy in Switzerland is incorporated into other policies that existed well before climate change became an important issue. The new CO_2 legislation (see section 4.2.1) establishes a broad framework for measures leading to the reduction of CO_2 emissions. Climate policy has become an issue in its own right, contributing to the overall strategic aim of sustainable development. The following areas of policy relate to the issue of climate change.

Area of policy	Aims, highlights
Environment	Reduction targets and timetables according to the CO_2 law. Policies on air pollution and on waste, based on the Federal Law on the Protection of the Environment, with a number of important ordinances, e.g. Ordinance on Air Pollution Control, Technical Ordinance on Waste Disposal, Ordinance relating to Environmentally Hazardous Substances.
Energy	Most CO_2 emissions are energy related. The CO_2 legislation adopted recently is fully compatible with approaches in energy policy such as the Energy Law and the related energy efficiency programmes ('Energy 2000' programme and the subsequent 'SwissEnergy' action plan).
Transport	Great consideration of environmental aspects (especially in the case of roads). Policy favouring rail for transalpine freight and passenger transport, and the internalisation of external costs.
Agriculture	Incentives for environmentally friendly production methods (agricultural reform).
Forestry	Sustainable logging; ban on clearing and clear felling.
Foreign economic issues and international affairs	Implementation of co-operation and development commitments under the UNFCCC. Fund for global environment projects as a cornerstone of bilateral activities.
Finance	Elements of ecological tax reform contained in financing schemes in the sectors of transport, energy and agriculture.

Table 4-1: Policy areas related to climate change (overview)

All of these policy areas contain elements of environmental and climate policy, thereby reflecting the government's intention to promote social and economic development in a sustainable manner.

At present, an informal group of representatives of several ministries under the chairmanship of the SAEFL is ensuring that international developments are followed up at the national level. The SAEFL is responsible for the implementation of the obligations resulting from the FCCC, in particular the preparation of this third national communication and the underlying emissions data.

4.2.1. Environmental and climate policy

Environmental legislation

The principles and instruments of Swiss environmental policy are formulated in the Federal Law on the Protection of the Environment, adopted in 1985 and revised in 1995. This modern legislative framework has been supplemented by the new Law on CO_2 Emissions, which was adopted in 1999. These two legislative frameworks provide the basis for the Swiss national policy on climate change.

A number of important regulations (ordinances) that address climate change are subordinate to the Federal Law on the Protection of the Environment. The most important are the following:

- **Ordinance on Air Pollution Control (1985, revisions 1992 and 1999):** This contains emission limits (targets for preventive measures) and air quality standards (targets for protective measures). Preventive emission limits have to be strengthened if air quality standards are exceeded locally or regionally.
- **National Clean Air Strategy (1986, revisions 1996):** This defines national targets and measures to reduce emissions of GHG precursors such as CO, NO_x and NMVOCs. Compared with their maximum levels between 1980 and 1985, in 2000 NO_x emissions had been reduced by 45 per cent, and NMVOC emissions were down by 54 per cent. However, to reach the final targets (emission level of 1960) further reductions are necessary.
- **Technical Ordinance on Waste Disposal (1991, revisions 1993, 1996, 1998, 2000):** This contains the national framework for waste management, and introduces a consistent controlling and monitoring system.
- **Ordinance Relating to Environmentally Hazardous Substances (1986, relevant revision for the national measures 1995):** This contains measures to avoid emissions of persistent substances with a high GWP (HFCs and PFCs in fire-fighting).

Federal Law on the Reduction of CO_2 Emissions; in force since 1 May 2000

In October 1999, the Swiss parliament passed a law stipulating an overall CO_2 emissions reduction target of minus 10 per cent by 2010 compared with 1990 levels, with emissions from combustible fuels to be cut by 15 per cent and from petrol/diesel by 8 per cent. The Law on CO_2 is to be implemented in two stages. The first phase, from 2000 to 2004, focuses on all kinds of voluntary measures taken by industry and households to decrease CO_2 emissions due to energy consumption. If (and only if) the reduction targets seem unlikely to be met, an incentive tax on fossil fuels (CO_2 tax) will be levied in the second phase from 2004 on. The maximum rate is fixed at 210 CHF per tonne of CO_2. However, the final tax rates on the different types of fossil fuels will be set according to the gap forecast between the real and envisaged path for the reduction of CO_2 emissions. The tax rates have to be approved by parliament.

The necessity for the tax, and the appropriate tax rate will depend on the extent of voluntary action as well as on the effectiveness of other instruments available, which are relevant to CO_2, e.g. the Energy Law (see below), the 'Energy 2000' and 'SwissEnergy' programmes, and the distance-related heavy vehicles fee. The mechanism of the Law on the Reduction of CO_2 Emissions suggests that private initiative is to be given priority over state intervention. If an incentive tax is nevertheless necessary, exemption from the tax will be granted to industries that enter a legally-binding CO_2 reduction commitment, for which energy intensive companies, big emitters and associated groups of emitters are eligible.

Net tax revenues will be fully redistributed to the economy (in proportion to the wages paid) and to the population on a per capita basis, without increasing national budgets.

4.2.2. Energy policy

Article 89 of the Federal Constitution obliges the government to provide a sufficient and secure energy mix that is economically as well as environmentally sound. Energy efficiency is to be enhanced taking account of regional equity and economic viability.

The federal Energy Law of 1998, and the corresponding ordinances shape the legal framework for federal energy policy. This policy calls for extensive co-operation with the private sector, reaffirms the principle of subsidiarity, and gives priority to voluntary measures. In addition, the sharing of competencies between the federal government and the cantons is regulated. The Confederation can provide funds for cantons that have established programmes favouring energy efficiency and renewable forms of energy. In the context of voluntary agreements, the tasks of co-ordination, evaluation, monitoring and reporting are delegated to private energy agencies. This notion is compatible with the spirit of the Law on CO_2 (see section 4.2.1.), which gives priority to voluntary action as compared with a command and control approach. To some extent, voluntary agreements included in the Energy Law coincide with private sector initiatives to avoid the CO_2 tax. Because of the strong correlation between energy consumption and CO_2 emissions, efforts through the Energy Law also contribute to meeting the reduction targets stipulated in the Law on CO_2.

Another positive interaction is through the 'Energy 2000' programme (see section 4.3.2.), which started in 1990, and is now being followed on by the new 'Swiss Energy' action plan (see section 4.4.2.) to further enhance energy efficiency and promote renewable forms of energy. In December 2000, at the outset of the liberalisation of the Swiss energy market, the parliament passed the Federal Law on the Electricity Market. A public referendum on this issue will take place in 2002. The law provides for substantial support for renewable electricity production. However, falling electricity prices might offset incentives to use energy more efficiently. A law on the natural gas market is also in preparation.

4.2.3. Transport policy

Since 1972, Switzerland has developed an integrated approach to transport, focussing on better co-ordination between transport modes, and emphasising environmental problems.

The Swiss transport policy follows the principles of sustainable development and aims to promote public transport. The following aspects are most important:

- modernisation of the railway infrastructure including the four major projects: RAIL 2000 (first and second phases); the NRLA (New Rail Link through the Alps) network with two new base tunnels (Gotthard: 57 km long and Lötschberg: 34 km long) supported by the Federal Resolution on the Construction of two new transalpine Railway Lines of 4 October 1991; the connection of Eastern and Western Switzerland to the European high speed rail network; and noise reduction measures on the railways;
- railway reform, providing increased flexibility for the railway companies and greater freedom of enterprise, making rail transport more productive and attractive;
- the Traffic Transfer Act of 8 October 1999 and supplementary measures: market economy measures and incentives will further improve the framework conditions governing the railways, so that the transfer of traffic from road to rail can be intensified and accelerated.

There are two trends for freight transport in Europe and in Switzerland: the total quantity is increasing rapidly, and an ever increasing proportion of it is being transported by road. As this is equally true for transport across the Alps, one of the major objectives of Swiss transport policy is the transfer of as much transalpine heavy goods traffic as possible from road to rail. This transfer has become a constitutional mandate since the acceptance - on 20 February 1994 - of the Alpine Initiative, obliging the Confederation to protect the alpine region from the negative effects of transit road traffic (see section 4.3.3 for details).

Based on this obligation and the general Swiss land transport treaty between Switzerland and the European Union (adopted in 2000), a new freight transport policy has been implemented, based on several new laws, which were accepted in a referendum in 1999. The cornerstone of this policy is the introduction of a new HGV fee and the parallel stepwise increase in the weight limits for heavy goods vehicles (HGVs). At the same time, the revenues from this new tax will be used to improve rail infrastructure. Thus the tax also creates the basis for a modern inter-modal financing scheme. Switzerland is the first country in Europe to introduce a distance-related heavy vehicle fee. Germany plans to introduce a HGV fee in 2002, but only on motorways.

Based on the environmental and energy legislation described above, Swiss transport policy has developed several measures to reduce air pollution and the specific energy consumption of passenger cars. These measures are supported by specific actions under the 'Energy 2000' programme (now followed up by 'SwissEnergy' action plan).

4.2.4. Agricultural policy

Swiss agricultural policy has been undergoing major reform over the past ten years. The changes in agricultural policy reflect a clear demand by the population, and the need to increase competitiveness and to fulfil international commitments. The tasks of farmers have been reformulated, highlighting competitiveness and the protection of the environment (maintenance of the fertility of the soil, conservation and promotion of biological and landscape diversity etc.).

In 1992, the federal parliament adopted the revision of the Federal Law on Agriculture, introducing a legal basis for substantially increasing direct payments not linked to production, and leading to a clear separation between policy on prices and on incomes. This enabled the system based on state guaranteed prices to be replaced by a system based on market signals and direct payments. Moreover, in 1996 the Swiss electorate accepted a new article at the constitutional level, expressing their willingness to support

agriculture by means of direct payments, provided that specific ecological practices are applied. In April 1998, a completely revised Law on Agriculture was passed, and this has been in force since January 1999. Thus, since 1999 all direct payments have been bound to the following requirements (cross-compliance):

- Balanced fertiliser accounts: only as much nutrient may be spread on the fields as the plants need.
- Creation of ecological compensation areas: at least 7 per cent of agricultural land must be managed as ecological compensation areas.
- Regulated crop rotation: in arable and vegetable farming, the rotation chosen is to have optimal effects on soil fertility (including erosion), plant health and water protection (prevention of nitrate losses to the groundwater).
- Appropriate soil protection: erosion and chemical pollution of the soil must be avoided.
- Limited application of plant treatment chemicals: pests are to be kept at bay by their natural enemies. Spraying of chemicals is only to take place if the level of the pest exceeds the acceptable limit.
- Sound livestock farming: the laws on animal protection must be strictly observed.

The response of farmers to the new political framework has been highly positive. At the end of 2000, environmentally friendly production systems meeting the requirements mentioned above had already been applied to over 90 per cent of the agricultural land in Switzerland, and it is expected that the percentage will continue to rise over the next few years, with quality targets and criteria included within this environmental programme.

4.2.5. Forestry policy

There is a long tradition of forest protection in Switzerland. The first Federal Forestry Police Act came into force in 1876, but it only covered mountainous regions. A stricter Forest Policy Act was introduced for the whole country in 1902. Its aim was to put a stop to the depletion of forests, to manage the remaining forest areas sustainably, and to promote afforestation. As a result of this legislation, the forested area in Switzerland has increased by nearly 50 % since the middle of the 19th century. The increase is the result of afforestation and change in land use, mainly from pasture to forest, and this is still continuing. Abandoned land, on which a population of trees has been growing naturally, is automatically subject to the Forest Law once the trees reach the age of 10 to 20 years. The new Forest Law, in force since 1993, confirms the preservation of the forest area, and protects the forest as an ecosystem that is close to nature.

The forests must fulfil many different requirements, and their importance constantly shifts according to changes in society. In recent years, there has been some decline in public interest in timber production. Today, the forest's ever-increasing protective functions (including the protection of drinking water) and its use for leisure (recreation, tourism, sport) are most important. Themes such as biological diversity and the fixing of carbon dioxide have found their way to the centre of public consciousness. Whereas the demands made on the forest are constantly rising, the proprietor's possibilities for appropriate tending are constantly being reduced. This is primarily a consequence of stagnating timber prices, while the costs of logging continue to rise. Where costs cannot be covered, we can no longer expect a forest owner to ensure that the forest satisfies the demands put on it by the public without any additional help. Apart from this, substances such as acidifying agents nitrogen compounds and ozone are still harming the forest and endangering its long-term stability.

Making better use of timber is crucial for the current Swiss forest policy. A timber promotion campaign is to be launched over the period 2001 to 2003, and there is to be a grant to support the use of wood as a source of energy. The goal of the campaign is to stop any further increase in the growing stock, which is already the greatest of all European countries, and to help to improve and maintain the structure of forest stands in good condition, so that their social and economic functions are ensured. Furthermore, it will reduce CO_2 emissions by substituting for fossil fuels.

4.2.6. Summary: most important developments since the last report

A big step forward was taken specifically in the areas of climate, energy and transport policy:

- The new CO_2 legislation provides an accepted framework for policy on climate change, focussing on transparent targets based on the Swiss commitments under the Kyoto Protocol. The modern approach uses economic instruments, enabling players in the private sector to take voluntary actions. It is based on the ongoing successful energy policy with a new national legal basis and programme activities that are carefully evaluated and monitored. The follow up 'SwissEnergy' action plan on energy efficiency is the action-oriented framework to reach the predefined CO_2 reduction targets.
- Successful consensus in freight transport policy allows Switzerland to follow its long-term approach of modal shift from road to rail, also considering improvements in efficiency in road transport. The heart of this strategy is the introduction of the new HGV fee, which takes account of the external costs of transport.
- No specific new measures have been introduced in the areas of air pollution and waste policy. Nevertheless, the policies implemented earlier have been further developed in line with the approach of the EU of strengthening air pollution targets.
- In agriculture and forestry, sustainability strategies have also been reinforced.

4.3. Measures implemented

4.3.1. Climate policy

The two stage mechanism of the Law on CO_2 (see section 4.2.1.) provides for the opportunity to meet the stipulated reduction targets by means of voluntary action only, thereby avoiding the CO_2 tax which may be introduced at the earliest in 2004 on a subsidiary basis.

In July 2001, guidelines for voluntary action by industry were released. As the Law on CO_2 focuses on emissions from fuel combustion, CO_2 reductions are closely linked to a lower consumption of fossil fuels. These guidelines therefore cover voluntary measures provided for in both the Energy Law (see section 4.2.2.) and the Law on CO_2. However, the types of measures to be taken are not regulated. The guidelines describe the relevant target values and how they can be determined, according to the remaining reduction potential of each industry, taking into account any measures already taken over the last decade and growth perspectives for the future.

Industries are offered two different tracks: they may either enter a convention to enhance energy efficiency and thus contribute to meeting the CO_2 reduction target, or they may engage in a more stringent commitment, aimed primarily at large-scale emitters, groups of companies making up a minimum size, and energy intensive industries. The Law on CO_2 allows these three categories to be exempted from the possible CO_2 tax. Companies exempted from the tax will not be entitled to a refund of the tax revenues. Therefore, industries that are less CO_2 intensive will be better off if they sign a convention, and benefit from different programmes within the context of 'SwissEnergy' (see section 4.3.2) to lower their energy cost as well as their tax burden in case a levy on emissions from fossil fuels needs to be introduced.

Companies entering a convention or a commitment are required to stick to a monitoring and reporting system outlined in the related guidelines. Moreover, the annex to the guidelines sets standards regarding key variables and the calculation of target values.

By means of these guidelines, companies are able to assess their reduction potential and, by setting targets, to enter the negotiation process either within their own industry to form a group, with an energy agency as a mediator, or directly with the Confederation, if they reach the required minimum emissions volume.

4.3.2. Energy

All measures within the energy sector also focus on the reduction of CO_2 emissions.

a) National level

Paragraph 89 of the Swiss Federal Constitution declares that the government has to provide for a sufficient, well assorted, secure, economic and environmentally friendly energy supply, and for the rational and efficient use of energy. In addition, the distribution of competencies between the federal government and the cantons are regulated. The Constitution also calls for collaboration with the cantons and the private sector. The consideration of regional equity, and the economic feasibility of measures to be taken are important criteria.

The Swiss Energy Law and the new Law on the Reduction of CO_2 substantiate the above targets with the following principles:

- Private initiative is given priority over state intervention. In the second phase, regulations and taxes (see section 4.2.2) are to be introduced, if voluntary measures have not been effective.
- The law allows the Swiss government to fund measures favouring energy savings and renewable forms of energy, by providing annual funding to those cantons that have established programmes favouring these elements. Direct funding at the federal level is allowed, but should be an exception. Funding from the Swiss government and the cantons may not exceed 40 per cent of incremental investment cost. Subsidies are not to cover operating costs.
- Before licensing the construction of a fossil fuel power plant, the cantons have to assess whether supply can reasonably be met by renewable energy, and whether there are possibilities for recovering heat. Also, distribution companies have to purchase electricity from producers. The prices for electricity produced by independent producers from renewable sources (in the case of hydro energy, up to 1 MW) are recommended by the Federal Office of Energy, and those for electricity from non-renewable sources should reflect market prices.
- The energy consumption of electrical appliances and vehicles is decreased based on voluntary agreements between market actors and the Federal Office of Energy. If no agreement has been made, or if the agreed target has not been met, the government may regulate the sale of appliances or vehicles. Target values and registration requirements have been set for 12 main domestic appliances (refrigerators, electric ovens, etc.), office equipment (fax machines, printers, video recorders) and passenger cars. The effect of these agreements has been assessed and labelling in line with EU regulations will be adopted.
- The government has the responsibility to inform and to advise the population on energy consumption, to encourage the exchange and dissemination of information, and to support training courses.
- Energy research and development is supported, especially that concerned with energy efficiency and renewable forms of energy.
- The outcome of the energy policy has to be regularly reported to parliament and to the public, and the effects of the measures have to be analysed.

In 1997, the federal parliament launched an investment programme aimed at creating employment, stimulating the economy and promoting sustainable development. The programme received 64 million CHF of funding between 1997 and 1999 to subsidise private investments in energy savings and renewable forms of energy in the building sector. This created investments totalling 1 billion CHF, and induced energy savings of 1.9 PJ.

After the storm 'Lothar' in December 1999, the federal parliament allocated 45 million CHF to fund using wood for heating.

'Energy 2000' and 'SwissEnergy' action plan

The 'Energy 2000' progamme started in 1991 and lasted until the end of 2000. It is now being followed up by the 'SwissEnergy' action plan. Considerable experience, and many products from 'Energy 2000' have been carried over into the 'SwissEnergy' action plan. The main changes are in the structural organisation and the brand.

In this section the products and results of 'Energy 2000' are described, and in section 4.4.2 the targets and organisation of the 'SwissEnergy' action plan, which started in 2001, are shown.

The 'Energy 2000' programme aimed to stabilise total fossil fuel consumption and CO_2 emissions at 1990 levels by 2000, and then to reduce them by 10 per cent by 2010. This aim is compatible with the CO_2 Law (under the commitments made at the Kyoto climate conference in December 1997). A continuous reduction in the growth rate of electricity consumption during the 1990s, and stabilisation of demand after 2000 were also foreseen. Thirdly, the proportion of renewable energy was to be increased by 0.5 per cent for electricity generation, and by 3 per cent for heat generation, by the year 2000. At the same time, the production of hydropower was to be increased by 5 per cent and the capacity of existing nuclear plant by 10 per cent.

Those targets should have been reached in three major ways:

- Voluntary measures focussing on energy efficiency and the use of renewable forms of energy;
- Legal framework for an adequate and secure, economical and environmentally safe energy supply for the economical and efficient use of energy;
- Discussions on disputed topics between the stakeholders involved.

The 'Energy 2000' programme induced many activities (not specially described here), such as energy management (for instance in hospitals), energy audits in companies, supporting the use of renewable energy, encouraging energy efficiency, information partnership in the building sector, energy saving services for small and medium enterprises, optimisation of construction technologies.

Based on a total budget of 558 million CHF over a ten year period, 'Energy 2000' conserved a quantity of energy equivalent to almost 20 per cent of the annual consumption in 1999 and valued at 4.7 billion CHF, reduced the quantity of CO_2 released by 10-14 million tonnes (min.-max.), created 4.4 billion CHF of investments, and generated employment amounting to almost 40,000 person-years. Numerous innovations were triggered, and new operational networks were established. Despite that, the action programme only partly achieved its objectives. Just under a third of the funding that had been promised at the outset in 1990 became available, and some of the legislative measures intended were not put into practice. As a result of the programme, a wide range of experience was gained, and this will be of value in ensuring unhindered transition from 'Energy 2000' to its follow-up programme 'Swiss Energy' which started in 2001 (see section 4.4.2).

The following table summarises the financial budget of the 'Energy 2000' programme, and the savings in energy and reductions in CO_2 emissions for the period 1991 to 2000.

Measures	Energy savings (PJ)	Reduction in CO_2 emissions (million tonnes, min.-max.)	Employment (person-years)	Investment (million CHF)	Federal budget (million CHF)
Voluntary measures	73.3	4.3 – 6.0	19,690	2,400	495.2
Statutory measures	90.3	5.4 – 7.5	9,305	1,000	
Investment programme	1.9	0.1 – 0.2	9,300	1,000	62.6
Total	**165.5**	**9.8 – 13.7**	**38,295**	**4,400**	**557.8**

Table 4-2: Cost-benefit analysis of 'Energy 2000' programme for the period 1991 to 2000 (source: Final Report on the 'Energy 2000' Programme and 10th Annual Report)

Small and medium-sized enterprises section of Energy 2000

Small and medium-sized enterprises (SMEs) in the industry and services sector typically spend between 10,000 and 150,000 CHF p.a. for energy, representing between 1 per cent and 5 per cent of their turnover. As these companies do not usually have access to energy experts, the prospect of saving energy is hardly sufficient to improve buildings, systems and processes. On the other hand, 44 per cent of the 500 enterprises surveyed declared that their awareness of energy matters had risen considerably over the last five years.

This section provides seven different products, often used in combination: declarations of intent and energy accounting, briefing of trustees, programmes for associations, energy check-ups, renovation packages, profile sketches, know-how exchanges, etc. 'Energy 2000' engineers work as intermediaries between the section and the enterprises. Because of their professional status, they normally work in the same business sector that they manage. The engineers put forward products and suggestions for activities either via associations or through direct contact. In co-operation with trade associations, the section has built up a network of about 70,000 enterprises. This is about 58 per cent of the approximately 122,000 business enterprises to be found in energy-intensive sectors.

In 1999, 350 TJ of energy were conserved in SMEs. This represents more than half the section's total energy savings during the course of 'Energy 2000'. This figure makes it clear that, provided there is sufficient time for implementation, voluntary measures can result in substantial energy savings by SMEs.

Evaluation programme

The independent evaluation of energy policy is an important instrument for achieving energy and environmental goals, and it helps to implement effective and efficient policy measures. The Swiss Constitution and the Energy Law oblige the government to report regularly on the effectiveness of the energy policy. Within the framework of the 'Energy 2000' programme, Switzerland has placed great emphasis on the evaluation of implementation procedures and the effectiveness of measures over the past ten years.

More than 60 evaluations were carried out in this period, with a total of some 7 million CHF spent. Independence of the evaluations was ensured by contracting external specialists to carry them out. All the reports had to be published, and they were submitted to the specialist media and the relevant parliamentary commission. A meta-evaluation was carried out in 1996, and is being repeated in 2001. The evaluators were experts from independent institutes with specific know how; and they were chosen according to transparent rules. The evaluation of energy policy had and still has an influence on future developments in the programme, on the final form of the Energy Law, and on the confidence of the public.

The consultant's evaluation report on the 'Energy 2000' programme contains recommendations for the 'SwissEnergy' follow-up action plan. The main requirement is to achieve a stricter separation between strategic (hierarchically superior) and specific evaluations, in order to ensure that the requirements placed on the specific evaluations are met in a way that is more satisfactory. There remains a need for an energy policy programme for sustainable development founded upon a stable political mandate (with an extended start-up phase until effects become visible), and based on co-operation, governmental measures, dialogue and voluntary activities. These factors must be made conditional on performance criteria. There is an absolute necessity for active presentation, concentration on a restricted number of priority activities, performance criteria for voluntary activities, fixing the programme in the regions, and independent and systematic performance assessments. Controlling must be done on a more committed basis, and evaluation on a more independent basis. The procedures for conflict resolution (conciliation) must be pursued on a professional basis, and the structure of the programme has to be simplified.

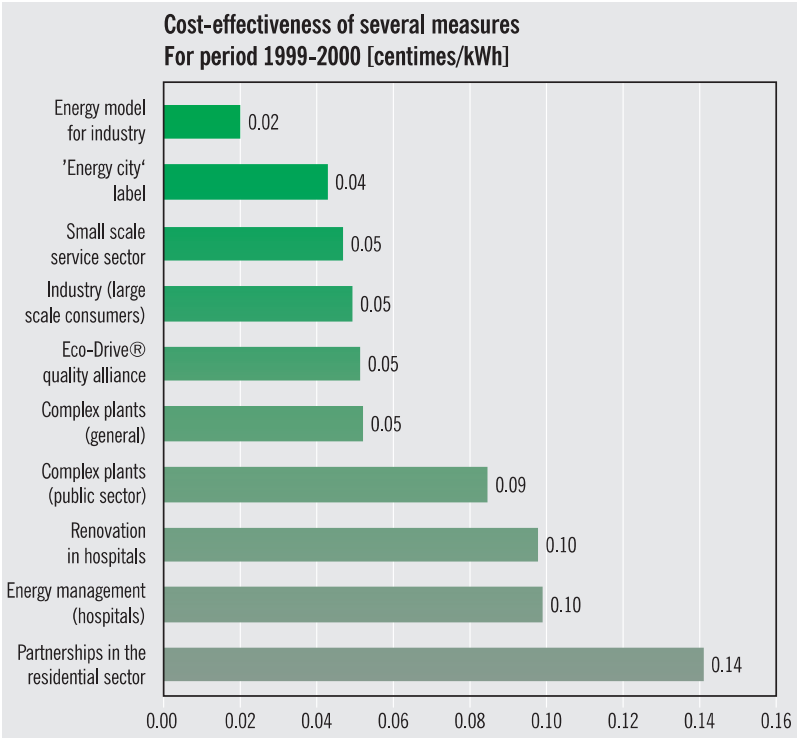

Figure 4-1: Cost-effectiveness of important measures within the 'Energy 2000' programme

The stringent monitoring process has led to detailed annual information on the effects of different measures for energy reduction, reductions in CO_2 emissions, effects on labour and investments, and cost-benefit ratios. Figure 4-1 illustrates the cost-effectiveness of several measures that are part of the 'Energy 2000' programme.

b) Cantonal level

All Swiss cantons have an energy law, mainly to establish energy efficiency measures related to the building sector. However, energy measures differ widely. The most important are energy planning tools (in particular to favour the consumption of specific fuels in defined areas), local regulations on the evaluation and monitoring of energy policy, developed standards for electricity devices in new administrative buildings and (financial) incentives for the renovation of existing buildings.

Several cantons have adopted guiding principles for a target oriented energy policy. Since 1991, the energy regulations on heat and electricity consumption have been amended in almost all cantons in accordance with current technology. In most cantons, new energy regulations are under discussion or have already been enforced (including extended requirements for new buildings). The national development of specimen regulations for cantonal energy policy is an important prerequisite for harmonisation. Unfortunately, the changeover from the federal responsibility on energy use in buildings to cantonal regulations has led to rescinding of important clauses. This was specifically the case for the consumption-related billing of heating costs in existing buildings. Most cantons promote energy efficiency and the use of renewable energy through their own promotion programmes. The enforcement of energy policy measures is facilitated in nearly all cantons by the production of implementation aids (implementation files, forms), information and training events, and regular monitoring of results. Quality assurance of energy measures in the building sector (checks on building sites) is still unsatisfactory. However, in the course of the last decade personnel resources at the cantonal level have generally been on the decline.

Co-operation between the Confederation and the cantons has continued to gain momentum over the past few years, and this has now become one of the most important determinants for the successful implementation of procedures. Most cantons give financial support to research and development work, and pilot and demonstration plants, aimed at increasing energy efficiency and the use of renewable energy, on a case-to-case basis. Together with the Confederation, the cantons play a decisive role in the training of energy professionals, especially the preparation and running of the 'Building + Energy' post-

graduate courses and individual courses on technical topics. In all cantons, structures have been created for public energy advisory services. In certain cantons, advice on energy topics is provided directly by the cantonal energy offices, in others via regional energy advisory offices.

Minergie standard

The Minergie standard requires buildings to fulfil high standards of comfort, economic efficiency and low energy consumption. In this way, the sustainability requirements placed on them may largely be met. The present airtight mode of building – which is required by current standards – gives rise to criticism with respect to air quality. The Minergie standard demands controlled ventilation and ensures optimum air quality.

In the building sector, Energy 2000 promoted the Minergie eco-label, which was developed by the cantons. Today, 'SwissEnergy' is becoming more closely involved in the future development of the standard and, in close co-operation with the cantons, Swiss Energy is promoting planning and quality assurance instruments in connection with the standard. Standards are currently available for residential buildings (houses, blocks of flats and hotels) and public service buildings (administrative buildings and schools). From 2001 onwards, the standards urgently needed for restaurants, stores, and buildings used for sports and commercial purposes should be ready for introduction.

c) Local authority level

All the larger cities in Switzerland have an energy policy that is being implemented. Representatives from these cities meet every year to exchange their experience. Many cities (for instance Berne, Winterthur and Zurich) have a solar power exchange, which allows customers to buy "green" electricity. Some cities (Basle, St. Gallen, Lucerne, Zurich) have set up energy funds, fed by the profits made by the city electricity utility, or by a tax on electricity consumption, as in Basle. The revenues are used to support projects on renewable energy or energy efficiency.

Energy city label

The energy city label is awarded to cities that have an active and effective energy policy. To attain energy city status, an energy programme with binding objectives, deadlines and budgets is essential, as is a suitable list of measures, the effects of which must be quantified and documented. The energy city project is an important part of 'Energy 2000' and of the 'SwissEnergy' follow-up programme. A million residents live in the 44 certified energy cities (6 certificates awarded in the whole of Switzerland during 2000). Until now, 134 towns with a total of more than 2 million inhabitants (more than one third of the population) have joined the 'Energy City Association'. Although opportunities for pursuing an independent energy policy differ greatly from one canton to another, experience shows that all cities have a certain degree of freedom. Over the years, the requirements for obtaining this eco-label have become increasingly strict. 'SwissEnergy' is taking part in an EU project, with the objective of certifying European cities in a similar way to the Swiss energy cities.

d) Private sector activities

The private sector is the most important partner of the 'Energy 2000' programme (now 'SwissEnergy'). Within all sectors, private partnerships and networks have been established, with the purpose of creating incentives for voluntary measures in the private sector. These measures have been co-ordinated by the respective business organisations, such as Swiss solar energy organisations, big retailers, the petroleum industry, car importers, Swiss small scale organisations etc. These organisations produce annual reports about their activities. Some examples are given below:

- The research fund of the Petroleum Association promotes technologies targeted towards low pollution and high energy efficiency. Among the projects supported financially were a combined heat and power (CHP) unit based on the principle of the Stirling motor, fuel cells, a low-power CHP diesel unit, a de-nitrification system for mobile applications, and a combined liquid gas fired CHP and photovoltaics unit.
- Greenpeace started the 'Solar Youth Project' campaign in which young people install solar electricity plants on the roofs of schools, of scouts huts and of youth hostels. Up to the end of 2000, 30 solar installations had been planned. Greenpeace has now gone a step further, by suggesting the integration of solar cells in the roofs of football stadiums.
- In Autumn 2000, the sanitary appliances sector took part in the national campaign to reduce hot water consumption, better known as 'Happy Shower'. Together with major retailers, the sector took part in PR campaigns and in the presentation of products at point of sale. The basic objective was to promote water-saving (and thus energy-saving) fittings, especially for showers.
- 'Sustainability: a challenge to engineers and architects' was the main topic of discussion within the Swiss Society of Engineers and Architects (SIA) during the period 1997-2000. A basic document was published by the Platform for Sustainable Building. This was followed by the a document entitled 'Criteria for Sustainable Buildings'. A process-oriented recommendation is now in preparation to motivate all those involved in the processes of planning and building; it aims at considering fully the three important aspects of sustainability: society, the environment, and the economy. A further activity is the revision of standards on energy use in buildings and plants. This is particularly relevant to the heating and ventilation sectors, where a whole series of European standards are approaching completion. Their content will need to be integrated into Swiss standards.
  Other activities are described in the chapter on 'industry' below.

4.3.3. Transport

a) Policy on CO_2 and the reduction of precursor emissions

The following key elements are important to mitigate climate change.

Heavy vehicle fee (HVF)

Transport should pay for all the costs it induces: its direct costs (infrastructure costs) and also its external costs (the costs of effects on health, damage to buildings caused by air pollution, noise and accidents). The non-internalisation of external cost leads to market distortions. The HVF is an instrument of the Swiss transport policy, and it internalises the full costs according to the polluter pays principle. The HVF is applied to vehicles for passenger and freight transport of more than 3.5 tonnes gross weight per vehicle. The fee is calculated according to three criteria: the kilometres travelled on Swiss roads, the highest authorised gross weight, and the pollutants emitted by the vehicle, according to EURO classes. The Swiss electorate and the cantons approved this principle on 20 February 1994, when they adopted Article 85 of the Federal Constitution. The application law for the HVF was accepted in a referendum on 27 September 1998, and its implementation began as planned on 1 January 2001, replacing the flat-rate fee. The rate of the HVF will be increased stepwise until 2008.

Noise and emission dependent landing charges in air transport

Emission charges were introduced at two major airports in Switzerland (Zurich 1997, Geneva 1998). The noise dependent landing charges are differentiated in addition according to emission criteria (NO_x and VOC emissions) of aircraft engines in order to provide incentives for airline operators to use aircraft with low emission engines.

Modal shift from freight road to rail

In addition to the HVF, the policy of transferring traffic from road to rail contains the following elements to promote public transport.

The construction of two new transalpine tunnels (57 and 34 kilometres long) will markedly improve transport through the Alps, in terms of capacity and speed, and thus make rail more competitive for both goods and passenger transport. Until the first of the two tunnels becomes operational (foreseen within the period 2006-7), the HVF cannot be levied in full. The Federal Law on the Transfer of Transalpine Freight Traffic to Rail and the supporting measures are transitional steps allowing the transfer to rail to begin to take place before 2006 to 2007. The Federal Law on the Transfer of Transalpine Freight Traffic to Rail fixes the maximum target of 650,000 heavy goods vehicles per year crossing the Alps by road, at the latest two years after the opening of the first alpine base tunnel. This means that, compared with 1999 levels, half of the heavy vehicles crossing the Alps should be transferred from road to rail.

The supporting measures are market-based instruments and incentives to improve the framework conditions of the railways, mainly subsidies for track use. In this way, the railways can increase their productivity and attractiveness.

The railway reform is an additional important element to increase the efficiency of rail transport. The reform came in force on 1 January 1999, and it ensures the adaptation of the railway to meet the requirements of a modern transport system. It is one of the most important preconditions to ensure that public transport in Switzerland is strengthened and gains an increasing share of the market.

Concerning the aviation sector, Swiss transport encourages the transfer of short-distance traffic from air to rail, by improving connections to the European high speed rail network. At the international level, Switzerland is active in promoting emission-dependent landing taxes, and the introduction of a tax on aviation fuel.

Energy saving programmes in the transport sector

Within the national 'Energy 2000' programme, several projects and programmes to increase energy efficiency in passenger and freight transport have been sponsored by the government, with an annual budget of around 6 million CHF, co-financed by the private sector. In the new Swiss Energy action plan, these actions will continue by means of an approach based on public-private partnership.

In the field of traffic, activities focus on the following points: fuel saving and safe driving (EcoDrive®), the promotion of energy-efficient cars, mobility management (Car Sharing), the promotion of cycling, and traffic management by local authorities. The crucial point of activities is co-operation with the market leaders in these segments. In this way, powerful sales channels and organisational elements can be used. The opportunities offered by multi-mode transport for commuter and business traffic are not yet generally appreciated. This was ascertained during the 'Mobile Manager' pilot project in which Swiss Federal Railways, Swiss Postal Coaches, Mobility Car Sharing and 'VBZ Zueri-Linie' (Zurich public transport) took part. Combined mobility, based on public transport and wide-ranging car-sharing facilities will be continued. Despite the appreciable impact that the activities have had, the continued increase in motor fuel consumption has not been halted. In 2000, the effects of voluntary measures amounted to 1 per cent of total motor fuel consumption.

Through EcoDrive®, drivers are taught to use higher gears. Driving instructors, garage owners and fleet operators adopt and promote a gentler style of driving, which means fuel savings of up to 15 per cent, fewer accidents, and improved protection of the environment. The organisers of the EcoDrive® driving courses, together with transport organisations and federal offices, have formed an association with the goal of providing long-term quality assurance. EcoDrive® has a marked effect at comparatively low cost: 39,100 drivers took part in courses during the period 1999 to 2000.

The private organisation Mobility Car Sharing offers 40,000 participants the shared use of 1,450 cars at 900 locations in 350 municipalities. A fleet of cars is available, with small cars, family cars, 7-seater vans, transporters and convertibles. The vehicles available may be booked conveniently by phone or via the Internet, 24 hours a day. Access to the cars is by means of an electronic card, and customers are invoiced regularly. For someone driving less than 15,000 km per year, combining Mobility with public

transportation is cheaper that running one's own private car. Up to 57 per cent of energy is saved, and less strain is put on infrastructure. Customers choose a flexible mode of transportation, enjoy changing cars, and do not mind driving a car that is not their own.

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 are speed reductions in city areas, parking measures and programmes for renewing bus fleets (use of CRT particle filters).

Most of the cantons apply a weight dependent motor vehicle tax, which provides an incentive to buy and use cars that are more fuel efficient. In 1996, the canton of Lucerne introduced a motor vehicle tax based on a bonus system. The tax rate differs according to EURO standards, and provides rebates for fuel efficient cars.

b) N_2O

The increase in N_2O emissions in the "transport" sector until 2000 was a result of the use of catalytic converters to reduce NO_x emissions. With the new converter series (to fulfil the EURO 3 and EURO 4 standards), this increase in N_2O will cease, and N_2O emissions in the transport sector should decrease from 2000 onwards.

4.3.4. Industry (including HFCs, PFCs and SF_6)

a) CO_2

The activities of the private sector were of major importance in the 'Energy 2000' programme. The whole programme focused on shared cost actions to include private companies and to create incentives to multiply the effects in the longer term. Real financial data to illustrate the level of involvement of the private sector are not available, but their involvement far exceeded the annual budget at the national level, which was more than 80 million CHF. The approach of creating voluntary agreements to save energy was fruitful, as shown by different evaluation projects.

In summer 2001, a guideline was issued advising large enterprises and trade associations how to implement voluntary measures and binding reduction commitments with a view to exemption from the tax that may be brought in through the CO_2 Law (see section 4.2.1).

The efforts of HCB 'Holderbank' Cement and Concrete to reduce energy consumption and CO_2 emissions are highly commendable. A 19 per cent reduction in specific CO_2 emissions has been achieved over the last ten years through the use of alternative fuels such as waste wood and substitute materials for clinker. These efforts already have a long tradition: the cement industry was the first sector to contribute voluntarily and substantially to the achievement of Energy 2000 targets.

The companies that are members of Swissmem (formerly Swiss Machine Industrialists, VSAM) organised a course on environmental management systems (EMS). Since many companies already have an EMS, attention is now shifting to the maintenance and extension of these systems. This involves looking beyond the manufacturing process to consider the entire life-cycle of products. The know-how exchange group on 'Eco-design', which meets every six months, is working on this topic. The courses for environmental protection officers held during the report period in the French and German-speaking parts of Switzerland were well attended. Swissmem and its 90 member companies contributed to the official Swiss energy statistics by collecting and processing energy data. It is customary for all those taking part to receive the results of the evaluation, enabling comparisons between sub-sectors.

The Swiss Trade Association helped to found the private Energy Agency of Trade and Industry (EnAW), which has the purpose of supporting enterprises in the implementation of the Energy Law and of the Law on the Reduction of CO_2 Emissions – no easy task taking into consideration the fact that 300,000 small and medium-sized enterprises (SMEs) do business in Switzerland (see section 4.3.2).

b) Fugitive fuel emissions

The CH_4 emissions in the 'fugitive fuel emissions' sector are mainly CH_4 losses from the gas distribution network in Switzerland. Based on the revised Ordinance on Air Pollution Control (1992), the emission standards for fuel distribution have been tightened, requiring vapour recovery units for petrol distribution. This has also had a positive impact on CH_4 emissions.

Swiss energy model

The Swiss energy model is based on groups of enterprises in the same area of business or in the same geographical area. These groups are responsible for setting targets and implementing voluntary measures to reach those targets. The 'Energy 2000' action plan (now 'SwissEnergy') provides a co-ordinator. The groups in the service sector are based on private business, whereas those in the industrial sector are mainly organised on a regional basis. These heterogeneous groups often use individual commitments on energy consumption. The Swiss energy model was launched several years ago by the Industry section and finally extended to cover large-scale consumers across the board. In 2000, four new Swiss energy model groups were set up, two of them in the services sector (banks, insurance companies, shopping malls). By the end of 2000, 25 groups were active in Switzerland and 5 were in the process of being created. By the end of 1999, the consumption of all companies involved in the Swiss energy model amounted to around 32 per cent of fossil fuels and around 28 per cent of electricity, reckoned according to total industrial value. To support this 'lead product', Energy 2000 organised two energy management courses, and ten motivation campaigns for employees of the companies taking part. This Energy 2000 product has had the biggest impact so far. It also put the lowest demand on finances per kilowatt-hour saved.

c) Other GHGs (HFCs, PFCs, SF_6)

In the industrial processes sector several areas are subject to regulation:

Fire protection

The amendment, on 29 November 1995 of annex 4.16 of the Ordinance relating to Environmentally Hazardous Substances forbids the supply and import, from 1 January 1996 on, of extinguishing agents made of gases (e.g. HFCs and PFCs) with a half-life of more than five years other than carbon dioxide, nitrogen, and the inert gases, and also the supply and import of appliances or stationary equipment containing such agents.

Aerosol propellants

The Ordinance relating to Spray Cans of 26 June 1995 forbids the use of HFCs or PFCs in most spray cans. It only allows the use of HFC 152a as propellant in spray cans containing cosmetics and household products.

Other products

Article 26 of te Ordinance relating to Environmentally Hazardous Substances of 9 June 1986 establishes that the marketing of all types of environmentally hazardous substances (including HFCs, PFCs and SF_6), and of products containing such substances, is subject to the self supervision requirement. This requirement allows the supply of a product in Switzerland only after it has been assessed by the importer/producer to show that its handling cannot present a hazard to the environment nor to persons indirectly through the environment.

Furthermore, according to Annex 2 of the Ordinance on the Movement of Toxic Waste, waste containing HFCs and PFCs counts as special waste. Thus, the movement of such waste is controlled, and such waste must be treated by licensed enterprises in an environmentally sound manner.

Announcement no. 2 (1994) concerning the Ordinance relating to Environmentally Hazardous Substances and the Ordinance on Air Pollution Control recommends that, according to the Ordinance on Air Pollution Control, the use of HFCs and PFCs as solvents is to meet the emission reduction requirements applicable to the most stringently-regulated class of solvents (class 1). It also states that "the Swiss Agency for the Environment, Forests and Landscape relies on the economic sectors concerned to refrain on a voluntary basis from using such substances. However, if the desired effects are not achieved, the Swiss Agency for the Environment, Forests and Landscape is prepared to propose appropriate measures."

Communication no. 1 (2000) relating to the Noise Abatement Ordinance and the Ordinance on Environmentally Hazardous Substances recommends avoiding the manufacture and installation of windows containing SF_6 as gas filler for fundamental ecological reasons.

d) Precursors and SO_2

NMVOC tax

While revising the Law on the Protection of the Environment in December 1995, the Swiss parliament approved an incentive tax on volatile organic compounds starting in 1999, and levied on both imported and domestically produced NMVOCs. Since 1 January 2000, VOCs and products containing more than 3 per cent of VOCs have been subject to an incentive tax of 2 CHF per kilogram. This rate will be increased to 3 CHF from 2003 onwards. As a consequence, a total emissions reduction of 27,000 tonnes of VOCs is expected. The estimated tax revenue of 100 million CHF will be reimbursed to the population on a per capita basis.

SO_2

Following the revision of the Ordinance on Air Pollution Control (1992), SO_2 emissions have decreased, due to the lower limits for sulphur content. The most important have been the decrease in the sulphur limit for diesel fuel (0.2 per cent to 0.05 per cent by weight in 1994) and the decrease of the sulphur limit of heavy fuel oil (1.5 per cent to 1 per cent by weight in 1991). In addition, the Swiss petroleum industry reduced the sulphur content of light fuel oil in a permanent manner (voluntary effort). Furthermore, based on the revised Law on the Protection of the Environment, a tax on the sulphur content of light fuel oil (sulphur content over 0.1 per cent) was introduced in July 1998. In 2000, the average sulphur content was 0.07 per cent for light fuel oil and 0.7 per cent for heavy fuel oil.

4.3.5. Agriculture

The measures described in section 4.1.4 are related to emissions of CO_2 , CH_4 and N_2O. Nowadays, most Swiss farms are managed in line with the ecological criteria set out in section 4.1.4. The fulfilment of these criteria is continuously monitored by the Swiss authorities. Over the last 10 years, the implementation of the agricultural policy reform and its specific measures has also led to a significant reduction of greenhouse gas emissions.

The progressive expansion of ecological cross-compliance, since 1992 in combination with the application of the Federal Law on Water Protection, which defines guidelines for the quality of surface waters and groundwater, were also responsible for more strict management of farmyard manure. The reduction in the amount of manure was basically obtained through a limitation on the number of cattle per hectare. To ensure high water quality, a limit of 3 cattle manure units (CMUs) per hectare was set for the highest yielding areas, to control stocking densities. In vulnerable and lower yielding areas, the cantons have to set limits lower than the federal maximum. The number of mature cows and non-diary cattle decreased, in Switzerland as a whole, from 1.85 million in 1990 to 1.6 million in 2000, with a corresponding decrease of about 10 per cent in the total amount of manure produced.

The requirement for balanced fertiliser accounts, and the creation of ecological compensation strips forced farmers to reduce manure application. The effects of the limitations on the use of farmyard manure and of mineral fertiliser are clearly reflected in the changes in emissions of methane and of nitrous oxide over time. This policy has resulted in a drop in the use of mineral fertilisers from 75 thousand Gg in 1990 to 53 thousand tonnes in 2000, and a reduction in the corresponding emissions of nitrous oxide (N_2O) from 1.38 Gg in 1990 to 0.98 Gg in 2000. Emissions of nitrous oxide decreased from 9.09 Gg in 1990 to 8.04 Gg in 2000, with reductions of 11 per cent for direct emissions; of 15 per cent for indirect emissions and of 9 per cent due to improvements in the management of manure, whereas emissions of methane, both from enteric fermentation and from manure management, dropped from 150.9 Gg in 1990 to 133.7 Gg in 2000.

4.3.6. Land use change and forestry

Forests act as a carbon reservoir and as a carbon sink, and they are completely protected by the forest law. The main instruments used are as follows.

- Prohibition of deforestation with strong regulations about exceptions, including the obligation to afforest an equal area.
- Obligation to reafforest devastated areas and clearings if natural regeneration is uncertain. During the years 1996 to 1999 12.9 million CHF of subsidies were paid annually to prevent and repair forest damages (previous four years 40.9 million CHF due to damages caused by cyclone Vivian in February 1990), and 3,150,000 (5,236,000) trees were planted annually.
- In Switzerland, forest management is strictly sustainable, and for nearly 100 years the felling of timber has only been permitted at a rate not in excess of replacement.

As a consequence of this policy, the forested area has still been increasing lasting recent years. There is a need to discuss the further development of this process because there are opposite or as yet undefined interests from the point of view of agricultural, forestry and climate policy. Some investigations have started. An assessment of the Swiss forest policy made by an international expert group put no emphasis on carbon storage (and its changes) as an element of Swiss forest policy. The result of the negotiations of the Kyoto Protocol concerning the sinks and the possible pressure of the economic sector to use sinks for carbon sequestration will be a concern of forest policy in the near future. The climate-related goal of Swiss forest policy is the promotion of sustainable uses of timber, with the aim of substituting for fossil fuels, rather than enhancing sink capacity (see section 4.2.5).

New objectives in agricultural policy have influences on the intensity of land use and may have an effect on carbon sinks (see section 4.2.4).

Other carbon reservoirs such as bogs, rare forest communities, hedges, copses and other natural habitats functioning as ecological balance areas are fully protected by the Federal Law on the Protection of Nature and Cultural Heritage, which was revised in 1996. Several hundreds of landscapes and biotopes have been declared as protected objects by the Confederation and are listed in inventories. They cover about 2 per cent of the area of Switzerland.

The laws concerning nature and landscape protection also require that zones acting as ecological balance areas, such as copses, hedges and natural vegetation on lake shores and river banks are to be established within areas used intensively by man. The duty to enhance the ecological value of farmlands has been supported by the promotion of more ecological agricultural practices over the past few years. Financial support for these activities has been several million CHF per year.

4.3.7. Waste management

Based on the Technical Ordinance on Waste Management, since 1991 all kinds of waste have had to be treated in an ecological manner. The cantons are responsible for implementation (planning capacity, installing, monitoring). Since 2000, combustible waste has had to be incinerated in specific plants This measure considerably reduces CH_4 emissions from landfill sites. The contribution of waste incineration to CO_2 emissions amounted to 3 per cent, which is negligible compared with emissions from waste disposal in landfill sites. In addition, 40 per cent of the energy can be reused for heating and electricity production. The residues from incineration are low in volume, and present fewer problems. Thus methane emissions from waste have been reduced significantly. In 1999, the percentage of CH_4 which stems from the waste sector amounted to 28 per cent of total methane emissions, and, based on the recent prohibition of disposal, this percentage is expected to be halved in the near future.

On 5 April 2000, the Federal Council decreed the introduction of a new tax earmarked for the purpose of restoring contaminated sites. Since 1 January 2001, waste disposal in landfill sites in Switzerland has been taxed at 15 to 20 CHF per tonne, depending on the type of waste, and any export of waste to landfill sites abroad are to be taxed at 50 CHF per tonne. Revenues are expected to amount to about 30 million CHF per year.

4.4. Policies and measures adopted or planned

4.4.1. General climate policy and Agenda 21

Law on CO_2

As mentioned in section 4.2.1, due to the 'carrot and stick' mechanism of the Law on CO_2, activities over the next few years will focus primarily on voluntary measures to avoid the introduction of a tax on fossil fuels. If (and only if) the reduction targets seems unlikely to be met by voluntary measures, and other policy relevant to CO_2, a CO_2 tax will be levied from 2004 onwards.

After the rejection of two energy taxation proposals, the CO_2 tax proposal is currently the only energy pricing measure based on existing legislation.

Action plan for sustainable development

In 1997, the Federal Council decreed a strategy for sustainable development in Switzerland and subscribed to eight different fields of action. An interim status report was published at the end of 2000.

- International involvement:
  Approval of guidelines in 1998 giving high priority to the needs of the poorest, and balancing economic growth and environmental protection in foreign policy.
- Energy policy:
  Enforcement endeavours to reduce energy consumption. Energy Law (see section 4.2.2.) and Law on CO_2 (see section 4.2.1.) brought into force. 'Energy 2000' programme (see section 4.3.2.) followed on by 'SwissEnergy' action plan (see section 4.4.2.).
- Greener public purchasing:
  Hosting of three conferences on greener public management in 1997 and 1998. Involvement to be increased over the next few years.
- Consumption pattern:
  Inclusion of the precautionary principle and the polluter pays principle in international trade agreements. Recognition and promotion of labels to facilitate environmentally and socially sound consumer behaviour.
- National security:
  Work on a new strategy is in progress, with recommendations for future peace policy and security.
- Public expenditure:
  A strategy for financing public transport was accepted in a referendum at the end of 1998, introduction of a heavy vehicle fee (see section 4.3.3.) partly earmarked for financing the new transalpine railway, and additional incentives for ecological farming in the agricultural reform.
- Ecological tax reform:
  Proposals were refused in a referendum (see section 4.4.2). New assessment of a possible scheme by the end of 2003.
- Implementation and monitoring:
  The Council for Sustainable Development was founded in 1998 (it merged with the Council for Spatial Organisation in 2001) and recommended the development of sustainability indicators. A task force comprising representatives of different federal offices is at work.

There is consideration of including the following three additional fields of action at a later stage: spatial development, housing, and the capital market.

Within the action plan of Local Agenda 21 (www.agenda21local.ch), a joint association of environmental and development organisations, 48 sustainability projects have been implemented by municipalities, companies and private institutions.

4.4.2. Energy

'SwissEnergy' action plan

The 'SwissEnergy' action plan (formerly 'Energy 2000' programme) covers all measures in energy policy. Many activities are being developed and carried out in co-operation with the cantons and the private sector. The main tasks of the action plan are producing voluntary agreements with private energy agencies and organisations, supporting measures favouring energy savings and renewable forms of energy, the promotion of renewable energy, research, training courses and the dissemination of information. There are four main topics: buildings, economy, mobility, and renewable forms of energy and energy efficiency. Most of the products of 'Energy 2000' have been transferred to 'SwissEnergy', which started at the beginning of 2001.

A strategic group with members from the federal authorities, cantonal governments, economic associations and environmental organisations is developing the programme. The Swiss government has political responsibility, and the Swiss Federal Office of Energy is in charge of operations.

The targets have been updated from the former 'Energy 2000' programme: a 10 per cent reduction in the consumption of fossil fuels between 2000 and 2010; the increase in electricity consumption is to be less than 5 per cent. In addition, an increase of 3 TWh in renewable heat production and 0.5 TWh in renewable electricity production should be achieved.

Supporting measures for the liberalisation of the energy markets

The Federal Law on the Electricity Market contains some regulations on renewable forms of energy. The law gives the possibility of indicating the origin of electricity production to customers. By means of this measure, the customer should know what electricity mix he/she is buying. Federal loans at cost price may be granted for the modernisation and maintenance of existing hydropower plants if the electricity company faces financial difficulties. Non-economic plants using renewable forms of energy, and of less than 1 MW capacity (0.5 MW for hydropower) have the right to use the electricity grid free of charge for ten years following the entry into force of the law. The federal authority may also determine the proportion of renewable electricity that the national grid company has to sell to its customers. By means of these regulations, the competitiveness of electricity produced from renewable sources is to be improved. The large proportion of hydropower (58 per cent of production in 2000) is to be maintained, and electricity production by new renewable techniques is to be increased. The law was adopted by parliament in December 2000. There is to be a referendum at the earliest in December 2001. The reason for the referendum is the limited public acceptance of the energy market liberalisation. If the law is accepted by the population it will be implemented in 2002.

Ecological tax reform

The Swiss government is to examine ecological tax reform in the long term. The most important measure under consideration is an energy levy on non-renewable fuels. The revenues will be used to reduce wage costs. This should lead to a decrease in energy

consumption and increased employment. Due to the negative result of the referendum (see box), a public initiative from the green party entitled 'taxing energy instead of work', to be voted on in December 2001, has been rejected by government and parliament. The proposals are more or less the same as those in the initiative that was rejected in 2000. Nevertheless, it is envisaged that a report with an evaluation of the situation and possible further steps will be prepared for the government by the end of 2003.

Failure of energy taxation proposals

Environmental organisations started a national initiative for a tax on non-renewable forms of energy (including nuclear power). Its revenues were to have been used to fund renewable forms of energy. Secondly they proposed an energy tax which would have been high enough to stabilise the consumption of non-renewable forms of energy, and should have later lead to an annual decrease in energy consumption of 1 per cent over 25 years. The revenue would have been distributed among the population and the economy. The federal parliament prepared two counter-proposals. The first was part of the ecological tax reform proposal, with ecological incentives, and the redistribution of the revenue (0.20 CHF/kWh); the second counter-proposal was to have generated financial resources (0.03 CHF/kWh) to promote renewable forms of energy, energy efficiency measures in the building sector, and hydropower. The opponents declared that voluntary measures are sufficient to save energy, and that the CO_2 Law with the possibility of introducing a CO_2 tax is a better way of solving the problem. All the suggestions were rejected in the national plebiscite in September 2000, with a majority of about 55 per cent. This decision is delaying the government plans for ecological tax reform.

4.4.3. Transport

Reduction in the specific fuel consumption of road vehicles

Based on the Decree on Energy Use of 1991, the Swiss government is entitled to adopt regulations on the specific fuel consumption of newly registered road vehicles. Thus, the Ordinance on the Reduction of the Specific Fuel Consumption of Passenger Cars was adopted in December 1995. It defines a reduction path in specific fuel consumption of the entire fleet of newly registered passenger cars (reduction of 15 per cent between 1996 and 2001) and the technical and organisational procedures. The target has not been reached so far (reduction of specific fuel consumption of 6.2 per cent between 1996 and 2000). Thus the Federal Office of Energy is evaluating enforced measures based on similar reduction targets per year. The introduction of a labelling system (Energy efficiency according to the practice in other European countries) and 'fuel consumption standards' are possible measures under discussion.

More stringent exhaust gas limits for motor vehicles (EURO III) will be introduced in Switzerland at the same time as in the European Union.

Sulphur free transport fuels

At the end of 2000 the Federal Council accepted a parliamentary proposal to promote the introduction of sulphur free transport fuels. By means of an incentive tax similar to that on heating oil (see section 4.3.4.) the sulphur content in both diesel and petrol are to be reduced to 10 ppm by 2004. The exact tax scheme is currently being evaluated.

"Slow" traffic or "human powered mobility"

Switzerland wants to promote pedestrians and transport by bicycle. Recent studies show significant potential benefits in terms of energy and the environment (for example air pollution). "Human powered mobility" offers the advantage of replacing short journeys otherwise travelled by individual motor vehicles. The potential increase depends on actions planned, the time span, and measures planned for other means of transport.

Investments in rail infrastructure

RAIL 2000 aims to improve public transport by extending the network, and using modern technology. This programme is made up of two phases: the first phase includes some 50 construction projects (maximum cost 7.5 billion CHF). The second phase will follow after 2005, and it will include new service sectors, while taking into account changing traffic requirements. The precise aims and thrust of the second phase of RAIL 2000 are at present being determined. A parliamentary bill concerning the second phase of RAIL 2000 is to be submitted in 2004.

Airport policy

The aeronautic infrastructure plan was adopted on 18 October 2000. Its main objectives are the integration of the aviation sector into the global system of transport and the protection of the environment. The different means of transport have to be developed according to their relative advantages. The development of the European High Speed Rail Network will favour the transfer of short-distance journeys from air to rail. Moreover, the aeronautic infrastructure plan obliges the Federal Council to commit itself to decreasing CO_2 emissions and other air pollutants in the areas surrounding airports.

4.4.4. Agriculture

Before additional measures are taken, the effects of the ongoing process have to be assessed. Further reductions in the emissions of methane and N_2O are expected as a result of the recent agricultural policy.

Since 1999, a special decree on sustainability in agriculture has required that periodical surveys of the agricultural policy and of the agricultural services be carried out by the Federal Office for Agriculture. The survey concerns the ecological, economic and social dimensions of sustainable agriculture. In addition, new research programmes are being carried out, aiming to develop standard tools for assessing the ecological impacts of farming at the level of the farm. These tools should also allow the consolidated evaluation of

agricultural policy at the national level. In this context it is also worth mentioning research projects for the estimation of the potential for carbon sequestration in agricultural soils. Ongoing efforts in the fields of education, communication and technical progress will lead to a more efficient utilisation of resources and due to this to a reduction in emissions.

4.4.5. Other GHGs (HFCs, PFCs, SF_6)

Policies and measures combining voluntary agreements, technical requirements and the regulation of production, trade, use and emission reductions are in preparation for the sectors of use that are not yet regulated (refrigeration, foams, solvents, the remaining uses of spray cans, the production of semiconductors, light metal production, high voltage electricity supply equipment, etc.).

It is intended that the use of these substances should be limited to the purposes for which other substances or techniques are hardly applicable or are worse from an environmental point of view. In a subsequent step, strict emission reduction measures will be requested in such cases. For SF_6 in high voltage equipment in particular, a voluntary commitment with emissions limits will be developed together with industry.

4.5. Summary tables

The following tables summarise the most interesting and promising measures in Switzerland. More detailed information is given in the fact sheets in annex 2.

4.6. Conflicting areas

Policy on integration with the European Union

The Overland Transport Agreement, accepted in 2000, liberalises and harmonises European road transport with Switzerland and gives Swiss railways free access to the EU rail network and vice versa. This agreement ensures the implementation of Swiss transport policy: the EU recognises the aim of switching from road to rail and the related instruments. However, the agreement provides for a transitional phase and a definitive regime after 2005 or 2007 to 2008. The 28-tonne limit for lorries in force in Switzerland is to be increased in stages: in 2001 to 34 tonnes and in 2005 to 40 tonnes. Switzerland is aware of a possible increase of lorries on Swiss roads, weakening the competitiveness of the rail sector during the transitional phase. To improve the chance of the rail sector in freight transport during this phase, Switzerland will increase the heavy vehicles fee step by step and implement several supporting measures (see section 4.3.3).

The productivity increases due to the liberalisation of the transport markets contain a danger for the transfer from road to rail. The productivity increase may lead to opposite effects. For passenger transport in regional areas, buses may be preferred to railways, mainly for financial reasons; in the case of freight transport, the productivity effects of the increase of the weight limit for lorries may outweigh the potential of the railways. Switzerland recognises these problems, and is supporting rail transport using specific financial resources.

Table 4-3 (to be continued on page 42): Most important GHG reduction measures implemented (for further details see the fact sheets in Annex 2)

Name of policy or measure	Objective and/or activity affected	GHGs affected	Type of instrument	Status	Implementing entity or entities	Impact indicators
CO_2 Law	Setting targets and timetables for reduction of CO_2 emissions (combustible fuels and petrol/ diesel, total 10 per cent reduction by 2010 compared with 1990)	CO_2, precursors	Framework legislation: - voluntary, with option for economic incentive tax	In force since 1 May 2000; guideline for voluntary action decreed in July 2001	Swiss Agency for the Environment, Forests and Landscape	Fulfilment of CO_2 requirements according to CO_2 legislation (periodic monitoring of overall emissions; progress reports by players engaged in voluntary agreements)
Energy Law	Ensure safe energy supply, contribute to rational and efficient energy use	CO_2	Framework legislation: - institutional - economic - regulatory	Implemented since 1998	Federal Office of Energy, cantons	Increase in overall energy consumption from 1990 - 2000: 69 PJ Energy savings through legal measures 1990 - 2000: 90.3 PJ
‚SwissEnergy' action plan (follow up programme of former ‚Energy 2000' programme)	10% reduction of fossil fuels from 2000 to 2010	CO_2	Voluntary agreements	Implemented since 1990, the ‚SwissEnergy' action plan is the follow up programme of former ‚Energy 2000'	Federal Office of Energy, cantons and partners in the public and the private sectors	Direct and indirect effects of the programme measured in energy saved and reduction in CO_2 emitted Overall energy savings 1990-2000: 165.5 PJ (9.8 - 13.7 million tonnes of CO_2)
Cantonal and communal energy laws	Adapt the Swiss Energy Law, according to the same goals	CO_2	Framework legislation: - institutional - economic - regulatory	Continuously implemented	Swiss cantons and communal entities; Energy 2000 and Swiss Energy	Cantonal energy indicators Analysis of the effects of energy policy
Energy efficiency programmes in the building sector	Implementation of Swiss Energy Law (labelling, co-operation, advice)	CO_2	Institutional Regulatory	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, cantons and partners in the public and the private sectors	Energy consumption in new and renovated buildings Energy savings of Energy 2000 in building sector in 2000: 0.8 PJ

Name of policy or measure	Objective and/or activity affected	GHGs affected	Type of instrument	Status	Implementing entity or entities	Impact indicators
Energy efficiency programmes in the commercial and industrial sector	Voluntary agreements, models for large-scale consumers to exhaust technical potentials	CO_2	Voluntary agreements	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, partners in the public and the private sectors	Energy savings of Energy 2000 in commercial and industrial sector in 2000: 12.4 PJ
Energy efficiency programmes in the transport sector	Voluntary agreements (EcoDrive, Car Sharing etc. to increase efficient use of fossil fuels	CO_2	Voluntary agreements	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, partners in the public and the private sectors	Energy consumption of new passenger cars Energy Savings of Energy 2000 in transport sector in 2000: 2.9 PJ
Energy efficiency programmes in the renewable sector	Increase of 3 TWh renewable heat production and 0.5 TWh electricity until 2010 by promotion activities	CO_2	Voluntary agreements Subsidies by cantons	Implemented since 1990 (follow up of former ‚Energy 2000' programme)	Federal Office of Energy, Cantons and partners in the public and the private sectors	Change in final consumption of renewable energy from 1990 to 2000: +21.9 PJ (136.8 PJ in total in 2000) Energy saved with energy efficiency measures Energy Savings 2000: 5.5 PJ
Distance-related heavy vehicles fee	Transfer of freight traffic from road to rail, reduction of Transalpine road traffic	CO_2, precursors	Economic measure (Internalisation of external costs)	Implemented since 2001	Federal Office of Customs, Federal Road Administration	Loading factors, change in vehicle-km road - rail Expected reduction in HGV vehicle-km for 2005: from 13.6 per cent up to 17.2 per cent
Modal split measures in freight transport	Transfer of freight traffic from road to rail, reduction of transalpine road traffic (supporting the HGV fee)	CO_2, precursors	Institutional subsidies (combined transport)	Beginning of implementation in 2000	Federal Office of Transport	Reduction in vehicle-km for HGVs, increase in combined transport, traffic volume of transalpine lorries: Expected reduction in HGV vehicle-km in 2005 (with HGV fee: from 18 per cent up to 21.7 per cent)
Sustainability and protection of forest area	Sustainable forest management, no reduction of forest area	CO_2	Regulatory education	Ongoing implementation since 1993	Swiss Agency for the Environment, Forests and Landscape	Number of trees, and their CO_2 absorption
Greenhouse gas mitigation in agriculture	Promotion of ecological practices on farms	CO_2, CH_4, N_2O	Economic voluntary	Ongoing implementation since 1993	Federal Office of Agriculture	Reduction in cattle, and in the use of mineral fertiliser
Ordinances relating to hazardous substances (Annex 4.16) and spray cans	Ban of use of synthetic gases depending on their half life in the air	HFCs, PFCs	Regulatory	In force since 1995 and 1996, respectively	Swiss Agency for the Environment, Forests and Landscape	Absence of certain fluorocarbons in fire extinguishing systems and spray cans
NMVOC charge	Reduction in fugitive fuel emissions	Precursors	Economic	Implemented since 1997, in vigour since 1999	Swiss Agency for the Environment, Forests and Landscape	Expected reduction: 27,000 tonnes of VOCs 100 million CHF in revenue

Table 4-3 (continued): Most important GHG reduction measures implemented (for further details see the fact sheets in Annex 2)

Name of policy or measure	Objective and/or activity affected	GHGs affected	Type of instrument	Status	Implementing entity or entities	Impact indicators
Law on electricity market	Supporting measures to the liberalisation of the electricity markets: consideration of renewable forms of energy	CO_2	Institutional regulatory	Adopted by parliament in 2000; subject to public referendum in 2002	Federal Office of Energy	Percentage of renewable electricity production in 2000: 59.2 per cent (139 PJ)
Ordinance relating to environmentally hazardous substances	Limitation of production, import, sale, use and emission of halogenated gases with a half life in the air of more than 2 years	HFCs, PFCs, SF6	Regulatory Voluntary Agreement Institutional	Possible decision in 2002	Swiss Agency for the Environment, Forests and Landscape	Contribution to Kyoto commitment
CO_2 tax	Reduction of CO_2 emissions according to legal requirements (10 per cent in 2010 compared with 1990)	CO_2, precursors	Economic	Adopted in the law on CO_2 reduction, introduction in 2004 will be discussed if voluntary measures are not sufficient	Swiss Agency for the Environment, Forests and Landscape	Fulfilment of CO_2 requirements according to CO_2 legislation
Ecological tax reform	Shifting tax burden from labour to energy use	CO_2, other emissions	Economic /energy levy and reduction of wage costs	Possible decision in 2004 together with CO_2 tax	Swiss government	Model calculations

Table 4-4: Most important GHG reduction measures adopted or planned (for further details see the fact sheets in Annex 2)

The recent frequent traffic jams on several motorways (Zurich to Berne, Geneva to Lausanne) and on the corridor across the Alps (Gotthard) are at the origin of the AVANTI popular initiative, which proposes to increase motorway capacity on these main routes in due time. Currently these proposals are being discussed within the government. There is a danger that such a policy might be accepted by the public and counterbalance the ongoing Swiss transport policy which favours modals shifts from road to rail. The government is preparing a counterproposal to this initiative.

Liberalisation of the energy markets

The electricity market and the gas market will be liberalised in the coming years. Price decreases will reduce incentives to save energy on the consumer side and an increased effort in energy efficiency will be necessary to overcome such a situation. The measures supporting renewable energy contained in the Law on the Electricity Market will support the energy saving policy (see section 4.4.2).

Technical trade-off between air pollution control and energy saving

In most cases, energy saving measures have a positive impact on air pollution and vice versa, but there are several sectors where one-sided promotion will cause problems. The following examples may be mentioned.

- The promotion of diesel cars in passenger transport saves energy but leads to increased emissions of particulates which may cause health problems.
- The promotion of combined cycle turbine plants to produce electricity is a very energy efficient method, but increases air pollutant emissions and CO_2 emissions compared with nuclear or other non-polluting forms of energy (hydropower, fuel cells, solar energy etc.).

Swiss environmental policy clearly aims at finding the best overall solutions to overcome these trade-offs. In such situations, a very effective measure is to set strict standards, such as emission standards, and to establish an information policy to raise public awareness.

Lack of popularity of energy taxation

As shown in the plebiscite in autumn 2000, energy taxation is not widely accepted for the time being, either by the business community or amongst the population. Despite the intended full return of the tax income by cutting labour cost for both employers and employees, the green tax reform was rejected by a narrow majority. Facing rising energy prices in the future, further proposals might have similar difficulties to pass at a referendum or with the legislative body. The Law on CO_2 (see section 4.2.1) stipulates the introduction of an incentive tax on fossil fuels, if the reduction targets seem unlikely to be met otherwise. The requirement for a tax, and the appropriate rate are being assessed by the Federal Council. However, the tax rates need to be approved by parliament. The composition of parliament at the relevant time will therefore be vital for the Law on CO_2 to be fully effective. If a majority of representatives is anticipated to be rather ill-disposed towards a CO_2 tax the 'carrot and stick' mechanism of the law will be undermined, and the voluntary phase could be seriously flawed as a consequence.

Nevertheless, the Swiss government still considers increasing the taxation of energy and reducing the compulsory supplementary wage cost an interesting option (see section 4.3.2). The decrease in energy consumption in Switzerland in the year 2000, in spite of remarkable economic growth, shows that price signals are very important, since market prices increased significantly over that period.

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5. Projections and the total effect of measures

5.1. CO_2

5.1.1. Energy related sectors

a) Energy scenarios: methodology and assumptions

To be able to estimate future changes in energy consumption and CO_2 emissions, the Federal Office of Energy has carried out several forecasting studies. These energy scenarios reflect different changes in the basic conditions, and different effects of implemented and planned measures. The scenarios are continuously updated.

The latest examines the possibility of phasing out nuclear energy (FOE/Prognos 2001). Several policy variants are worked out.

These forecasts are based on three essential assumptions.

- The economic and demographic framework develops as expected (rapid upswing in the economy: average yearly GDP growing at 2.2 per cent from 2000 to 2010, and afterwards at 1.3 per cent; population increase of 600,000 by 2010). The process of substituting low CO_2 or CO_2-free sources of energy (renewable forms) continues.
- Energy policy is implemented gradually. The measures contained in the energy legislation and the energy efficiency programmes will increase energy efficiency, in particular within the residential sector and in industry. However, due to rapid economic growth, the CO_2 targets set in the CO_2 legislation will not be reached on time. This is particularly the case for the transport sector.
- There is still nuclear power capacity within Switzerland, and electricity purchasing agreements with France are renewed. The alternative of the stepwise replacement of the existing domestic nuclear power capacity by modern gas-fired power stations or coupled heat and power installations by the year 2030 would increase emissions of CO_2 by about 12 per cent and the importation of natural gas would be more than twice the present level.

The scenario calculations are based on bottom up models. Energy demand is determined using separate models for households, for commerce and industry, and for transport. Cost analyses are worked out for each separate model, enabling the economic aspect of individual measures to be assessed for different energy prices, and taking account of the assumptions concerning the degree of implementation of measures and instruments.

In the energy forecasts a distinction is made between different policy variants:

- Energy legislation, used for the projections 'with measures implemented'
- CO_2 legislation, used for the projections 'planned measures'.

The individual models are as follows.

Households

Factors that are particularly considered are the number of flats and households; size of flats; type, age and use of the building; type and technical standard of heating installations and equipment for heating up water; the provision of households with electrical appliances and their energy properties and useful life.

Services

Various domains were investigated (trade; banking and insurance; hotel trade, schools; hospitals and homes; buildings in the transport sector; retail trade; wholesale trade; agriculture; culture and sport; other public buildings; auxiliary buildings). The energy code number (energy consumption index) for electricity distinguishes between 32 sectors.

Industry

Thirteen sectors of industry and 24 sub-sectors were studied, including the number of employees, the net industrial production, the various surfaces using energy, installations etc.. For each sub-sector a large number of production processes were investigated (type, replacement cycles, energy consumption etc.).

Transport

A distinction was made between freight and passenger transport, as well as between transport by road, rail, air and water. Tonne-kilometres, passenger-kilometres, and vehicle-kilometres were all included and measured on the basis of model estimations (link model). For vehicles, other criteria were capacity, number, category, size, age, local trips, regional trips, motorway trips, transit, border traffic etc..

Equilibrium models were used to determine the effects of energy policy on economic and demographic framework data. Table 5-1 shows the most important assumptions concerning the framework data.

	1998	2005	2010	2020
World oil prices (US$/per barrel)				
real	12.7	16.5	17.0	21.5
nominal	12.9	19.0	21.5	33.2
Domestic energy prices (real)	(1992)			
Fuel residential (CHF/tonne)	441	341	351	403
Fuel industrial (CHF/tonne)	404	330	339	384
Electricity (CHF/kWh)	0.159	0.135	0.123	0.130
GDPbillion CHF (1990prices)	329	381	425	498
Population (millions)	7.1	7.4	7.5	7.4
Number of cars (millions)	3.383	3.599	3.740	3.906

Table 5-1: Key variables and assumptions in the analyses of energy projections (Source: FOE/ Prognos 2001)

b) Scenario 'with measures implemented'

The most relevant trend scenario is the consideration of the effects of the energy legislation, the use of nuclear energy until existing nuclear plants reach the end of their life span, and high economic growth. In this scenario, it is assumed that the voluntary approach of CO_2 legislation (without a CO_2 tax) will not be able to reach the predefined targets. Overall energy consumption increased by 5.2 per cent between 1990 and 2000 and will further grow at rates of 4.1 per cent (from 2000 to 2010) and 0.6 per cent (from 2010 to 2020). It is estimated that, after 2020, there will be a reduction. The most

dynamic sector is transport, and the greatest savings will be achieved in the household sector. Table 5-2 shows the changes in energy consumption by source of energy.

PJ	1990	1998	2000	2005	2010	2015	2020
Heating oil	262	239	233	225	216	207	198
Transport fuels	256	277	285	294	303	312	318
Natural gas	69.8	97.5	101	108	112	114	116
Electricity	167	176	181	192	199	200	202
Distant heating	8.5	10.9	11.1	11.4	11.2	11.0	10.9
Wood	24.3	30.2	30.1	30.0	30.0	29.8	29.6
Coal	15.1	3.8	3.2	4.3	4.1	4.1	4.1
Waste	6.9	14.8	15.0	15.1	16.3	17.2	16.8
Other renewable forms of energy	1.7	4.6	5.1	6.8	8.7	9.9	11.3
Total	**811**	**853**	**865**	**886**	**901**	**905**	**906**

Table 5-2: Projections of energy demand (final energy consumption) between 1990 and 2020 (trend scenario 'with measures implemented'), source FOE/Prognos 2001)

5.1.2. Non-energy and other sources

The results presented here are based on the official forecast for all pollutants (SAEFL 1995). The assumptions are those described in the Second National Communication. A complete recalculation will be done in the period 2003 - 2004.

Most of the CO_2 emissions in the sector of industrial processes stem from the cement industry. The rapid decline in CO_2 emissions between 1990 and 1995 is the result of a reduction in the production of cement (20 per cent decrease). The 1995 production level is assumed to remain constant until 2020.

Most of the CO_2 emissions in the waste sector are from waste incineration plants. The continuous increase in CO_2 emissions is the result of the increasing amount of waste being burnt.

No data are yet available for agricultural soils. Detailed inventories and forecasts taking account of the change in agricultural land use, and the change in soil carbon stocks are being developed. Since the contribution of agriculture to CO_2 emissions is fairly low, it has been neglected in the following carbon balances (less than 1.5 per cent of total fuel consumption in Switzerland is related to the agricultural sector).

5.1.3. Removals by sinks and reservoirs

The oldest afforestations are now more than 100 years old. According to the IPCC guidelines, this would mean that there is no longer net carbon sequestration in these areas. However, growth is slower in higher zones and therefore the lifetime of a tree in the alpine region, where most of the afforested areas are situated, may be several centuries. For this reason, the change in the growing stock is extrapolated from the difference between national forest inventory 1 (1985) and national forest inventory 2 (1995). The linear extrapolation is modified by the change in forest area and removals of wood, assessed each year. Natural losses and non-removed slash from harvesting processes are also extrapolated from the assessment of the national forest inventories.

As a consequence of Swiss forest policy (see section 4) forest area and growing stock are still increasing. A constant sink of 4,000 to 4,500 Gg CO_2 p.a. can be expected during the next few decades, with the reservation that no serious damage occurs from events such as the storm 'Lothar'. No carbon enrichment in the soil is included in this figure, because abandoned pastures have rather a high carbon content, so an increase as suggested by the IPCC guidelines is rather unlikely.

The contribution of the strategies in nature and landscape protection to CO_2 sequestration is difficult to assess. It is estimated to be 1 to 2 per cent of those in the Swiss forests.

5.1.4. Scenario 'with measures implemented'

a) CO_2 trends

Table 5-3 and Figure 5-1 present an overview of the CO_2 forecasts for 1990 to 2020. Total gross emissions will decrease by 3.7 per cent between 1990 and 2010, with a further 2.8 per cent reduction between 2010 and 2020. The most dynamic sector is transport, where an increase of 6.3 per cent is expected between 1990 and 2010.

CO_2 1,000 Gg	1990	2000	2005	2010	2015	2020
Energy	**41.75**	**41.12**	**41.04**	**40.80**	**40.28**	**39.57**
Fuel combustion of which	41.70	41.04	40.96	40.72	40.20	39.50
Energy and transformation	1.09	1.14	1.11	1.11	1.11	1.11
Industry	6.61	6.11	6.14	5.99	5.89	5.82
Transport	14.40	15.12	15.25	15.47	15.45	15.30
Small-scale combustion	18.83	17.95	17.67	17.34	16.90	16.39
Other	0.77	0.72	0.79	0.81	0.84	0.87
Fugitive emissions	0.06	0.08	0.08	0.08	0.08	0.08
Industrial processes	3.36	2.30	2.30	2.30	2.30	2.30
Solvent use	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Agriculture	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Waste	1.32	1.40	1.50	1.60	1.60	1.60
Total gross emissions	**46.43**	**44.82**	**44.84**	**44.70**	**44.18**	**43.47**
Land use and forestry	-3.19	-3.00	-4.50	-4.50	-4.50	-4.50
Total net emissions	**43.24**	**41.82**	**40.34**	**40.20**	**39.68**	**38.97**

n.o. = not occurring; n.e. = not estimated

Table 5-3: CO_2 projections for 1990 to 2020 (scenario 'with measures implemented')

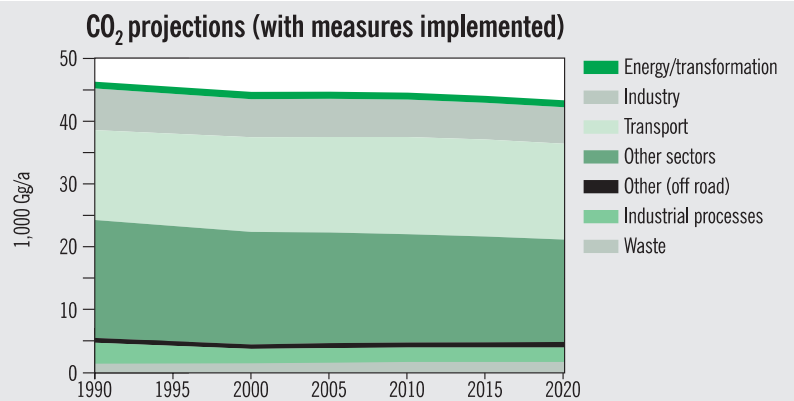


Figure 5-1: CO_2 projections for 1990 to 2020 by source ('with measures implemented')

b) Total effect of measures

Switzerland has not elaborated a scenario showing future changes without measures. Moreover, the effects of measures are estimated in different ex ante evaluation studies (results shown in the summary tables in section 4.5). In addition, a continuous ex post analysis attempts to evaluate the ongoing effects of the measures implemented in the energy sector (see section 4.3.2). The real future changes in energy demand are thus compared with the modelled changes, considering the change in exogenous factors such as economic growth and world energy prices. This analysis shows that growth effects and energy price increases have outweighed the energy saving effects due to the measures implemented. Table 5-4 shows the different contributions based on the model estimations. Although the energy savings would have been 65.4 PJ for this period, total energy demand has grown, especially due to growth effects. Without the measures implemented, the growth in energy demand would have been twice as great.

Change in energy demand from 1990 to 99 due to (isolated effects)	Fossil fuels (PJ)	Electricity (PJ)	Others (PJ)	Total (PJ)
Climate variations	+ 6.8	+ 0.7	+0.5	+8.0
Growth effects	+ 74.9	+ 21.3	+ 1.8	+ 98
Policy and technology improvements	- 55.8	- 7.3	- 2.2	- 65.4
Energy prices	+ 2.9	- 1.7	+ 4.7	+ 6.0
Statistical corrections	+ 8.6	+ 1.2	+ 4.5	+ 14.4
Total 1990 to 1999	**+ 37.4**	**+ 14.2**	**+ 9.3**	**+ 60.9**

Table 5-4: Ex post analysis of energy demand between 1990 and 1999

5.1.5. Scenario 'planned measures'

The effects of the new CO_2 and Energy Laws, together with additional measures are simulated in a further energy scenario (scenario with the implementation of a CO_2 tax on fuels, according to FOE/ Prognos 2001). This scenario assumes that the Swiss CO_2 legislation targets can be fulfilled on time, introducing a CO_2 tax. Table 5-5 compares the two scenarios. The scenarios only cover CO_2 emissions related to energy. CO_2 emissions will decrease by 10 per cent between 1990 and 2010 (according to targets). A further decrease of 5 per cent is expected between 2010 and 2020. The greatest differences between the two scenarios are related to the sectors transport and industry.

1,000 Gg CO_2	1990[1)]	2000	2010	2020
Scenario 'with measures implemented' (Energy Law)				
Energy transformation	1.5	1.5	1.5	1.4
Residential	13.3	12.4	12.1	11.5
Commercial and institutional	5.4	5.4	5.1	4.8
Industry	7.2	6.5	6.6	6.5
Transport	14.4	15.1	15.5	15.3
Total	**41.8**	**41.0**	**40.8**	**39.6**
Scenario 'planned measures' (CO_2 tax)				
Energy transformation	1.5	1.5	1.5	1.4
Residential	13.3	12.4	10.9	10.2
Commercial and institutional	5.4	5.4	4.7	4.3
Industry	7.2	6.5	6.1	5.9
Transport	14.4	15.1	14.6	14.1
Total	**41.8**	**41.0**	**37.8**	**35.9**

[1)]energy-related emissions from modelled data, not fully consistent with GHG inventory

Table 5-5: Comparison of changes in CO_2 emissions for scenarios 'with measures implemented' and 'planned measures' (energy related CO_2 emissions only, in 1,000 Gg)

Further explanation

Link between inventories and projections of energy-related CO_2 emissions, 1990

The Swiss greenhouse gas inventories are based on official Swiss energy statistics. The final energy consumption in the statistics is split into four sectors: residential; commercial and service; industry; and transport. Additional divisions in the inventories refer to these sectors.

In contrast to that, the CO_2 emission projections are based on a bottom-up model (FOE / Prognos 2001). Thus the time series are not exactly the same. The differences are mainly the result of the climate correction in the model (combustion sector). The model also defines a slightly higher fuel consumption in the transport sector (differences in fuel consumption; the transport calculations in the inventory are based on a physical model, whereas those in the Prognos model are based on economic estimations). The following table shows an approximate relation between inventory data and model data. Only energy-related CO_2 emissions are shown in the table. 1990 is the base year for modelling. Thus inventories and model results have to be compared in 1990.

(Gg CO_2)	1990 inventory	1990 model data
Combustion fuels	24,270	26,035
Motor fuels	15,460	15,720
Total energy	39,730	41,750

5.2. CH_4

5.2.1. Agriculture

Emissions of methane (CH_4) from Swiss agriculture for the period 1990 to 2020 were calculated using the IPCC methodology described in detail in Minonzio et al. (1998). This so-called method 2 is based on the original IPCC method (IPCC, 1994), with specific adaptations for Switzerland. The energy demand of animals for 2000 to 2020 was computed assuming that the energy demand per head remains stable in comparison to 1999, in line with the most recent statistics (Schweizerischer Bauernverband, 2000). The assumed number of livestock is shown in Table 5-6 (Federal Office for Agriculture). The most relevant change in comparison to the Second National Communication can be explained by the more rapid decrease in the population of mature cows and non-diary cattle than expected, due to the new agricultural policy.

Parameter	1990	1995	2000	2005	2010	2015	2020
Mature cows	795	763	721	712	694	675	657
Non-dairy cattle	1,060	986	879	868	845	823	801
Pigs	1,787	1,446	1,420	1,420	1,420	1,420	1,420
Poultry	6,530	6,064	6,800	6,975	7,150	7,325	7,500
Sheep	395	387	420	420	420	420	420
Goats	68	53	60	60	60	60	60
Horses and mules	42	41	50	50	50	50	50

Table. 5-6: Livestock input data (thousand heads).

The calculated annual emissions of methane from Swiss agriculture for the period 1990 to 2020 are summarised in table 5-7. The projected decrease by the year 2020 is 19 per cent compared to 1990. This decrease is significantly more marked than the 4 per cent decrease given in the Second National Communication (1997). The difference between the new and old emission projections reflects the changes in the projections of the livestock input data (table 5-6), in particular the less conservative estimate of the future cattle population. In fact, the emissions from this category contribute about 90 per cent of the total methane emissions from Swiss agriculture. It should be noted however, that assumptions concerning the future of Swiss agriculture reflect best guess estimates, and are rather uncertain.

	1990	1995	2000	2005	2010	2015	2020
Enteric fermentation	130.2	127.0	115.2	113.8	111.0	108.2	105.5
Manure management	20.7	20.2	18.5	18.3	18.0	17.7	17.3
Total	**150.9**	**147.2**	**133.7**	**132.1**	**129.0**	**125.9**	**122.8**

Table. 5-7: Past and projected annual methane emissions from agriculture (Gg CH_4) 1990-2020.

5.2.2. Other sources

The results presented here are based on official forecasts for all pollutants (SAEFL 1995). The assumptions are those described in the Second National Communication. A complete recalculation will be done in the period 2003 to 2004.

Emissions of CH_4 in Switzerland are dominated by emissions from agriculture (62 per cent in 1990, 74 per cent in 2010 and 73 per cent in 2020). Fugitive emissions from fuels are mainly losses from the gas distribution network (at present about 6 per cent of the total methane emissions in Switzerland). This distribution network is constantly being upgraded; so despite the rapid increase in gas consumption, a decrease in fugitive emissions of 23 per cent is expected for the period 1990 to 2020.

5.2.3. Overview

Table 5-8 shows overall trends of CH_4. Total emissions will decrease by 57 per cent between 1990 and 2010. A further decrease of 4 per cent is expected between 2010 and 2020.

CH_4 Gg	1990	2000	2005	2010	2015	2020
Energy	21.95	17.70	16.61	15.93	15.98	16.00
Fuel combustion of which	7.32	5.40	4.81	4.63	4.68	4.70
Energy and transformation	0.06	0.07	0.07	0.07	0.07	0.07
Industry	0.43	0.50	0.51	0.50	0.49	0.49
Transport	3.92	1.81	1.24	1.00	0.92	0.92
Small-scale combustion	2.54	2.63	2.58	2.60	2.73	2.73
Other	0.37	0.40	0.42	0.46	0.48	0.49
Fugitive emissions	14.64	12.30	11.80	11.30	11.30	11.30
Industrial processes	0.43	0.44	0.47	0.50	0.50	0.50
Solvent use	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Agriculture	150.90	133.70	132.10	129.00	125.90	122.80
Land use and forestry	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Waste	68.61	61.60	46.30	29.30	29.30	29.30
Total	**242**	**213**	**195**	**175**	**172**	**169**

n.o. = not occurring

Table 5-8: Projections for CH_4 emissions from 1990 to 2020

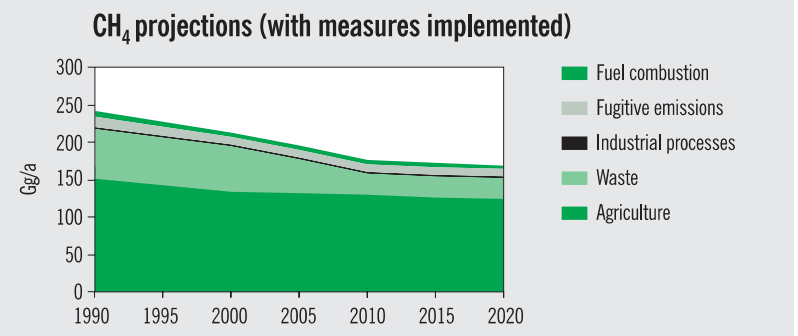


Figure 5-2: CH_4 projections 1990 to 2020 by source

5.3. N_2O

N_2O emission data have been revised since the Second National Communication. The reason for the lower figures in the present report is the application of the most recent IPCC methodology (method 2) for the calculation of agricultural N_2O emissions and recalculation of road transport emissions (with the new converter series to fulfil EURO 3 and EURO 4, N_2O emissions in the "transport" sector will decrease from 2000 onwards).

5.3.1. Agriculture

Unlike the emission data published in the Second National Communication (1997), which were computed according to the IPCC methodology, the recent emissions of nitrous oxides (N_2O) from Swiss agriculture for the years 1990 to 2020 were calculated using the IULIA method (Schmid et al., 2000). This method is based on the IPCC method (IPCC/OECD/IEA, 1996), but attempts to remove some obvious inconsistencies. Moreover, it accounts for additional sources of nitrous oxide such as biological nitrogen fixation and the decay of plant residues returned to the soil in meadows and pastures. The IPCC method only considers these emissions for arable crops. The emissions factors used in the IULIA method are the same as those proposed by the IPCC. In addition to the number of livestock (table 5-6), the IULIA method requires the total amount of fertilisers and the crop production as additional input data (table 5-9), as well as the area of meadows and pastures (table 5-10).

For the year 1995, in the Second National Communication (1997) temporary data published by the Swiss Farmers Association were used. For this third communication some minor corrections have been made, with respect to the definite data now available for the year 1995.

Parameter	1990	1995	2000	2005	2010	2015	2020
Mineral N fertilisers	75	67	53	50	48	47	45
Legumes	10	14	14	20	26	29	31
Cereals	1,279	1,246	1,162	1,225	1,250	1,250	1,250
Root crops	2,074	1,705	2,383	2,240	2,305	2,305	2,305
Vegetables	360	307	350	350	350	350	350
Fruit	510	365	400	390	380	370	360
Wine	173	155	160	156	156	156	156
Tobacco	1	2	1	1	1	1	1
Energy crops	0	4	5	5	5	5	5

Table 5-9: Mineral fertiliser input (thousand tonnes) and crop production (thousand tonnes harvested biomass).

	1990	1995	2000	2005	2010	2015	2020
Area	785	799	797	796	794	793	792

Table 5-10: Area (thousand hectares) of meadows and pastures.

The calculated annual emissions of nitrous oxide from Swiss agriculture for the period 1990 to 2020 are summarised in table 5-11. The projected decrease by the year 2010 is 14 per cent, relative to 1990 (17 per cent by the year 2020). The decrease chiefly reflects the decline in the use of N fertilisers and, to some extent, the decrease in the population of mature cows and non-diary cattle. In the Second Communication (1997), the projected decrease in total emissions by the year 2010 relative to 1990 was 18 per cent, a value somewhat larger than the 14 per cent given here. The difference arises from the use of the IULIA method, instead of the IPCC method adopted for the Second National Communication (1997). Overall, the results presented here indicate that the agricultural reform has had positive effects on emissions of greenhouse gases.

Gg N_2O	1990	1995	2000	2005	2010	2015	2020
Direct	4.33	4.16	3.87	3.82	3.76	3.70	3.64
Manure management	2.09	1.98	1.90	1.90	1.87	1.83	1.80
Indirect	2.67	2.46	2.27	2.24	2.20	2.15	2.10
Total	**9.09**	**8.60**	**8.04**	**7.96**	**7.83**	**7.68**	**7.54**

Table 5-11: Past and projected annual emissions of nitrous oxide from agriculture (Gg N_2O) 1990 to 2020.

5.3.2. Other sources

The results presented here are based on the official forecast for all pollutants (SAEFL 1995). The assumptions are those described in the Second National Communication. A complete recalculation will be done during the period 2003 to 2004.

5.3.3. Overview

The main source of N_2O emissions is agriculture (81 per cent of total N_2O emissions in 1990; 76 per cent in 2010 and 77 per cent in 2020). Table 5-12 shows that overall emissions are expected to decrease by 8 per cent between 1990 and 2010. A further decrease of 5 per cent is expected between 2010 and 2020.

N_2O Gg	1990	2000	2005	2010	2015	2020
Energy	1.24	2.01	1.68	1.27	1.07	1.03
Fuel combustion of which	1.24	2.01	1.68	1.27	1.07	1.03
Energy and transformation	0.008	0.003	0.003	0.003	0.003	0.003
Industry	0.045	0.040	0.040	0.039	0.038	0.037
Transport	0.98	1.78	1.44	1.03	0.82	0.78
Small-scale combustion	0.18	0.17	0.16	0.17	0.17	0.17
Other	0.03	0.03	0.03	0.03	0.03	0.03
Fugitive emissions	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Industrial processes	0.32	0.31	0.31	0.31	0.31	0.31
Solvent use	0.35	0.39	0.40	0.41	0.41	0.41
Agriculture (one year average)	9.09	8.04	7.96	7.83	7.68	7.54
Land use and forestry	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Waste	0.22	0.33	0.46	0.50	0.50	0.50
Total	**11.2**	**11.1**	**10.8**	**10.3**	**10.0**	**9.8**

n.o. = not occurring

Table 5-12: Projections for N_2O emissions 1990 to 2020

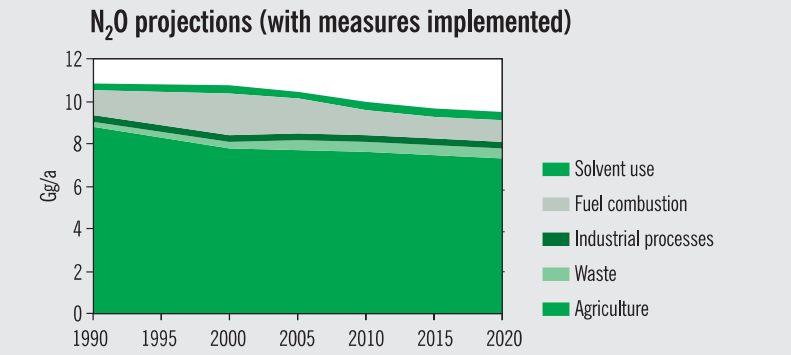


Figure 5-3: N_2O projections 1990 to 2020 by source

5.4. Other GHGs (HFCs, PFCs, SF_6)

Table 5-13 presents projections for the most important HFCs and SF_6. The results are based on a substance flow analysis for Switzerland for the years 1997 and 1998. Import and export information was used to estimated the trend for several substances between 1990 and 2000. This historic trend was extrapolated to 2010. Additional expert interviews provided information concerning technological and legal changes within Europe, which was used to correct extrapolated figures.

Data for 1990 and 1995 are preliminary emissions estimates, which are only partially based on empirical or modelled data. HFC projections do not include the category 'foam blowing', for which data are not yet available (in 1999, emissions from foam blowing made up less than 5 per cent of total HFC emissions). For PFCs, no trend data are available (actual PFC emissions in 1999 were about 5 per cent of CO_2 equivalent emissions from all "new gases"). The main sources of PFCs are 'semiconductor manufacturing/solvent use' and 'aluminium production'. Projections for SF_6 do not take into account the potential effects of a voluntary agreement concluded in late spring 2001 with all major enterprises of the electrical equipment sector.

Gg CO_2 equivalents	1990	1995	2000	2005	2010
HFCs	0	135	530	930	970
PFCs	n.a.	n.a.	n.a.	n.a.	n.a.
SF_6	160	130	130	140	150
Total	**160**	**265**	**660**	**1,070**	**1,120**

n.a. = not available

Table 5-13: Projections for other GHGs (HFCs and SF_6) from 1990 to 2010

The most important HFCs for Switzerland are HFC 134a (mainly used in commercial refrigeration and mobile air conditioning) and HFC 143a (produced for commercial refrigeration). The projections for emissions of SF_6 due to high voltage switchgear are stated without taking into consideration the impact of the voluntary agreement for SF_6 emission reduction by the industries concerned.

5.5. Aggregate effects of policies and measures

The following table shows the aggregate effect (scenario 'with measures implemented'). The figures shown are the emissions of CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 expressed in CO_2 equivalents. The projections expect an overall reduction of emissions between 1990 and 2020 of 6,400 Gg. Between 1990 and 2010, the expected reduction is 3,800 Gg or 7.3 per cent. This is mainly due to a reduction in CO_2 and CH_4 emissions. Also notable is the increase in sinks of about 50 per cent by 2020.

CO_2 equivalent (Gg)	1990	2000	2005	2010	2015	2020
CO_2	46,430	44,820	44,840	44,700	44,180	43,470
CH_4	5,080	4,480	4,100	3,670	3,610	3,540
N_2O	3,480	3,440	3,350	3,200	3,100	3,030
HFCs	0	530	930	970	n.a.	n.a.
PFCs	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SF_6	160	130	140	150	n.a.	n.a.
Sinks	-3,190	-3,000	-4,500	-4,500	-4,500	-4,500
Total	**51,960**	**50,400**	**48,860**	**48,190**	**46,390**	**45,540**

n.a. = not available

Table 5-14: Projections for all GHGs in CO_2 equivalents (1990 to 2020)

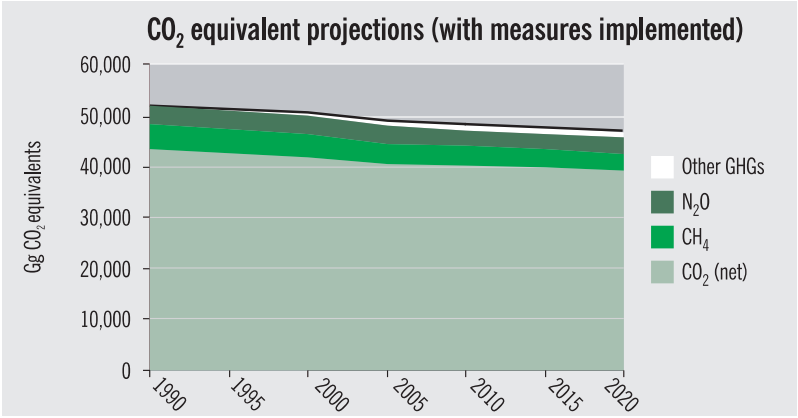


Figure 5-4: Projections of CO_2 equivalent emissions from 1990 to 2020 (based on energy scenario 'with measures implemented'; HFCs, PFCs, SF_6 emissions kept constant after 2010)

5.6. Precursors

The results presented here are based on the official forecast for all pollutants (SAEFL 1995), which is corrected with new figures in energy consumption (FOE/Prognos 2001) and with the effects of the NMVOC tax. The basic assumptions are those described in the Second National Communication. A complete recalculation will be done during the period 2003 to 2004.

The emissions of precursors in the energy sector were calculated with energy consumption data from the prognostic model described in section 5.1.1. The emissions of the sectors of industrial processes and solvent use were calculated with product quantities and the corresponding emission factors.

In the sector of waste, different approaches were used. Emissions of waste incineration plants were calculated in the same manner as fuel combustion emissions in the energy sector, emissions from landfill sites were calculated with a sophisticated formula for degassing (similar to 1995 IPCC guidelines).

Table 5-15 and Figure 5-5 show the predicted trends for 1990 to 2020. Due to air pollution measures, all emissions of precursors will decline. The overall reductions will be as follows between 1990 and 2010:

- NOx emissions: 59 per cent down
- CO emissions: 58 per cent down
- NMVOC emissions: 56 per cent down.

In 1990, NO_X emissions were dominated by transport emissions. Due to the effects of EURO 3 and EURO 4, the domination of road transport emissions in 1990 will cease in 2020 (road transport emissions 63 per cent in 1990; 29 per cent in 2020). The sector of small-scale combustion (residential and commercial or institutional) is expected to contribute about 14 per cent in 1990 and 32 per cent in 2020.

Three sectors are chiefly responsible for CO emissions, namely transport, small-scale combustion and other; i.e. road transport (75 per cent in 1990 and 38 per cent in 2020), small-scale combustion (12 per cent in 1990; 30 per cent in 2020) and other (7 per cent in 1990; 22 per cent in 2020). The sector "other" mainly covers off-road vehicles.

Emissions of NMVOCs are dominated by the sectors of solvent use and transport. Due to the effects of EURO 3 and EURO 4, road transport emissions will decline rapidly. Solvent use contributed 53 per cent in 1990 and will contribute 65 per cent in 2020, whereas the transport sector contributed 32 per cent in 1990 and will contribute 8 per cent in 2020. The expected effects of the NMVOC tax are included (reduction of total emissions 10,000 tonnes in 2000, 20,000 tonnes in 2005 and 30,000 tonnes in 2010, see section 4.3.4).

Precursors	1990			2000			2005			2010		
Gg	NOx	CO	NMVOCs	NOx	CO	NMVOCs	NOx	CO	NMVOCs	NOx	CO	NMVOCs
Energy	149.17	650.47	120.98	92.96	380.83	48.72	74.36	309.45	37.54	62.83	277.17	33.47
Fuel combustion of which	149.11	650.44	102.71	92.92	380.82	42.16	74.31	309.44	31.21	62.76	277.15	27.12
Energy and transformation	1.73	0.37	00.43	1.12	0.30	0.042	0.88	0.27	0.041	0.88	0.27	0.041
Industry	17.58	18.15	0.51	10.59	17.20	0.50	9.93	16.64	0.50	8.95	16.62	0.48
Transport	98.61	504.48	87.98	53.45	223.74	26.77	37.06	158.08	15.34	26.46	122.88	11.00
Small-scale combustion	22.38	78.25	7.23	18.77	85.88	7.33	16.25	78.05	7.30	15.68	79.68	7.35
Other	8.81	49.20	6.95	9.00	53.70	7.53	10.20	56.04	8.03	10.80	57.70	8.25
Fugitive emissions	0.06	0.03	18.27	0.04	0.01	6.56	0.05	0.01	6.33	0.07	0.02	6.35
Industrial processes	0.46	14.35	8.21	0.31	10.40	7.87	0.31	11.10	8.12	0.32	12.00	8.44
Solvent use	0.04	0.08	147.00	0.05	0.09	91.00	0.05	0.09	85.00	0.05	0.09	79.00
Agriculture	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Land use and forestry	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.	n.o.
Waste	6.75	8.23	2.71	5.00	2.75	0.97	2.69	2.55	0.80	2.71	2.43	0.62
Total	**156**	**673**	**279**	**98**	**394**	**149**	**77**	**323**	**131**	**66**	**292**	**122**

n.o. = not occurring; n.e. = not estimated

Table 5-15: Projections for precursors 1990 to 2020

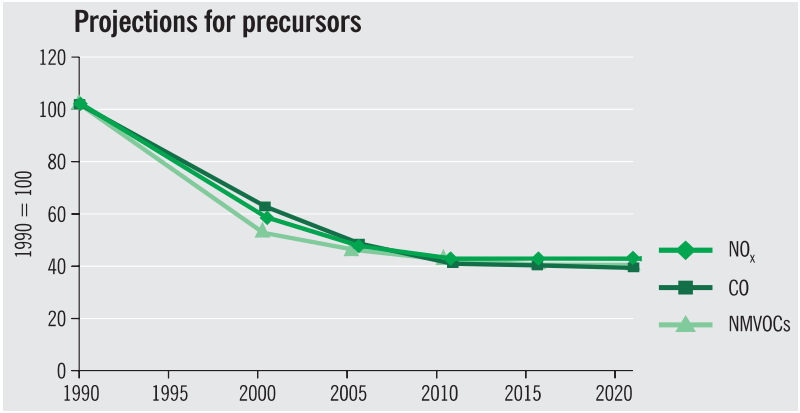


Figure 5-5: Projections for precursors 1990 to 2020

5.7. SO_2

The results presented here are based on the official forecast for all pollutants (SAEFL 1995), which is corrected with new figures in energy consumption (FOE/Prognos 2001) and SO_2 tax. The basic assumptions are those described in the Second National Communication. A complete recalculation will be done during the period 2003 to 2004.

Calculations were done in the same manner as the calculations for precursors (see previous section). Calculations of SO_2 emissions in the energy sector are directly influenced by energy consumption and the sulphur content of the fuels. Since 1980 the sulphur content of fossil fuels has decreased constantly. The mean sulphur content of heavy fuel oil fell from 2 per cent to under 0.7 per cent in 2000, and for light fuel oil decreased over the same period from 0.4 per cent to about 0.07 per cent in 2000.

Fuel combustion (small-scale combustion and industry) is the main source of SO_2 emissions in Switzerland.

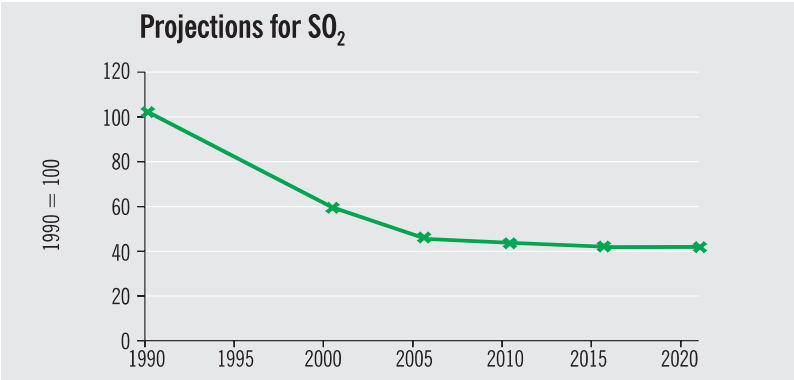
Emissions in the energy sector will decline as a result of air pollution measures. Thus a decline of 58 per cent in total is expected between 1990 and 2020.

Table 5-16: Projections for SO_2 from 1990 to 2020

SO_2 Gg	1990	2000	2005	2010	2015	2020
Energy	**30.26**	**19.10**	**13.83**	**12.98**	**12.31**	**12.26**
Fuel combustion of which		19.10	13.83	12.98	12.31	12.26
Energy and transformation		1.16	1.09	1.09	1.09	1.09
Industry	4.88	4.96	4.38	3.96	4.18	
Transport		1.68	0.47	0.47	0.47	0.47
Small-scale combustion		11.13	7.06	6.79	6.52	6.25
Other	0.24	0.25	0.25	0.26	0.27	
Fugitive emissions		n.o.	n.o.	n.o.	n.o.	n.o.
Industrial processes	**8.66**	**3.52**	**3.11**	**3.13**	**3.13**	**3.13**
Solvent use	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**
Agriculture	**n.e.**	**n.e.**	**n.e.**	**n.e.**	**n.e.**	**n.e.**
Land use and forestry	**n.o.**	**n.o.**	**n.o.**	**n.o.**	**n.o.**	**n.o.**
Waste	**3.41**	**2.21**	**2.27**	**2.31**	**2.31**	**2.31**
Total	**42.4**	**24.9**	**19.2**	**18.5**	**17.8**	**17.7**

n.o. = not occurring; n.e. = not estimated

Figure 5-6: Projections for SO_2 1990 to 2020



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6. Vulnerability assessment, impacts and adaptation

6.1. Expected impacts of climate change

According to the final results of the National Research Programme on 'Climate Changes and Natural Disasters' (NRP 31) (Bader & Kunz, 2000), noticeable changes are likely in Switzerland as warming increases. An analysis of data on climate (49 stations) and precipitation (135 stations) for the period 1961 to 1990 (Aschwanden et al., 1996) shows that the average temperature over Switzerland increased by 1°C over this 30-year period, with spring and early summer becoming colder and late summer and autumn showing above average warming. Precipitation increased by 12 per cent over the same period, whereas the length of periods of sunshine decreased, particularly in the spring and summer.

In a warmer climate the summer season of torrents and mudflows will thus probably start earlier in spring and end later in autumn, as the winter snow cover with its water-retaining function is already not lasting as long as before. This means that rather more incidents may take place each year. The retreat of glacial ice and subterranean ice (permafrost) due to the higher temperatures may make hazardous local situations more critical. The shrinking of the ice cover will enlarge the areas of bare rubble at high altitudes. This may give rise to major mudflow incidents for which there is no historical parallel, with effects that are felt at far lower levels. Greater hazards will also arise from the instability of slope. The incidents which occur are basically not expected to become more extreme, but their frequency and annual pattern will probably change. The absence of, or significant decrease in, winter snow cover at low and medium altitude, coupled with higher precipitation in the winter months, will give rise to more marked winter flooding, with higher peak values for surface runoff. The situation will be further aggravated if the circulation system in the northern hemisphere is changed by global warming; this would increase the frequency of extreme precipitation events, particularly in the winter months.

6.1.1. Ecosystems

Recent research using dynamic forest models suggests that the potential natural vegetation of Swiss forests is likely to change in a high-CO_2 world. Studies at test sites along environmental gradients (e.g. Fischlin & Gyalistras 1997, Bugmann 1997, 1999) suggest that as a result of these warmer conditions, an upward shift of forest communities would result in some places, whereas in other places communities would form that have no analogue under current climatic conditions. Areas above the current alpine treeline could become afforested, whereas some forests may be replaced by open woodland or steppe vegetation, particularly in the dry central alpine valleys. Static equilibrium models of the distribution of plant communities (Kienast et al. 1996) and individual tree species (Bolliger et al. 2000) yielded broadly similar results. For example, with a warming of 1°C to 1.4°C, between 30 and 55 per cent of the Swiss forest inventory points would be expected to have a different vegetation type. As a result of these warmer conditions, plant communities in some zones would be replaced by others (mountain / subalpine belt: replacement of conifers by broad-leaved species; colline / submontane belt: replacement of beech-dominated by oak & hornbeam-dominated communities). However, under warmer and wetter conditions, the shifts in vegetation may not be as marked. Actual observations in undisturbed colline to submontane forests in Switzerland for the period 1961 to 1995 have shown unexpectedly large changes in species composition (Klötzli et al. 1996). Over this period temperatures increased by 1°C, resulting in mild winters and hot summers, and subsequently the appearance of exotic broad-leaved evergreen species in northern and southern Switzerland and palm trees in southern Switzerland.

Despite a great deal of research it remains difficult to make general statements concerning the direct effects of increasing CO_2 concentrations on plants and ecosystems. Recent Swiss research indicates two main facts for high alpine sites. First, there is no change in plant biomass, even when nitrogen is not limited. Secondly, fast-growing plants out-compete more robust, slow-growing species, leading to reduced resistance of the vegetation. In meadows, an increase in the root mass is documented, but it is not known whether more carbon is being stored in the soil. It also appears that the effects of elevated CO_2 concentrations are non-linear, with little or no additional effect above 420 p.p.m.

6.1.2. Hydrological cycle and cryosphere

There seems to be a consensus amongst scientists that a global increase in average temperature will lead to an intensified hydrological cycle and more heavy precipitation (>30 mm/day) in Switzerland, in particular during the winter half year. This mechanism may be especially relevant to the southern side of the Alps where heavy precipitation events are frequent and are related to large-scale moisture transport (Frei et al. 1998).

Such heavy precipitation events may lead, in turn, to more frequent rockfall, flooding, mudflows and landslides. Moreover, changes in the river runoff characteristics are expected as a result of warming induced change in the fraction of snowfall in precipitation. For the large Alpine rivers, this mechanism is expected to lead to a gradual shift from a nival to a more pluvial runoff regime and thereby enhance the potential for winter-time flooding. Generally speaking, erosive processes will tend to accelerate under this scenario.

The risk of floods has been greatly reduced through civil engineering projects and other measures taken during the second half of the 19th century. One study demonstrated the importance of dams, which had been built to create artificial reservoirs for hydroelectric power generation, in reducing the maximum runoff resulting from extreme events (LHG, 1991). However, more recently the claim and damage sums for flood events have begun to climb again. This is primarily due to land use pressure, rather than climatic changes in the alpine region.

Effects on aquifers, including on the chemistry and quality of groundwater resources, are expected to be negligible for a doubling of atmospheric CO_2, and most of the major porous aquifers in Switzerland appear to be relatively insensitive to climatic variations (Bouzelboudjen et al., 1998). Since 1950, the surface temperature of lakes and rivers in Switzerland has in some cases increased by more than 2°C. A fraction of this warming can be attributed to the enhanced greenhouse effect. Results from Lake

Zurich show that long-term trends and short-term variability go parallel with night-time minimum temperature but not day-time maximum temperature (Livingstone, 2001), which is important because temperature increases are greater at night.

One study concluded that it is not possible to estimate the future development of hail and winter storms on the basis of the assumptions made concerning average temperature and precipitation changes in Switzerland. Such estimates require more precise information on changes in the mesoscale circulation over the north Atlantic and European regions (Schiesser et al, 1997).

Snow and ice in the Alps are particularly sensitive to climate change. Since 1850, the glaciated area of the European Alps has decreased by about 40 per cent, and about 50 per cent of glacier volume has been lost (Haeberli and Hoelzle 1995). Mass balance measurements and the first results from the new Swiss Glacier Inventory indicate a marked acceleration of this trend since the mid-1980s. Pronounced secular warming (1 to 2°C) is being observed in 100 m deep boreholes installed for the ongoing EU project on Permafrost and Climate in Europe (PACE). Again, an acceleration trend has been documented since the mid-1980s (about 0.5°C/decade; Vonder Muehll et al. 1998). Such changes have been shown to lead to slope instability in both consolidated and unconsolidated material (Haeberli et al. 1998).

One study of the village of Saas Balen in the Canton of Valais highlighted the risks associated with a sudden failure of high alpine lakes that have begun to form and enlarge as a result of glacier retreat, and it suggested protection measures to reduce these risks. Such events have repeatedly led to severe damage in alpine villages. Studies are underway using remote sensing and GIS technologies to assess the extent to which other communities are at risk from such events.

6.1.3. Selected economic sectors

Financial services and insurance

The insurance business and government insurance (and relief) schemes are directly affected by catastrophes related to changes in climate because of their involvement in property insurance against weather events such as storms, flooding and drought. Claims due to natural disasters have risen constantly over the past decade, although direct attribution to climate change has not been possible. Insurers will attempt to manage the increased risk of a changing climate by applying the precautionary principle and the best scientific information available about the expected damages. Increasingly the financial sector too, builds up or supports scientific research teams in order to develop a forecast system to have cutting edge knowledge at hand in time. The banking divisions that would be acutely affected by climate change are project finance, real estate finance, corporate banking, asset management and corporate finance services related to the sectors of the economy that would be the most heavily impacted. Economic impacts on the banking transactions of individual sectors of the economy such as ski tourism and insurance are already visible today.

Tourism

The analysis indicates that if the altitude at which adequate snow exists on 100 days per year were to increase by 600 m (from 1,200 m to 1,800 m, which would be the case, if the temperature were to increase by 4ºC), then only 2 per cent of small ski stations and 44 per cent of larger ski areas would have adequate snow cover, as compared with 40 per cent and 85 per cent today (Bürki, 2000). The most common adaptive responses are to install artificial snow equipment, to move ski stations to higher altitudes or glaciers (where this is practical), or to diversify the type and seasonal focus of the activities offered. Summer tourism could also be affected by damage to the Alpine landscape resulting, for example, from the retreat of glaciers. In general, there is a tendency to create equipment for alternative activities; but there is no long-term strategy for adapting to climate change.

Agriculture

Swiss agriculture is in a conflict situation, as a result of factors such as the challenge of more open markets, pressure for best environmental practice (BEP; production level according to PARCOM / OSCOM – North Sea Conference) and more environmentally friendly products, loss of income from secondary occupations (for instance winter tourism) and decreasing demand for some products. Crop and grassland productivity may increase in many cases in response to projected climate change and increased atmospheric CO_2. However, for instance due to effects on related sectors, climate change could contribute to structural changes, accelerating the shift from mountain agriculture to agriculture in low lying areas. Thus the livelihood of people living in mountainous areas could be threatened (e.g. Behringer et al., 2001).

6.1.4. Energy supply and demand

No systematic analysis of the impacts of climate change on energy supply and demand in Switzerland has been made to date. In general, the expected fluctuations are believed to be small in comparison with natural variability between years, and currently are not a high priority for the utilities.

6.1.5. Infrastructure

One sensitivity study indicates that increased river flow due to climate change can affect the geometry of river beds and enhance erosion (Overney et al., 1997). This situation would represent a risk for the stability of structures anchored in river channels, such as bridges and water pipelines. Reduced flow, on the other hand, would lead to enhanced sedimentation and more flooding.

6.1.6. Indirect effects

No comprehensive analysis has been conducted on the indirect effects of climate change for Switzerland. One example of such effects would be an increase of tropospheric ozone and other air pollutants as a result of rising temperatures.

Another category of indirect effects are those impacts that take place elsewhere, but which nonetheless have repercussions for Switzerland. Such impacts might include aggravation of the North-South conflict (due to inadequate food and water supplies in developing countries); an increase in "environmental refugees" seeking asylum in Switzerland; losses to the insurance industry due to drought, sea-level rise and storms in other regions of the world; or increasing demands for financial support for disaster relief and adaptation measures in developing countries. Thus the indirect effects of the impacts of climate change outside the geographic boundaries of Switzerland could prove to be significant for Switzerland in the medium to long term.

6.2. Vulnerability assessment

Vulnerability depends on the sensitivity of a system to climate changes and the degree to which the system can adapt, either autonomously, in the case of pristine ecosystems, or purposefully, through concerted actions. To date, no comprehensive assessment of the climate vulnerability of various ecological and human systems in Switzerland has been undertaken in a systematic way. In particular, the adaptive capacity has not been adequately and systematically assessed. There is a need to consolidate the available information on biophysical and socio-economic impacts, to assess likely autonomous adjustments, and to evaluate the various adaptation options. Nonetheless, the available information points to the following systems that may be particularly vulnerable to climate change:

6.2.1. Sensitive ecosystems

In general, plant and animal communities that are already living at their ecological limits (minimum temperature, minimum precipitation requirements) would tend to be vulnerable to climate change. Vulnerability also depends on other pressures on ecosystems, such as pollution levels, habitat fragmentation, soil and water quality and many other natural and human factors.

Mountain ecosystems

It is likely that the most vulnerable would be the cryosphere, which is already showing a response to the 1°C warming over the past 30 years (see section 6.1), and the high-alpine plants, which have been documented to be moving upwards (e.g. Grabherr et al. 1994). However, recent studies of alpine treeline dynamics suggest that the treeline-alpine ecotone is unlikely to be a sensitive indicator of the ecological impacts of global changes (Bugmann and Pfister 2000).

Forests

Recent research indicates that under warmer and drier conditions, beech-dominated communities in the colline-submontane belt are vulnerable to replacement by oak-hornbeam communities and that the dominance of conifers in the montane and subalpine belt would be seriously threatened by the intrusion of broad-leaved species from the current low montane and submontane belt. Other studies yielded a striking insensitivity of most low-elevation beech forests to warming (Bugmann 1997, 1999), instead suggesting that forests near the cold and dry treelines would be most sensitive to change, including rare but highly valued communities such as the larch-stone pine forests in the Valais and the Engadine (Bugmann 1999).

Freshwater ecosystems

Temperature increases have a major impact on the partial pressure of gases and thus on the activity of organisms. This can reduce the oxygen concentration to levels which lead to conditions that are toxic to aquatic plants and animals. Lake temperatures are increasing faster in the upper layers, which leads to a long-term increase of thermic stability and a shortening of the circulation period with negative effects on the oxygen content of deep water layers (Livingstone and Imboden, 1996). For instance, the maximum temperature that can be tolerated by local species of trout in Swiss rivers will soon be exceeded in some stretches of the larger lowland rivers (Jakob, Liechti and Schädler, 1996).

6.2.2. Sensitive economic activities and sectors

Tourism

In 1998, tourism contributed 20.7 billion CHF in income for Switzerland (about 5.4 per cent of GNP) and accounted for 11.6 per cent of export income, making tourism the third most important export sector in Switzerland (STV 2000). Activities related to tourism provide 9 per cent of all jobs (300,000 jobs) and a much higher fraction in mountain regions. Important factors for the success of tourism have been the snow cover, the length of season and the scenic value of glacial landscapes. Global warming will lead to more winters with little snow, with low-lying ski resorts particularly vulnerable.

Agriculture and Forestry

Swiss agriculture is practised at elevations ranging from 300 to 2,500 m above sea level, with large differences in meteorological, topographical and pedological conditions. Climate change may affect agriculture by increasing or decreasing crop and grassland productivity, and by altering the need for irrigation and weed and pest control. These effects are likely to show regional differences, which may in turn lead to changes in the spatial pattern of productivity (e.g. Riedo et al., 2001).

The frequency and intensity of rare heavy storms that have affected Swiss forests have increased over the past 100 years. In 1990 a extreme storm named “Vivian” damaged a volume of 4.7 million m^3 of wood. Forest damage due to the storm named “Lothar” at the end of the year 1999 was the most severe ever recorded. 12.5 million m^3 of timber were felled (compared with a normal annual harvest of 4.5 million m^3), and an area of about 46,000 hectares was severely affected. For restoration of the destroyed forests and protection against bark beetle and other pest outbreaks public funds of 270 million CHF are being provided for the period 2000 to 2003.

Heavy storms may lead to a loss in the protective functions of forests for the area downhill. The necessity for temporary artificial protective measures cannot be judged in general terms but must be assessed case by case depending on the local situation and the potential damage involved.

Insurance

Property insurance and reinsurance are vulnerable to extreme climatic events. The insurance industry is currently under stress from a series of billion dollar storms since 1987, resulting in dramatic increases in losses. Nevertheless, both public and professional awareness of the potential climate risk seems to be still in its infancy because there is plenty of capacity in the market and only moderate attempts are visible to rise prices to a risk adequate level. Higher losses strongly reflect increases in infrastructure and economic worth in vulnerable areas as well as a possible shift in the intensity and frequency of extreme weather events.

6.2.3. Sensitive regions

High alpine villages

The increasing potential for natural disasters due to melting of permafrost, glacial retreat, heavy precipitation events, and shifts in the form of precipitation will contribute to the vulnerability of alpine settlements and infrastructure (e.g. roads, bridges, railway lines and ski-lifts) to climate change.

Low altitude ski areas

Economic hardship from negative impacts on both winter tourism and mountain agriculture, as well as other pressures related to structural changes, could make communities that are dependent on these two economic bases particularly vulnerable to climate change (small single lifts and ski areas in the Jura mountains, the Canton of Ticino, and the eastern and central Swiss Alps) (Abegg, 1996; Meier 1998; Bürki, 2000).

River valleys and floodplains

In the alpine environment of Switzerland the major damage is not usually caused by flooding in the floodplains. Valleys are much more vulnerable to flood disasters because the villages and infrastructure such as roads, railways and motorways with many bridges are frequently situated close to the river on the small bottom of the valley. Floods are primarily hazardous in four ways (Petrascheck and Schädler, 1992).

1. Vertical and lateral erosion of riverbanks, together with subsequently collapsing embankments which can lead to the collapse of structures well above the water level.
2. Flooding by water with deposits of river bed-load, and blockages due to timber or bed-load (at outlets, bridges etc.) and natural narrow passages.
3. River bed aggradation due to a rising river bed forcing the river to divert to a new bed, causing flooding at unexpected places.
4. Debris flow, a high density mixture of water and solids, which often causes severe damage due to the enormous quantities of solid material.

6.3. Adaptation measures

6.3.1. Natural hazards

Located in the Alps, Switzerland is a small 'hazard prone' country exposed to natural disasters, such as debris flows, earthquakes, floods, forest fires, hail storms, landslides, rockfalls, wind storms and snow and ice avalanches. Reliable data on the frequency and intensity of landslides, flooding and others hazards are now available.

Between 1972 and 1998, floods and landslides caused about 200 million CHF of direct financial damage per year (Röthlisberger, 1998), with more than 1,250 observed events. For snow avalanches, the financial damage covered by insurance was around 6 million CHF per year (Wilhelm 1997) over the period 1972 to 1993. In February 1999, 1,200 destructive snow avalanches occurred, showing that snow avalanche damage can be very expensive (620 million CHF total damage, SLF, 1999). The financial damage from the storm named 'Lothar' in December 1999 reached almost 1.8 billion CHF (WSL/BUWAL, 2001), and the floods of May 1999 about 600 million CHF.

The 1.5 billion CHF that have been spent for avalanche control measures and for land-use planning since the catastrophic winter of 1950 to 51 have reduced the number of fatalities to about one or two per year. Unfortunately the winter of 1998 to 99 was an exception, not only in terms of financial damage but also human victims: 17 of the 37 victims were killed by avalanches on the road or in their homes. 1999 was also an extreme year for causalities due to flooding, landslides and storms. For the first time more than 20 people were killed by floods related to outdoor activities (canyoning) in one event (Saxetbach in July), whereas the average between 1972 and 1996 was only slightly above 2 fatalities per year for floods, landslides and related processes.

Legal regulations have not been designed to cope with potentially disastrous changes in the climate system. These regulations are sector-based and present notable omissions, particularly with regard to natural hazards that occur rarely but cause massive damage. The distribution of tasks and roles (responsibility, subsidiary support) is also unclear. Nevertheless, strong efforts have been made to apply the same strategy and similar approaches for dealing with all kind of natural hazards. The legal and technical framework for the management of natural risks has undergone considerable changes during recent years. Since 1987, when major flooding affected many valleys, the strategy has shifted from fighting against the natural disaster towards the management of risk. Two new regulations, the Federal Law on Flood Protection and the Federal Forest Law came into force in 1991 to protect human lives, objects of value and the environment from damaging effects caused by water, landslides, forest fires and snow and ice avalanches. But the responsibilities still remain at cantonal level. The main emphasis is now to an increasing extent placed on preventive measures. Therefore, hazard and risk assessment, the definition of protection targets, the integral planning of measures (mapping, technical measures and warning systems) and the limitation of the residual risk are of central importance. The cantons are required to establish registers of events and hazards maps at a scale of 1:5,000 (local large-scale map) depicting endangered areas. They also have

to take hazards into account for the purposes of land-use planning. For the elaboration of registers of events and hazards maps, the federal government provides subsides to the cantonal authorities of up to 70 per cent of the costs, as well as helping with new guidelines to elaborate these hazard maps (Kienholz & Krummenacher 1995, Petrascheck & Loat 1997, Lateltin 1997). A digital database (StorMe) to register all the events is now operational at the Swiss Agency for the Environment, Forests and Landscape.

For engineering-based action, the total financial support from the Confederation between 1988 and 1999 was 65 million CHF per year for flood protection and 80 million CHF per year for protection against snow avalanches, erosion and landslides. The federal government assists the cantons in the protection of built-up areas and transport infrastructure, providing early warning systems and the associated monitoring points and information systems. Avalanche forecasting and subsequent measures such as the evacuation of people, the closure of traffic routes, and the artificial release of avalanches under controlled conditions allow risk to be minimised in areas not kept safe by long-term protective measures. In order to alert the authorities responsible, and any endangered industrial sites, an alarm system has been installed at various sites in Switzerland, and this automatically reports a breach of specified water levels to a permanently staffed control centre. This centre, located at the Federal Office for Water and Geology, alerts parties concerned and publishes daily hydrological data via the Internet.

The large variety of natural hazards, the intense use of endangered areas, the impacts of climate changes and the high dependence on technical systems require a re-evaluation of the natural hazard policy. A global approach to coping with natural hazards must be taken, and climate change aspects have to be included. A concerted effort by all players enables efficient reductions in future disasters. The reduction of destruction caused by natural disasters requires an integral prevention strategy. Natural hazards, socio-economic conditions and cultural values have to be given equal consideration. The implementation of the measures requires co-operation with the population directly affected. It is not possible to achieve 100 per cent safety. The existing land use defines the safety objectives necessary. In the long term, the acceptance of certain risk has to be discussed openly. The step from the battle against nature to a distinct management of risks ('risk culture') proclaimed since 1997 by the national platform for natural hazards (PLANAT) is being prepared in Switzerland. It also enables changing hazard conditions due to global warming and changing demands and possibilities of society to be considered adequately and quickly.

6.3.2. Forests and sylviculture

The history and models of changes in vegetation with time suggest that forests will be affected, though the mode of transition is uncertain. Impacts will vary between different regions. Damage must be expected from storms, drought, atmospheric pollution, and (according to the level of warming) new or intensified pests and diseases. During the 20th century, increasing forest damage through extreme climatic events has been reported. No adaptation strategy exists to prevent such effects, but well-suited legal provisions are in place that allow for public assistance, where necessary, to counteract damage to forests and their protective functions. In addition, a number of measures are in place to preserve forests that serve the objective of damage prevention.

1. Addressing ecological imperatives through sylviculture:
- Ban on clear-felling.
- Regeneration practices imitating the natural behaviour of a 'virgin' forest (near natural forest management).
- Sustainable sylviculture with financial support for forest management, logging and hauling the timber, since total costs of near natural forest management are high. Average annual subsidies of 65.2 million CHF were spent in the period 1996 to 1999 (60.35 million CHF from 1992 to 1995). Special emphasis has been placed on re-establishing well adapted stands on the forested areas destroyed by the storm Lothar. For this purpose, a special guide for decision-making on areas damaged by storm has been established. After the storm Lothar, 10 million CHF were provided to gain more information for preventing disasters due to heavy storms.

2. To maintain the vitality of forests, average annual subsidies were 12.875 million CHF between 1996 and 1999 (a total of 40.9 million CHF from 1992 to 1995) for the following measures:
- Measures to prevent and combat pests and parasites.
- Repairing damage where forest conservation might be threatened.

3. Conservation of the genetic resources of forests (0.37 million CHF average annual subsidy for 1996 to 1999) using the following measures:
- National register of seed tree stands on the basis of internationally defined parameters.
- Launching a gene conservation network.
- Creation of seed orchards to improve the supply of indigenous reproductive material.

All these measures are intended to improve the stability and autonomous adjustment of forest stands to changing natural conditions.

6.3.3. Economic sector

In the economic sector, planning periods are hardly more than ten years. As a consequence, leadership and planning in business is more flexible, which leads to a certain continuous adaptation to short-term fluctuations under normal business practice. At the same time there is a growing tendency to sustainable production. However, there is no long-term strategy for adapting to the effects of climate change, so the increasing frequency of extreme events or long-term shifts could be particularly damaging. Adaptive measures have so far been very limited, and generally of an ad hoc nature. They have been mainly in the tourism industry, and in the financial and insurance sectors.

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7. Financial resources and transfer of technology

7.1. Introduction

Two federal offices are responsible for the planning and implementation of development aid: the **Swiss Agency for Development and Co-operation (SDC)**, part of the Federal Department of Foreign Affairs, and the **State Secretariat for Economic Affairs (seco)** which is part of the Federal Department of Economy. The principal instruments at their disposal are: technical co-operation, financial aid, economic and trade measures, and humanitarian aid.

The **Swiss Agency for Development and Co-operation (SDC)** is responsible for the following four areas of activities: bilateral development co-operation, multilateral development co-operation, humanitarian aid and technical co-operation with Eastern Europe. In the climate field, the SDC focuses on institutional and human development issues and know-how transfer. The SDC facilitates the dialogue among stakeholders with a view to develop climate policies in line with local sustainable development goals. As of 2001, the SDC has included vulnerability and adaptation issues in its agenda.

The **State Secretariat for Economic Affairs (seco)** determines economic and commercial measures for development co-operation, including mixed credits (involving both the Confederation and the financial sector), balance of payments assistance, trade promotion and, in collaboration with the international community, promotion of basic products. A substantial share of these measures is destined for countries of Eastern Europe and the CIS. The seco is also the main actor in the scheme to reduce the debt burden of those countries most in debt. Because of its focus on promotion of the private sector, the seco's priorities in the context of climate change are related to the flexible mechanisms, which entails technology transfer and policy support, which will ensure a level playing field for the players of the future carbon markets.

The **Swiss Agency for the Environment, Forests and Landscape (SAEFL)** is responsible for planning and implementing environmental policy at the national and international level. In this capacity, the SAEFL is leading and co-ordinating the negotiation and implementation of the UNFCCC and the Kyoto Protocol. In addition, the SAEFL is responsible for the Swiss policies and contribution to the GEF.

7.2. Bilateral assistance

7.2.1. Bilateral assistance to developing country parties

The Swiss Global Environmental Programme

In 1992, with additional resources, Switzerland launched a bilateral Global Environmental Programme (GEP), the objective of which is to support the efforts of developing countries in the implementation of the multilateral environmental conventions. The GEP has 3 focal areas: climate change/energy, bio-diversity/management of natural resources and management of hazardous substances. More information is available on the following web site **www.ddc.admin.ch.**

In the focal area of climate change, the priority themes are the following:

- Elaboration of policies and action plans;
- Human and institutional development;
- Policy dialogue nationally, regionally and internationally;
- Promotion of renewable energy and energy efficiency;
- Cross-cutting issues (climate/forestry, positive interactions between conventions).

The main goal of all these activities is primarily the promotion of the local socio-economic development, with the global environmental benefits considered as added value and not the other way around. In its technology transfer programmes Switzerland applies the following principles:

- Demand-driven approach where technology is considered as a entry point to address socio-economic development issues also;
- Micro-macro linkages in which experience at the project level fertilises the debate on international policy;
- Pilot project design with capacity building, in order to ensure the dissemination of good experience;
- Identification of win-win potential situations;
- Long term co-operation to ensure sustainability.

Table 7-1 gives an overview of mitigation projects and programmes that were supported between 1997 and 2000.

During the period 1997 to 2000, 18 projects received a total of 24.7 million CHF in the sector of energy, transport and industry.

A particular effort was made in documenting two of these programmes in the form of two published case studies that were presented in side-events in the context of UNFCCC COPs. One of these projects is a refrigeration project in which the potential for positive interaction between the Montreal Protocol and the Kyoto Protocol were highlighted. The other project is an energy efficiency project in the small-scale foundry sector, where the relevance of CDM and sustainable local development were examined.

Tables 7-2 to 7-6 illustrate in some more detail these two projects and a selection of further projects in the area of bilateral co-operation with developing country parties.

Recipient	Funded project/programme	Sector	Software(S) Hardware(H)	Disbursements (in 1,000 CHF) 1997	1998	1999	2000
Central America	Hot water production using solar energy	Energy	S/H	1,000	806	86	9
Central America	Reduction of fuel emissions from motors	Transport	S	1,200	1,013	1,154	1,412
Chile	Quality of air monitoring in 4 towns	Transport	S	220	-	120	-
Chile	Environmental programme Talcahuano	Transport	S	-	-	150	105
China	City of Kunming Masterplan public transport	Transport	S	300	166	413	284
Ecuador	Quito air quality	Transport	S	-	-	500	152
India	Development of PV market (cf GEF)	Energy	S	860	1,000	540	1,100
India	Ecological refrigeration ECOFRIG	Energy	S/H	950	306	550	-
India	Energy efficiency	Industry	S/H	1,500	1,520	1,350	766
India	Development of low-pollution three-wheelers	Industry	S	150	100	81	244
Indonesia	Clean air Jakarta	Transport	S	-	577	956	972
Morocco	Water desalinisation using solar energy	Energy	S	-	7	-	-
Tajikistan	UNDP-GEF co-financing domestic refrigeration	Industry	S/H	-	-	-	115
Tunisia	Integrated solar energy production PAESI	Energy	S	-	91	116	-
Tunisia	Integrated industrial development poles POLEDURME	Industry	S	-	167	228	425
West Africa	Bush fire prevention using rural radio stations	Forestry	S	-		-	20
Global	Discussions of policy on climate change	Industry	S	200	-	151	158
Global	Promotion of renewable forms of energy (small hydro plants)	Energy	S	110	104	143	109
TOTAL			**6,490**	**5,857**	**6,538**	**5,871**	

Table 7-1: Overview of projects and programmes that were supported between 1997 and 2000

Project / programme title: Promotion of domestic and commercial hydrocarbon refrigerators in India

Purpose: Support the transfer of hydrocarbon technology as an alternative to CFCs and HFCs, and in doing so promote the integration between the Montreal Protocol and Kyoto Protocol

Recipient country	Sector	Total funding	Years in operation
India	Domestic and commercial refrigeration	6 million CHF	1993-2000

Description: The project has supported several private companies and academic institutions in India in the field of hydrocarbon technologies. This support was provided in the form of hardware (pilot plants) and software. The main purpose of this project was to enable the Indian players in the refrigeration sector (government, private sector, academia) to take informed decisions regarding technology choices in the context of the Montreal Protocol and Kyoto Protocol. In a second stage, the programme shifted its focus towards training activities in the service sector (formal and informal education).

Factors that led to the project's success:

- Establishment of a broad platform of stakeholders
- Good national and international networking for dissemination of experience
- Demand orientation
- Flexible project management in order to react quickly to specific needs
- Pooling of competence Intensive policy discussions nationally and internationally

Technology transferred: Hydrocarbon technology in commercial and domestic refrigeration including testing instrument (calorimeter)

Impact on greenhouse gas emissions/sinks: A case study on the CDM relevance of this project has been published (ISBN 81-85419-73-6)

Table 7-2: Facilitating and/or financing the transfer of, or access to, environmentally-sound technologies: promotion of domestic and commercial hydrocarbon refrigerators in India

Project / programme title: Clean air project South-East Asia

Goal: Making valuable contributions to improved urban air quality at selected project locations in South-East Asia.

Purposes:

- Initial measures to reduce air pollution caused by traffic in Jakarta are consolidated and project activities are gradually phased out
- Stepwise expansion into the South-East Asian region, and development, testing and refining of existing and new CAP approaches in the field of traffic-related air pollution and ambient air monitoring. Focus is on Manila and the Mekong region, particularly Vietnam.

Recipient country	Sector	Total funding	Years in operation
Indonesia, Philippines and Vietnam	Urban environment/ clean air	4.6 million CHF (2002 – 2004)	Since 1997

Description: The 3-year phase has the objective of stepwise dissemination of the know-how gained and the programmes designed into the South-East Asian region, and of gathering additional experience at a few project locations (Jakarta, Vietnam, Manila), and of making contributions to reducing air pollution caused by motorised traffic in selected urban areas. This phase consists of the following three components:

- Consolidation Jakarta The Jakarta component will consolidate activities in the conurbation of Jakarta and in West Java. It is based on the achievements of the previous phases of the project, and will mainly support the implementation of a mandatory inspection and maintenance (I&M) system for private cars in Jakarta, and the promotion of bus maintenance and fuel-saving measures. This component of the project is to be phased out by the end of 2003.
- Programme development The programme development component will support the development and testing (pilot activities) of existing and new clean air initiatives in the field of traffic-related air pollution reduction and ambient air monitoring in Vietnam and Manila. It will develop stepwise into the region and will produce a clear strategy for continuation at the end of this process-oriented phase.
- Project management The expected expansion and shift of geographical area and programme content is bound to increase the complexity of the project, and therefore increase the demand for clearly structured project management. This component has to ensure proper implementation of the project as stipulated in the project document.

Factors which led to the project's success: During its 4 years of implementation, the CAP has produced promising results in the fields of:

- Public campaigning, which has considerably increased public and political awareness
- Development of a mandatory I&M system for private cars in Jakarta, combined with pilot projects in collaboration with the private car maintenance sector Inspection & Maintenance programmes in the commercial vehicles sector resulting in a "win-win" situation. Fuel savings outweigh the costs of I&M and of the training of drivers.

Technology transferred:

- Air monitoring
- I&M systems
- Training in I&M
- Training of drivers

Impact on greenhouse gas emissions/sinks: Not quantified

Table 7-3: Facilitating and/or financing the transfer of, or access to, environmentally-sound technologies: clean air project South-East Asia

Project / programme title: Energy efficiency in small-scale foundries			
Purpose: Mitigate CO_2 emissions and air pollution (win-win)			
Recipient country	**Sector**	**Total funding**	**Years in operation**
India	Small-scale industry	2 million CHF	1993-2001
Description: Designing a new and adapted solution for energy efficiency and air pollution mitigation in the small-scale foundry sector. Test the design in pilot plants and disseminate the technology through local and national foundry associations. More information is available at the following web site: www.teriin.org			
Factors that led to the project's success: • Competence pooling: all the players of the project bring their competence together, and the positive interactions between them result in an appropriate solution. • Bottom-up participatory approach: the inadequacy of ready made solutions calls for a dynamic design process, in which the local foundry units are the central players.			
Technology transferred: Know-how in the field of energy efficiency (divided blast cupola) Appropriate pollution control (variable throat venturi scrubber)			
Impact on greenhouse gas emissions/sinks: A case study on the relevance of this project in the CDM context has been performed and published (ISBN-81-85419-73-6)			

Table 7-4: Facilitating and/or financing the transfer of, or access to, environmentally-sound technologies: energy efficiency in small-scale foundries

Project / programme title: Kunming Urban development and public transportation initiative			
Purpose: The initiative is based on the partnership between the cities of Kunming (China) and Zurich (Switzerland), which was established in 1982. Devising and achieving sustainability-oriented urban development was defined as the overall goal of co-operation between Zurich and Kunming. This entailed: • Appropriate urban planning and management approaches and mechanisms • The implementation of a modern transportation policy • Devising and implementing a cost-effective, efficient public transportation system, and supporting non-motorised means of transportation • Emphasising that urban and transportation planning are intrinsically linked			
Recipient country	**Sector**	**Total funding**	**Years in operation**
China	Urban planning, transportation, environment	1.74 million CHF 1996 – 1999 (SDC)	1993 - 2001
Description: Phase I (1993 – 1996) focused on the general strategy and planning of an integrated public transportation system and network for Kunming with an tramway as the backbone. The priorities shifted in phase II (1996 – 1999) to detailed traffic planning and management, urban planning and design, preservation of the old town, and training and capacity building. Regular visits and workshops in Kunming and Zurich facilitated exchanges between leaders, official representatives and working groups from both sides, and capacity building. Official meetings allowed the results achieved to be assessed, and the next steps to be defined. Priorities – addressing goals and meeting the immediate needs of implementation – were set jointly during these meetings. One of the most important outcomes of the close co-operation between the two cities was the definition and endorsement by the political leaders of a more regional approach to future urban development. Finally, phase III (2000 – 2001) focusses on the integration of planning and implementation in the daily management of urban development.			
Factors that led to the project's success: • Long-term commitment and partnership • Close co-operation between technical professionals and politicians • (Acknowledged) expertise and ownership of the project within Kunming's administration and at the political level • Site visits and professional exchanges in/with Switzerland and other countries • Visible improvements through planning and implementation (bus-lane) • International symposiums to enhance visibility			
Technology transferred: • Urban and environmental planning approaches and methodologies • Transportation planning, traffic management • Renovation of the old town, and urban design • Case studies: regional development and public transportation			
Impact on greenhouse gas emissions/sinks: Fewer car trips due to improved public transportation links (as the outcome of an assessment of a car-based development scenario versus development based on public transportation)			

Table 7-5: Facilitating and/or financing the transfer of, or access to, environmentally-sound technologies: Kunming urban development and public transportation initiative

Project / programme title: Structural and institutional transformation processes towards sustainable development: policy dialogue and capacity building in climate change/CDM			
Purpose: To better understand selected structural transformation processes for sustainable energy development and natural resource management in the context of climate change			
Recipient country	**Sector**	**Total funding**	**Years in operation**
India and Nepal	Research institutions, NGOs	683,280 CHF	1996-2001
Description: By means of a macro level research module, the project has supported the investigation of sustainable carbon and energy path options for India and Switzerland, based on different scenarios. By means of a micro level research module, several research institutions and NGOs in India and Nepal have been supported in studying the potential of technology-based innovations induced at the household level to strengthen local initiatives promoting sustainable development. The dissemination of low-cost environmentally sound technologies applied in the building materials/housing and irrigated agriculture sector have been selected for study at the micro level. Through a module of discussions on policy, the project has initiated a stakeholder process and contributed to capacity building and institutional strengthening in Indian research institutions with regard to climate change issues, in particular issues relating to CDM and Indian sustainable development priorities.			
Factors that led to the project's success: Strategic performance achieved in initiating a stakeholder process and networking with Indian research institutes in the field of policy and research on the environment and climate.			
Technology transferred: • Capacity building in environmental research and scenario methodologies. Know-how and skills transferred, discussions initiated on policy related to climate change, especially CDM methodologies and guidelines.			
Impact on greenhouse gas emissions/sinks: Not quantified			

Table 7-6: Facilitating and/or financing the transfer of, or access to, environmentally-sound technologies: policy dialogue and capacity building in climate change/CDM

Guiding principles in technology transfer

Swiss development co-operation considers the following principles relevant when transferring environmentally sound technologies from (mostly) industrialised to developing countries, especially when aiming at an increase of private sector participation:

Building up knowledge-based skills and capacities

- Technical, engineering, and managerial capabilities, which are expected to help in technology absorption and diffusion on a continuous basis by the participating partners in developing countries, have to be strengthened and institutionalised.
- This also applies for adequate, appropriate indigenous research, and R&D capabilities.

Facilitate making informed decisions and choices

Enhance the capabilities of participating partners in developing countries to effectively exploit the diversity of available technological options and services by:

- The dissemination of information and the exchange of experience through seminars and workshops, technical visits, papers, and reports.
- International networking with qualified, committed research institutions and suppliers of state-of-the-art technology.
- Creation of infrastructure for adaptive research and pilot testing.

Support technology adaptation and ownership

- The need for technology adaptation according to local circumstances is crucial. This can be facilitated by providing blueprints and assuring intellectual property rights when technology transfer is completed.
- Collaborating governments have an important role to play in e.g. facilitating project agreements and exempting the equipment and materials from customs duties, taxes, port and other charges.

Build partnerships based on trust and confidence

- Strong but voluntary partnerships based on trust and confidence between collaborating governments, industries and research partners are a key factor for successful technology transfer.

7.2.2. Bilateral measures aimed at Central and Eastern Europe and the CIS

The countries of Central and Eastern Europe require enormous financial resources to pay for the cost of adapting, renewing and rebuilding their industries and infrastructure. Swiss bilateral co-operation with Central and Eastern Europe is based on three framework credits approved by the federal parliament in 1990, 1992 and 1999. Out of the total amount of 2.55 billion CHF, 1.7 billion CHF were allocated for financial co-operation. Over the last ten years, the emphasis of the co-operation has shifted from Central and Eastern Europe to South Eastern Europe and the CIS.

Bilateral financial co-operation with Switzerland is primarily based on two instruments: grants and credit guarantees.

Grants

Switzerland uses grant financing to support priority projects that cannot be financed commercially, because their earning power is insufficient, if the Swiss economy can provide equipment and services for their implementation on competitive terms. As far as most countries in Central and Eastern Europe are concerned, the contribution envisaged, and the field of application are defined in bilateral agreements. The priority fields of application are the environment, energy and infrastructure. Generally speaking, the projects are proposed by the partner countries. The evaluation of the projects, the decision, and the financing are within the competence of the Swiss side. The partner country is expected to bear the costs of the project as far as possible, especially with regard to local cost components.

Credit guarantees

Credit guarantees are used to finance the export of Swiss goods and services to manufacturing companies or for infrastructure projects, the profitability of which allows commercial financing. Such guarantees are used in countries where the Swiss export risk guarantee (ERG) does not apply, or applies only in part. The environmental dimension is taken into account at the application stage. These mechanisms have sometimes promoted the importation of goods which have a direct impact on air quality.

7.2.3. Specific support for both developing and transition countries

The Cleaner production programme

In the context of economic co-operation, Switzerland seeks to support developing and transition countries in their capacities to negotiate and to comply with and/or benefit from rules related to trade in the Rio conventions. The main goal of these activities is to strengthen sustainable growth in these countries by helping them to benefit from participating in the world trade system. Therefore, special emphasis is given to supporting efforts of partner countries to define their own policies and strategies in order to improve the acceptance and foster the implementation of international environmental conventions. A specific focus is the promotion of the transfer of environmentally sound technologies. In order to enhance this transfer, Switzerland is supporting the creation of Cleaner production centres (CPCs). CPCs are service centres that provide services in the field of technical and managerial assistance, technical training and financial advice for industry and the public sector, receiving partial or full compensation for their costs. Table 7-8 gives more details about the CPC programme.

So far, Switzerland has supported CPCs in Colombia, Costa Rica, El Salvador, Guatemala, Brazil, Morocco and Vietnam. In addition, centres are planned in India, China and Peru. Furthermore, Switzerland has financed the first sink project in the context of the International Tropical Timber Organization (ITTO) in Colombia.

Additional information is available at: **www.seco-admin.ch**

Recipient	Sector	Disbursements (in 1,000 CHF)		
		1998	1999	2000
Costa Rica	energy	300	300	300
Guatemala	energy	300	300	300
El Salvador	energy		150	200
Colombia	energy	750	750	750
Vietnam	energy	200	250	350
Morocco	energy		100	300
Total		**1,550**	**1,850**	**2,200**

Table 7-7: Funding of know-how transfer projects under the Cleaner production programme (1998 to 2000)

Project / programme title: Cleaner production centres

Goal: Promote the use of environmentally sound technologies and the introduction of manufacturing processes that conserve resources, in selected developing countries, with the help of Swiss technologies and know-how.

Recipient country	Sector	Total funding	Years in operation
Peru, Colombia, Central America, Morocco, Indonesia, Vietnam, Pakistan	Industry, commercial, public services	5.6 million CHF (1998-2000)	Since 1998

Description: Cleaner production centres are service centres that provide the following services for industry and the public sector, receiving partial or full compensation for their costs.

Establishment of an environmental information system:

- Locating and disseminating general information on environmental technologies available in Switzerland (concentration on sectors in which Switzerland has comparative advantages) and advising on specific applications
- Documentation on experience with environmental technologies in Switzerland and in developing countries, which could help develop relations between companies
- Consulting services for industrial enterprises and government agencies on resource questions, environmental issues and the application of laws. Consulting services for government agencies on the drafting of environmental policy guidelines.
- Intermediary and liaison services for arranging business opportunities between companies in developing countries and transition countries, respectively, and in Switzerland (in collaboration with the Swiss Organisation for Facilitating Investments (SOFI)).

Technical assistance:

- Conducting demonstration projects in selected industrial sectors
- Introducing environmental management systems (using the ISO 14000 series)
- Conducting life-cycle analyses (analysis of products and operations)
- Introducing eco-efficient production methods and minimising the production of waste
- General risk analysis for the prevention of chemical and physical industrial accidents

Training

"On the job" training in demonstration projects

- Conducting workshops to disseminate specific know-how among industries of selected sectors
- Conducting public seminars on environmental pollution in companies Financial consulting
- Support in the formulation of environmental investment projects and in the search for sources of finance

Factors that led to the project's success:

- The centres are established in close collaboration with the private sector and, where appropriate, with government offices and agencies in the developing countries.
- Each centre in a developing country is linked to a "reference centre" in Switzerland (an institute of higher education in science and technology, a university, the Swiss Federal Office for Materials Testing and Research (EMPA) etc., which is responsible for relations with Swiss industry and service providers, and for development and support of the Cleaner production centre.
- The standards, sanctions and incentives to be applied are defined in close consultation with the authorities in the country concerned.
- In addition, the centres participate in relevant international networks such as that of UNIDO.

Technology transferred:

- Environmentally friendly technologies (e.g. modification of galvanising processes to reduce the toxicity and amount of waste water)
- Energy efficient products and energy saving procedures (e.g. heat recovery in drying processes, energy savings in the service sector)
- Environmental management strategies and systems

Impact on greenhouse gas emissions/sinks: Not quantified

Table 7-8: Fact Sheet: Cleaner production centres

The Swiss AIJ Pilot Programme

The Swiss AIJ Pilot Programme (SWAPP) was officially launched in April 1997, when the SWAPP Secretariat took up its work. The SWAPP was established to allow Switzerland to participate in the pilot phase for AIJ ("activities implemented jointly"), which was initiated in March 1995 under the UNFCCC, to gain experience with the joint implementation of climate protection projects across national borders (JI).

In order to take full advantage of the AIJ pilot phase, the SWAPP undertakes a broad range of activities:

- Government financing of AIJ projects: The Swiss government aims to provide financial support for the AIJ component of up to four investment projects during the pilot phase. These projects will be identified through bi- and multilateral channels already in place for Swiss government co-operation with developing and Central & Eastern European countries. For the time being Switzerland has been implementing one AIJ project together with the Government of Romania (Swiss thermal energy project, STEP).

- Designing incentives for private sector investment: One of the main objectives of the SWAPP is to encourage private sector investment in the AIJ component of greenhouse gas reduction projects (e.g. in the form of co-financing), even though the most obvious incentive (crediting) is explicitly excluded during the pilot phase. Initiating discussions with players in the private sector, to develop the necessary incentives is a priority.

- Contribution to methodological progress: In parallel with the implementation of AIJ investment projects under the Swiss programme, and in co-operation with partner (host) countries, an effort is made to find operational solutions to the various methodological challenges associated with the AIJ/JI/CDM instruments. Actions include studies by consultants or NGOs, support for methodological workshops, reviews of experience with AIJ, and case studies of existing projects ("simulation studies").

- Capacity-building activities, networking and information: The AIJ pilot phase, by its nature, is a learning experience for all participants, and capacity-building activities are an integral component of the SWAPP. The targeted dissemination - to the the private sector and NGOs - of information concerning the AIJ pilot phase, the flexible instruments and the Swiss AIJ pilot programme, both domestically and in conjunction with potential host countries, is a high initial priority.
  For additional information, please refer to: **www.admin.ch/swissaij**

7.3. Multilateral activities

7.3.1. Multilateral financial contributions

Multilateral financial institutions of which Switzerland is a member country (for instance the World Bank, the International Monetary Fund and regional development banks) play an important role in technology transfer. Indeed, almost all the investments made by development banks concern the transfer of environmentally sound technology.

The projects submitted to these organisations are systematically screened for their environmental impact, and a growing number of projects in the environmental field are financed in this way. Switzerland attaches importance to the inclusion of environmental questions in the projects.

World Bank: National JI/CDM strategy studies programme (NSS programme)

In order to strengthen the capacities of developing and transition countries with regard to their position towards the Kyoto Protocol, Switzerland is financing a comprehensive capacity building programme managed by the World Bank for the elaboration of National Activities Implemented Jointly / Joint Implementation / Clean Development Mechanism Strategy Studies for developing countries and countries in transition; better known as NSS programme. The NSS initiative helps interested developing countries and countries in transition to formulate their own national AIJ/JI/CDM strategies, and stimulates their interest in developing JI/CDM projects. In addition to that, the whole process of elaborating the study stimulates internal discussions between the different government bodies responsible. Furthermore, this initiative supports the developing countries in that they have their own experience on establishing the rules of the game for the Clean Development Mechanism and are therefore able to formulate concrete national needs. Various studies in South America, Africa, Asia and Eastern Europe have already been implemented.

Asian Development Bank

A division of the Asian Development Bank is devoted entirely to the environment, thereby ensuring the integration of environmental concerns into all its activities.

Inter-American Development Bank

An environmental management committee systematically examines all IADB projects for their environmental impact. To link the granting of credits to improvements in the environment, six specialists have been appointed by the IADB to the regional agencies to monitor projects for compliance with agreed environmental standards.

African Development Bank

In the course of the 1990s, the African Development Bank formulated several objectives aimed at resolving the serious environmental problems of the African continent (desertification, destruction of tropical forests, etc.). The main objectives are as follows:

- Evaluation of the state of the environment in Africa;
- Application of environmental policy to all regions at risk;
- Assistance to African countries in formulating their national policies on the environment.

	Contributions (million CHF)			
	1997	1998	1999	2000
Global Environment Facility	10.6	10.6	8.1	11.2
Multilateral institutions:				
International Bank for Reconstruction and Development (IBRD)	5.9	5.4	0.2	3.4
International Development Association (IDA)	94.9	108.5	140.0	140.0
International Finance Corporation (IFC)	5.1	-	-	-
African Development Fund (FAD)	28.6	49.8	46.0	92.0
Asian Development Fund (ADF)	23	10.6	17.8	10.6
European Bank for Reconstruction and Development (EBRD)	2.0	5.5	6.6	7.8
Inter-American Development Bank (IADB)	14.7	-	3.2	-
United Nations Development Programme (UNDP)	57.4	58.5	52.0	52.0
World Bank (NSS Programme)	3.1	0.9	-	3.9
Multilateral scientific programmes:				
Consultative Group on International Agricultural Research (CGIAR)	11	10.4	10.9	4.4
International Fund for Agricultural Development (IFAD)	5	14.9	0	0.1
International Union for the Conservation of Nature (IUCN)	0.8	0.8	0.8	0.8
WMO Programmes	0.7	0.7	0.7	0.8
European Co-operation in the Field of Scientific and Technical Research (COST)	7.4	8.7	7.6	7.7
OECD Environment Directorate	0.4	0.4	0.7	1.1
Multilateral technology programmes:				
UNIDO	2	1.6	1.7	1.8
Ozone Fund UNEP	3.3	3.3	3.3	3.1
UNEP	4	3.9	3.8	3.7
Multilateral training programmes:				
UNITAR (climate and environment)	0.5	0.6	0.6	0.6

Table 7-9: Financial contributions to the operating entity or entities of the financial mechanism, regional or other multilateral institutions and programmes (1997 to 2000)

7.3.2. Involvement in international task forces

Switzerland participates in various technology transfer task forces in a number of international bodies such as the OECD, GATT, UNIDO, UNCTAD and the Commission on Sustainable Development (CSD). It is therefore well placed to help improve general conditions at both national and international levels. Such conditions promote the transfer of technology and know-how, especially by strengthening the institutional infrastructure and supporting programmes of education, training and information.

8. Research and systematic observation

8.1. Research

The results presented below refer to research on global change, and not specifically to climate research. The data are based on the Research-InfoSystem of ProClim-, the Forum for Climate and Global Change of the Swiss Academy of Sciences. ProClim- constantly updates the research activities, publications and the list of experts on climate research. More specific studies and analysis of the research activities can found on the web under http://www.proclim.ch.

8.1.1. Domestic research

In the year 2000, there were 420 research projects on climate and global change research and its human dimension in progress. The detailed analysis of 1996 has not yet been updated, but the basic findings are still the same. The Swiss 1997 UNFCCC report gives further details.

Distribution of the research projects by research area

The research projects are currently distributed as follows (in per cent of all projects). Not all projects are classified, and multiple selections can be made for a project (e.g. research on atmosphere and hydrosphere). The statistics are approximate, as only about two thirds of the projects were classified by research area. The others are assumed to follow more or less the same distribution.

	per cent of all projects
Earth system process studies	54
Human processes	27
Causes of change	15
Impact of global change	41
Response options	23
Biology	20
Palaeo	17
Atmosphere	16
Pedo- and lithosphere	15
Hydrosphere	12
Human health	4

About 120 of the projects specifically focused on climate change, the others and especially the human dimensions projects focused on global change issues, and were indirectly related to climate change.

Energy research

An important area for research concerns the field of energy use and production. Publicly-funded energy research in Switzerland is focused on the energy research strategy of the federal government. The Swiss Federal Office of Energy (FOE) is responsible for co-ordinating, accompanying, implementing and establishing research work at the national level. The FOE has funds available to promote research, and these are used to support the efforts of private and public research institutions. The FOE also promotes the implementation of research results in practice. The FOE and the Swiss Federal Commission for Energy Research (CORE) collaborate in these matters.

Energy research has the long-term goal of reducing CO_2 emissions in Switzerland. In the energy research strategy of the federal government for 2000 to 2003, elaborated by the CORE, a reduction of CO_2 emissions to the level of 1 tonne per person per year within the next 50 years is proposed. This is to be achieved by a policy inspired by the strategy of the "2 kilowatt society" developed by the board of the Federal Institute of Technology (ETH).

Some important points of the research strategy are as follows:

- A well co-ordinated research corresponding to international standards is intended, considering short-term as well as long-term aspects.
- Stimulation of international collaboration and communication as well as the linking up of research institutions.
- Improving the energy aspect of existing techniques for the production, transformation, storage and distribution of heat and electricity.
- Continuing the efforts for clean and efficient techniques of combustion and heating, also with regard to new chemical fuels.
- Developing new, environmentally-compatible, efficient techniques for producing and storing heat and electricity, especially using biomass (wood and organic waste), solar energy and ambient heat.
- Due consideration of the social and economic context.

The strategy distinguishes four main domains: (1) The development of energy-efficient systems and new technologies is at the centre of research. (2) In the sector of energy-efficient systems an increase of the financial resources is planned. (3) Satisfying results were obtained in the domain of the economic optimisation of components and systems. (4) A focus of energy research of decreasing importance deals with the security and reliability of nuclear installations.

A wide range of economic, ecological, social and political questions is investigated in the "Fundamentals of Energy Economics" research programme. The prime purpose of measures related to energy policy is to help implement the national energy policy, through the use of scenarios and a variety of measures that are studied for their impact on the economy as a whole. The particular research efforts must take into account the economic, ecological and societal consequences (including acceptance questions) of proposed energy technology innovations, particularly insofar as their acceptability is concerned. Technology transfer, from the level of research to the level of applications, is another main concern. In this way, valuable fundamental knowledge is gained and further scrutinised, and energy questions are investigated not only from the technical, but also from the economic and social points of view. The forecasts for energy and CO_2 presented in this report were developed in the framework of the "Fundamentals of Energy Economics" research programme. This programme will expand in the future.

Transport research

National Research Programme NRP41 on "Transport and Environment" began in 1997 and ended in 2001. NRP41 has achieved scientific progress and successful practical implementation. It has provided a series of building blocks and recommendations for sustainable transport policy.

8.1.2. Highlights

Some of the research results are cited in chapter 6. In the field of research on climate and global change, every year about 500 contributions are published in international refereed scientific journals. Publications in the different fields of research can be found on the ProClim-homepage:http://www.proclim.ch/Publications.html.

Two research programmes focussing specifically on climate research, namely National Research Programme 31 "Climate Changes and Natural Disasters" and the co-ordinated project "CLEAR", which is part of the "Environmental Technology and Environmental Research" Priority Programme, have come to an end since the last submission of a national communication by Switzerland. Both programmes have contributed substantially to the present knowledge summarised in chapter 6.

A new National Centre of Competence in Research (NCCR) on climate change was created in April 2001 (intended duration of 12 years). The NCCR Climate brings together experts from a wide range of universities. It will address broader issues of natural climate variability and predictability by combining the contributors from relevant disciplines into an integrated network of competence. This network includes expertise from the physical, chemical, biological, economic and sociological disciplines. It will be active on several research fronts and the vision for its functioning is as follows:

- First, disciplinary work in the individual research groups to ensure continuous cutting-edge progress and to facilitate access to and sharing of latest results and methods through international co-operation (e.g. EU projects).
- Second, research within the various modules to provide thematic co-ordination of research and the integration of results.
- Third, a university-based, long-term Swiss centre of competence on basic issues of natural climate variability, extreme events, climate projections and processes, and the attendant ecological and economic processes relevant for improved predictive capability and risk assessment.

The overall goals of the NCCR Climate will be to:

- Acquire better understanding of climate system processes, variability and predictability and the complex inter-relationships between climate, economic and societal driving factors.
- Adapt and refine scientific tools and knowledge acquired for Switzerland, considering specific characteristics in physical, chemical, biological, geographical, economic and societal factors.
- Transfer and apply the knowledge to assess the future cost and risks of expected climate change, and to provide a basis for adaptation strategies.
- Educate young scientists of all disciplines with an emphasis on interdisciplinarity, in order to prepare a young generation of decision-makers for the future. The management will establish a regular series of thematic summer schools and forms of participatory teaching.
- Investigation of new financial and economic tools to hedge against the increased probability of extreme events.

8.1.3. International contribution

International programmes

Switzerland makes a major contribution to the World Climate Research Programme through individual research projects, research conducted at federal institutes and within co-ordinated programmes (e.g. NRP-31) and by operating monitoring stations and networks, as well as calibration and data centres (for monitoring see section 8.2). It also plays a leading role in several regional climate research programmes.

Switzerland also contributes significantly to the International Geosphere-Biosphere Programme (IGBP), both directly and through relevant research activities. The Core Project Office for the IGBP Past Global Changes project (PAGES) is located in Berne and is jointly financed by Switzerland and the USA. Swiss scientists are engaged in GCTE and PAGES, and also participate in most other Core Projects. Swiss participation is also significant in the DIVERSITAS programme.

Switzerland has also contributed significantly to the International Human Dimensions Programme (IHDP) on Global Environmental Change. During the initial phase (1993 to 1996), Switzerland co-financed the IHDP Secretariat, which was located in Geneva. Swiss researchers are active in fields relevant to the IHDP and have also made important contributions to the United Nations University over the years.

Swiss participation in COST and the EU's Specific Programme on Environment and Climate is sound and growing.

International assessment activities

The involvement of Swiss scientists in international assessment activities is varied. Swiss scientists (and the Swiss government) are very active in the Intergovernmental Panel on Climate Change, but participation in the International Ozone Assessment is limited to a few individuals and no Swiss scientists played a role in the Global Biodiversity Assessment.

Energy research

The research studies are closely linked to international activities, especially in the context of the International Energy Agency (IEA) and of European Programmes (EUREKA, COST, EURATOM, EU Framework Programme). An attempt is being made to reinforce collaboration with Eastern European countries and developing countries.

Despite decreasing financial resources, publicly-financed energy research in Switzerland was able to continue pursuing its goals throughout 2000. By international comparison, Swiss research in this field is amongst the leaders, and in certain domains

even in the lead (for instance integration of solar cells into buildings, gas-combustion systems, and light vehicles).

8.1.4. Funding

Funding information for the projects is available for about three quarters of the 420 projects that were ongoing in 2000. The average level of funding per project was 96,000 CHF per year. Based on the assumption of a similar level of funding for the remainder of projects we obtain a total funding for climate and global change related projects of 40 million CHF, or 12 million CHF per year for the projects which specifically focus on climate change.

More than half of all climate research is funded via grants to individual researchers by the Swiss National Science Foundation. EU projects contribute about 15 per cent of all projects. The National Centre of Competence in Research "Climate" (NCCR Climate) was granted 8.2 million CHF funding for the first three years. This competence centre will, pending funding approval by the parliament, be complemented by another centre focussing on partnership with developing countries and sustainable development. While the resources available for these projects will only be about 15 per cent of the total amount of funding, their impact may become substantially more pronounced through the internal co-ordination of these projects. Other important sources of funding are federal government offices, federal research institutes and the cantons.

The figures cited above for total research funding generally neglect or underestimate both indirect research support through university and institute budgets (salaries, equipment) and projects financed and / or conducted directly by federal offices such as the Swiss Agency for the Environment, Forests and Landscape.

In 1999, the public funding for energy R&D was 180 million CHF in comparison with 183 million CHF in 1998; for the time being we estimate a similar amount in 2000. In 1999, 34 per cent of this amount was dedicated to international co-operation, mainly within the IEA Implementing Agreements and the EU Framework Programmes. The contribution of the FOE was about 38 million CHF. The breakdown by use was the following: 37 per cent for renewable energy sources, 31 per cent for rational uses of energy, 26 per cent for nuclear energy and 7 per cent for research on measures related to energy policy. Despite decreasing funds for energy research - mainly in the nuclear sector - in the last 5 years (215 million CHF in 1995), about 0.05 per cent of gross domestic product has been spent on energy research. However, by international comparison, this is a considerable proportion.

8.2. Systematic observation

The information provided below is a summary of the joint national report on Global Climate Observing System (GCOS), which is - for the first time - requested by UNFCCC. For more detailed information, see the report edited by MeteoSwiss 'Swiss Contribution to the Global Climate Observing Systems 2001' (also available at www.climatereporting.ch).

National plans and support

The Swiss authorities encourage and support research and systematic observation on the climate system mainly in the framework of their climate policy, in order to better understand climate changes and their consequences. This support extends to the specialised international organisations and programmes. It also takes into account related capacity-building needs in developing countries.

The Swiss climate observing system in the atmosphere and the related terrestrial systems constitute a part of the general environmental monitoring. They are mainly under the responsibility of federal agencies committed to operate them on a long-term basis with federal resources (e.g. MeteoSwiss, the FOWG and the SAEFL). Federal funding is generally fixed at the present level. Regional administrations contribute mainly to regional environmental monitoring. Research institutes (e.g. EMPA, PSI, PMOD/WRC, WSL-SLF, ETHZ, Universities of Zurich and Berne) contribute significantly to world-wide and national monitoring efforts, either under direct federal contracts or through other research funding sources. In the latter case, funding is subordinate to project allocation.

Observational networks are particularly well developed in Switzerland, and many long-term time series contribute to a sound description of the national climate, including its variability, changes with time, and impact on the environment. Switzerland has implemented numerous permanent observation programmes and supporting activities within the different components of the GCOS, with the exception of the GOOS (oceanic observations). Contributions in relation to space-based observing programmes have up to now focused on a few projects. During recent years, the Swiss contribution to different components of the GCOS has been significantly increased (e.g. GAW). The Alps – with large climate differences on a local scale – are particularly appropriate for hosting GCOS atmospheric and terrestrial observations. The high Alpine station at the Jungfraujoch is becoming a major atmospheric background monitoring station and constitutes, together with Payerne, Arosa/Davos and the other Alpine GAW stations of Germany and Austria, a surface based environmental "Alpine profiler" through the atmosphere. The Alpine glaciers and permafrost also provide excellent climate indicators.

Once collected and quality controlled, the data sets are documented with metadata, processed and archived using modern computer technology. Most of them are transmitted to the operational world data centres and exchanged within the scientific community. The submission of data to the WDCA should start in 2002. Most contributors maintain a web-site with up-to-date information.

The main components of the **national programme** are summarised below.

Metereological and atmospheric observing systems for climate (GCOS, GAW)

- **GCOS meteorological surface network (GSN):** Within the normal climate network, MeteoSwiss exploits 12 reference stations with long-term time series according to the GCOS principles. Two of them belong to the official GSN list; their data submission to the data centre will be improved.
- **GCOS meteorological upper air network (GUAN):** The Swiss sounding station has a 50-year time series and is operated according to the GCOS principles and the GUAN best practices, however it does not belong to the official GUAN list.
- **Atmospheric constituents (GAW, NDSC):** Switzerland has been monitoring total ozone at Arosa (since 1926 + Umkehr profiles since 1956) and ozone profiles at Payerne (since 1966) according to the GAW standards. An ozone microwave radiometer has recently been put into long-term operation. A complete aerosol-measuring programme is operated at the high Alpine station Jungfraujoch (3,580 m) according to the GAW aerosol objectives. In addition, extensive measurements of the chemical composition of the atmosphere are performed at Jungfraujoch by the Swiss responsible for the world calibration centre for surface O_3, CO and CH_4. Payerne and Arosa belong to the official list of GAW ozone stations, and the Jungfraujoch is a regional GAW station.
- **Radiation (GAW, BSRN):** The Swiss Radiation Monitoring programme is performed at 4 stations at altitudes ranging from 366 to 3,580 m (CHARM network); measurements include the UV, visible and IR domains (global, diffuse, direct, reflected) as well as spectral lines. Payerne is a BSRN station with full measuring programme meeting the highest achievable accuracy standards. An Alpine Surface Radiation Budget network is operated within a research project. Swiss researchers are active in the space-based monitoring of the solar constant.

Terrestrial and ecological observing systems for climate (GTOS)

- **Hydrological observations:** The FOWG exploits a large network in order to monitor water balance on a long-term basis in undisturbed basins in the 18 different hydrological regimes of Switzerland as well as water quality; observations correspond fully to the GCOS/GOOS/GTOS climate monitoring principles, and data are supplied to or exchanged with international surveillance programmes.
- **Glacier and permafrost monitoring (GTN-G, GTN-P):** Swiss researchers are very active in these two pilot projects of GCOS/GTOS (national and international level), with contributions to the different tiers of both projects. The new Swiss Glacier Inventory 2000 is presently being compiled taking advantage of high-resolution satellite imagery. A Swiss Permafrost Monitoring Network has been established and borehole measurements complete these observations.
- **Snow:** The SLF runs a network of stations that are spread all over the Swiss Alps for avalanche forecasting and climatological investigations.
- **Ecological observations** (forestry, phytophenology, soil, radioactive isotopes, biodiversity, etc.): Different monitoring networks are dedicated to the impact of climate change. Environmental quality and general environmental statistics (e.g. European programmes and CORINAIR) are regularly updated. Researchers are beginning to investigate carbon flux.

Current monitoring activities concerning the physical climate system and the impact of climate and environmental change are judged to be adequate to fulfil Swiss obligations required by the UNFCCC.

International services and capacity building

During recent years, high priority has been given to contributions to international and national activities assuring and maintaining the required high data quality standards and the exchange of data. A couple of world calibration centres (radiation: GAW-WORCC; surface O_3, CO and CH_4: GAW-WCC), QA/SAC (GAW) and world data centres (BSRN: WRMC; Glacier: WGMS) are operated and funded by Switzerland. Arosa hosted several international Dobson intercomparisons. Furthermore many individual specialists contribute to international working and co-ordination groups within the GCOS affiliated programmes. For example, Swiss scientists are active within GAW Science Advisory Groups, within the GAW German-Austrian-Swiss collaboration, as well as for the Strategic Plan of GAW; others are in charge or co-responsible for monitoring networks related to glacier and permafrost. Contributions to international projects can also be mentioned (SINGADS, PACE).

Capacity building has been strengthened, especially in relation with the GAW programme. The international GAW centres (QA/SAC, WCC and WORCC calibration centres) as well as the Data Centres for other GCOS-components contribute significantly to capacity building. Furthermore, the twinning arrangement with Kenya for the training of personnel at the ozonesonde station of Nairobi has been successful. In the hydrological field, a project related to the Aral Sea is worth mentioning.

National GCOS structure

MeteoSwiss acts as national focal point for GCOS, due to its role as national permanent WMO representative (gcos@meteoswiss.ch) and will co-ordinate the actions and enquiries requested by GCOS. Due to the existing national structures related to different monitoring programmes within GCOS (GAW, BSRN, GTN-G, GTN-P, hydrology) and to the national co-ordination group for environmental monitoring, there is presently no need for a comprehensive national GCOS structure. Co-ordination activities will be settled each time that it is necessary.

9. Education, training and public awareness

9.1. Climate related government activities

A large number of institutions and initiatives contribute to maintaining the generally high level of environmental awareness in Switzerland. The following sections highlight only activities with an explicit link to climate protection and greenhouse gas emissions, while leaving aside those that have a more general focus on sustainability and the protection of the environment (e.g. Agenda 21 activities, training centres for environmental professionals in businesses and the administration).

Federal government activities often involve the participation of cantons or local authorities. Even though their contribution is of great importance to the success of policy programmes, they are not reported on in detail.

General information and activities to raise awareness

On the occasion of the annual COP of the Climate Convention, the SAEFL produces documentation for the mass media which takes stock of the most important issues and developments relevant to climate policy at the national and international level. At the same time, updates are produced regarding emissions trends and the state of knowledge in climate science.

Important reports by the IPCC are presented to the public in collaboration with specialised institutions such as ProClim- and Swiss scientists involved in the IPCC process. Through the translation of reports (e.g. summaries of IPCC assessment reports, IPCC Technical Paper No.4 on effects of reduction measures on CO_2 emissions) Switzerland contributes to the wider dissemination of IPCC results.

The media have shown great interest in the climate issue. This is reflected in recent surveys which indicate that more than 50 per cent of the population consider climate change an issue where more should be done to avoid severe damage to society and the environment. Protection from hazards related to climate change is regularly seen as a top priority of national environmental policy.

SAEFL climate website

Since 1998 a climate site has been built up within the SAEFL homepage covering climate science, policy, as well as statistics (URL <http://www.klima-schweiz.ch>, mostly in German and French). According to an evaluation in 1999, amongst all issues covered by the SAEFL homepage, the climate site was visited the most often. The site complements the personal information services offered by SAEFL staff to the numerous private individuals and NGO representatives interested in the topic of climate change and its effects on Switzerland.

Climate facts interactive database

In collaboration with the climate module of the Priority Research Programme Environment (see section 8.1.) and ProClim- (see section 9.3), the SAEFL has made the interactive data base "Climate Facts" on recent research related to climate change and its impacts on Switzerland accessible to the broader public (URL <http://proclimfm.unibe.ch:591/im/index.html>, including an English version). The SAEFL is sponsoring the continuous upgrading and maintenance of the data base making it an up-to-date tool for easy access to research findings. Interactive elements allow the user to better appreciate uncertainties by depicting the effect of different assumptions about the development of physical and social parameters. The database was also presented to the participants of COP5 in 1999 where it met with considerable interest due to its usefulness for educational purposes.

School related activities

From 1997 to 1999, the SAEFL sponsored the development and implementation of an educational programme offered to teachers of secondary school classes. The programme links the emotional climate in the class room with the way we care for the climate of planet Earth. A project building on the experience gained in this context is presently under consideration by the Federal Office of Public Health.

Since 1998, Switzerland has been participating in the GLOBE initiative which was initiated by ex US vice president Al Gore. Students collect data on weather and climate and exchange their observations internationally via the internet. Classes from all parts of the country are involved in the project.

Sponsoring of private initiatives

The SAEFL and other federal agencies support events that contribute to a more active involvement of individuals at home, at work and as citizens. Examples are the yearly SUN21 conferences dedicated to the promotion of renewable energy, an educational trail on the risks of climate change in mountain regions, and projects aimed to illustrate the relevance of different lifestyles on greenhouse gas emissions (e.g. tools to calculate the individual emissions budget and the effect of changing behaviour).

9.2. Government activities in the energy sector

The Energy Law has several paragraphs that aim to raise public awareness, support education and information exchange. The government has to inform and to advise the population on energy use, encourage information exchange and dissemination, and support training courses. Most of the measures in the 'Energy 2000' and 'SwissEnergy' action plans have the intention to increase the awareness of energy savings and the rational use of energy. Specific courses, publications, information events, seminars and educational materials are provided. The evaluation programme (see section 4.3.2) helps the government to identify and communicate the policy objectives achieved and not achieved.

The competence of professionals in the energy area is essential with a view to the construction and maintenance of buildings that meet modern energy requirements. Thus, the efforts of the Confederation and the cantons concentrate on joint projects with vocational associations and schools. The most important in the context of the 'Energy 2000' programme was the co-ordination of Building and Energy post-graduate courses across Switzerland. In 60 courses, over 1,200 planners were trained according to a standardised curriculum. The preparation of the 'Building and Energy' handbook, containing training material in 5 volumes, was directly linked to the course.

At the start of the 'Energy 2000' programme, attention concentrated especially on planners (architects and professional engineers as target group). As the 'Energy 2000' programme continued, attention was focused increasingly on those carrying out the actual installation work, primarily building services installers.

In co-operation with the WWF Swiss Centre for Environmental Education, teaching aids were developed. A teaching aid for technical schools is in the final phase of development. Ten teaching modules have been created for the building, electrical and metalworking trades for energy-relevant topics in technical training.

The activities of the FOE and the cantons were supported financially by the RAVEL (efficient use of electricity) and PACER (renewable energies) impulse-programmes which were wound up in 1996. Many of their publications on topics concerning renewable energy and the efficient use of electricity are still regarded as state of the art. The FOE took over the co-ordination of courses, including deficit guarantees, within the framework of the Energy 2000 programme. While the number of courses declined considerably after 1996, 'energy receptions' ('Energie Aperitif'), i.e. gatherings of professionals focussing on recent developments in selected fields of energy use, met with an enthusiastic echo. 3,000 to 4,000 professionals take part in these events annually.

The FOE information division, which is responsible for media contacts, provides support to the programme management, and several branches of Energy 2000 organised media events. In addition to this, a large number of queries were handled, contacts arranged and interviews given. Articles on the action programme were written for various magazines. The media office mandated by the FOE to provide information on 'Pilot and Demonstration Plants' frequently placed reports in professional publications and daily newspapers on projects supported financially by the FOE.

Five publications are produced by the FOE:

Energy Extra: FOE and Energy 2000's 'magazine in the magazine' was published every two months as a supplement in various magazines (Swiss Municipalities, Solar Energy, Swiss Engineer and Architect, Property). Additional copies were distributed by the Energy 2000 sections, e.g. during exhibitions and events (35,000 copies per issue per language).

Energy and Environment: The FOE, together with representatives of the French-speaking cantonal energy offices, the SAEFL and cantonal environmental authorities, is represented on the editorial committee of this magazine, which reports on Energy 2000 activities, and is distributed to all households in western Switzerland.

Energy 2000 News: Since 1993, this information and agenda have been sent every month along with the Energy 2000 Media Report to around 100 programme participants (in February 2000 for the last time in paper form). As of September 2000, it was replaced by an electronically distributed newsletter, which initially concentrated on the transition from Energy 2000 to Swiss Energy.

Energy Innovation: Apart from the 'Pilot and Demonstration Plant' and 'Good Solutions' series of leaflets, the third series 'Energy 2000 in Practice' presented decision-makers in business with practical examples of Energy 2000 topics.

ENET News: The ENET office publishes energy research and other reports on behalf of the FOE. As a consequence of the new ENET mandate, this publication was discontinued at the end of 1999. From September 2000 onwards, ENET News has recommenced publication with a new editorial strategy and a new format.

Until now, the FOE and Energy 2000 have published separate websites (www.admin.ch/bfe and www.energie2000.ch). Individual branches and programmes have continually extended Energy 2000's presence on the Internet. A completely new website – an 'energy portal' – has been on-line since the presentation of the 'Swiss Energy' programme on 30 January 2001 (www.swiss-energy.ch), replacing the two previous websites.

The FOE and Energy 2000 were present at many exhibitions (e.g., Swissbau, Habitat & Jardin, Muba, Sion Expo and Foire de Fribourg). Appearances in the German-speaking part of Switzerland concentrated on sustainable construction. In western Switzerland, close co-operation was maintained with the cantons. Furthermore, the programme management assisted the promoters of various exhibitions with informative material. On the basis of the Energy Law, information activities of private organisations were supported financially. In 1999, around 170,000 CHF were spent, and in 2000 it will be around 200,000 CHF (e.g. for conferences, action days, exhibitions, brochures, youth camps, internet, and energy film festivals).

9.3. Other related activities

Parliamentary group on "Climate Change"

A parliamentary group on climate change was founded in 1996. The group meets regularly (usually once during each parliamentary session) to encourage the flow of information about the impacts of climate change and about science, and also to open debate on the issue. The meetings are now very well established with 16 meetings covering topics as wide as climatic effects on biodiversity and the opportunities for locally produced biological products or the limits to statistically evaluate the impact of climate change on extreme events and the consequences for the reinsurance industry. The meetings give background information and examples of business opportunities through forward-looking strategies, presented both by leading scientific experts and by decision makers from the private sector.

ProClim - Swiss Academy of Science's Forum for Climate and Global Change

Progress in science normally circulates well within the corresponding disciplines. What is needed however are broad discussions not only between scientific disciplines but on specific topics also with policy makers outside the scientific community. To provide professional support and co-ordination to groups who crucially need to understand each others views, the Swiss Academy of Science established ProClim- in 1988. To be able to reach out to hundreds of scientists, ProClim- runs an information system with access via the

www. The web server provides not only the information on experts with their publications, research programmes and projects and a web calendar of events, but also fact sheets containing easy understandable background information on topical climate issues.

Drawing heavily on its broad network, ProClim- also serves as the voice of the global change research community in government bodies, organises workshops and public forums, and encourages the participation of scientists in the decision-making process. ProClim- serves as the secretariat of the parliamentary group on "Climate Change" (see above) and of the 'Advisory Body on Climate Change' (see below).

OcCC - Advisory Body on Climate Change

An Advisory Body to the federal administration on climate change research and policy (Advisory Body on Climate Change OcCC) was formed under the auspices of the Swiss Academy of Sciences on 1 January 1997 and is funded by the SAEFL. The secretariat is located at ProClim-, which guarantees a non-governmental view. The OcCC made several recommendations and published synthesis reports on specific issues. At least as important is the process, in which the synthesis is reached in workshops with scientists and decision-makers from politics, the economic sector and federal agencies.

Climate Change Information Centre

The Climate Change Information Centre of MeteoSwiss began operations in January 1998. The information centre lends collated information material on specific topics and, upon request, prepares reviews and background reports on the functioning of the climate system. The information centre collaborates closely with ProClim- (see above). Whenever possible requests are answered and information prepared in German, French or Italian, depending on the needs of the user. This is achieved through scientists at the main office of MeteoSwiss at Zurich, at the Geneva Meteorological Centre and the Locarno-Monti Meteorological Centre.

Annex 1: Swiss greenhouse gas inventory 1999 – summary and trend tables

TABLE 10 EMISSIONS TRENDS (CO_2) (Sheet 1 of 5) Switzerland 1999 / Submission 2001

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
1. Energy	**0**	**39'729**	**41'924**	**41'917**	**39'682**	**38'861**	**39'837**	**40'627**	**39'967**	**41'216**	**41'181**
A. Fuel Combustion (Sectoral Approach)	0	39'673	41'854	41'846	39'611	38'789	39'764	40'554	39'894	41'140	41'104
1. Energy Industries		891	1'201	1'280	962	1'039	1'094	1'267	1'176	1'423	1'126
2. Manufacturing Industries and Construction		5'237	5'410	4'994	4'862	4'861	5'098	4'853	4'736	4'893	5'499
3. Transport		14'144	14'668	14'983	13'933	14'117	13'815	13'885	14'462	14'691	15'315
4. Other Sectors		18'631	19'810	19'830	19'100	18'023	19'013	19'810	18'785	19'402	18'437
5. Other		770	765	759	754	749	744	739	735	731	727
B. Fugitive Emissions from Fuels	0	56	70	71	71	72	73	73	73	76	77
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		56	70	71	71	72	73	73	73	76	77
2. Industrial Processes	**0**	**3'363**	**3'034**	**2'736**	**2'548**	**2'731**	**2'622**	**2'220**	**2'207**	**2'204**	**2'238**
A. Mineral Products		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
C. Metal Production		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other Production		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
4. Agriculture	**0**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
A. Enteric Fermentation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Manure Management		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils[2]		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry[3] (3 years average)	**0**	**-3'188**	**-3'257**	**-3'355**	**-4'325**	**-4'340**	**-4'310**	**-4'460**	**-4'636**	**-4'570**	**-4'226**
A. Changes in Forest and Other Woody Biomass Stocks		-3'188	-3'257	-3'355	-4'325	-4'340	-4'310	-4'460	-4'636	-4'570	-4'226
B. Forest and Grassland Conversion		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
C. Abandonment of Managed Lands		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. CO_2 Emissions and Removals from Soil		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	**0**	**1'317**	**1'327**	**1'337**	**1'336**	**1'336**	**1'346**	**1'365**	**1'375**	**1'394**	**1'407**
A. Solid Waste Disposal on Land		137	137	137	136	136	136	135	135	134	134
B. Waste-water Handling		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Waste Incineration		1'180	1'190	1'200	1'200	1'200	1'210	1'230	1'240	1'260	1'273
D. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (please specify)	**0**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Total Emissions/Removals with LUCF[4]	**0**	**41'221**	**43'028**	**42'635**	**39'241**	**38'588**	**39'495**	**39'752**	**38'913**	**40'244**	**40'600**
Total Emissions without LUCF[4]	**0**	**44'409**	**46'285**	**45'990**	**43'566**	**42'928**	**43'805**	**44'212**	**43'549**	**44'814**	**44'826**
Memo Items:											
International Bunkers	**0**	**3'200**	**3'100**	**3'300**	**3'440**	**3'550**	**3'770**	**3'900**	**4'050**	**4'230**	**4'520**
Aviation		3'200	3'100	3'300	3'440	3'550	3'770	3'900	4'050	4'230	4'520
Marine		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	**0**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**1'880**	**1'930**	**1'890**

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
						(Gg)					
Total Emissions	0.00	241.90	242.86	240.46	238.31	234.14	233.16	229.99	226.77	221.92	217.49
1. Energy	0.00	21.87	21.69	20.95	20.28	19.45	18.82	18.71	18.26	18.37	18.06
A. Fuel Combustion (Sectoral Approach)	0.00	7.23	7.23	6.79	6.51	6.18	6.04	6.03	5.68	5.90	5.68
1. Energy Industries		0.05	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.08	0.07
2. Manufacturing Industries and Construction		0.25	0.27	0.26	0.27	0.27	0.29	0.35	0.37	0.43	0.40
3. Transport		3.92	3.69	3.39	3.12	2.93	2.72	2.53	2.36	2.46	2.31
4. Other Sectors		2.65	2.91	2.77	2.76	2.61	2.66	2.78	2.58	2.62	2.60
5. Other		0.37	0.29	0.30	0.30	0.30	0.29	0.29	0.31	0.31	0.31
B. Fugitive Emissions from Fuels	0.00	14.64	14.46	14.16	13.77	13.27	12.78	12.68	12.58	12.48	12.38
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		14.64	14.46	14.16	13.77	13.27	12.78	12.68	12.58	12.48	12.38
2. Industrial Processes	0.00	0.43	0.43	0.42	0.41	0.41	0.40	0.41	0.41	0.42	0.43
A. Mineral Products		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
C. Metal Production		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other Production		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Agriculture (3 years average)	0.00	150.99	152.52	151.28	150.29	147.35	147.41	145.35	143.58	139.50	136.41
A. Enteric Fermentation		130.20	131.68	130.67	129.85	127.34	127.66	126.00	124.08	120.40	117.55
B. Manure Management		20.79	20.84	20.61	20.44	20.01	19.75	19.35	19.50	19.10	18.86
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry (3 years average)	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
A. Changes in Forest and Other Woody Biomass Stocks		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Forest and Grassland Conversion		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. CO_2 Emissions and Removals from Soil		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	0.00	68.61	68.22	67.82	67.32	66.93	66.53	65.53	64.53	63.62	62.60
A. Solid Waste Disposal on Land		66.90	66.50	66.10	65.60	65.20	64.80	63.80	62.80	61.90	60.88
B. Waste-water Handling		1.35	1.38	1.40	1.43	1.46	1.48	1.51	1.54	1.57	1.60
C. Waste Incineration		0.36	0.34	0.32	0.29	0.27	0.25	0.22	0.19	0.15	0.12
D. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (please specify)	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:											
International Bunkers	0	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	0	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass											

TABLE 10 EMISSIONS TRENDS (N_2O) (Sheet 3 of 5)

Switzerland 1999 / Submission 2001

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
Total Emissions	0.00	11.34	11.44	11.51	11.55	11.59	11.56	11.56	11.47	11.69	11.66
1. Energy	0.00	1.23	1.38	1.53	1.63	1.76	1.84	1.92	1.96	2.26	2.32
A. Fuel Combustion (Sectoral Approach)	0.00	1.23	1.38	1.53	1.63	1.76	1.84	1.92	1.96	2.26	2.32
1. Energy Industries		0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00
2. Manufacturing Industries and Construction		0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04
3. Transport		0.98	1.13	1.29	1.40	1.53	1.61	1.68	1.74	2.01	2.09
4. Other Sectors		0.18	0.19	0.19	0.19	0.18	0.18	0.18	0.17	0.18	0.17
5. Other		0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
B. Fugitive Emissions from Fuels	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1. Solid Fuels		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	0.00	0.32	0.32	0.32	0.31	0.31	0.31	0.31	0.31	0.31	0.31
A. Mineral Products		IE		IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry		IE		IE	IE	IE	IE	IE	IE	IE	IE
C. Metal Production		IE		IE	IE	IE	IE	IE	IE	IE	IE
D. Other Production		IE		IE	IE	IE	IE	IE	IE	IE	IE
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use		0.35	0.35	0.36	0.37	0.38	0.38	0.38	0.39	0.39	0.39
4. Agriculture (3 years average)	0.00	9.23	9.16	9.06	8.99	8.88	8.74	8.65	8.51	8.42	8.32
A. Enteric Fermentation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Manure Management		1.48	1.46	1.44	1.43	1.41	1.39	1.38	1.38	1.37	1.36
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		7.76	7.70	7.62	7.56	7.47	7.35	7.27	7.14	7.05	6.95
E. Prescribed Burning of Savannas		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry (3 years average)	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
A. Changes in Forest and Other Woody Biomass Stocks		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Forest and Grassland Conversion		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. CO_2 Emissions and Removals from Soil		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste	0.00	0.22	0.23	0.24	0.25	0.27	0.28	0.29	0.30	0.31	0.32
A. Solid Waste Disposal on Land		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Waste-water Handling		0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07
C. Waste Incineration		0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25
D. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
7. Other (please specify)	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items:											
International Bunkers	0	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	0	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass											

TABLE 10 EMISSIONS TRENDS (N_2O) (Sheet 4 of 5)

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)										
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**355.00**	**468.38**	**365.54**
HFC-23									IE	0.0001	0.0000
HFC-32									IE	0.0005	0.0028
HFC-41									IE	0.0000	0.0000
HFC-43-10mee									IE	0.0806	0.0000
HFC-125									IE	0.0114	0.0182
HFC-134									IE	0.0000	0.0000
HFC-134a									IE	0.2228	0.1871
HFC-152a									IE	0.0643	0.0056
HFC-143									IE	0.0000	0.0000
HFC-143a									IE	0.0083	0.0175
HFC-227ea									IE	0.0000	0.0008
HFC-236fa									IE	0.0000	0.0000
HFC-245ca									IE	0.0000	0.0000
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**60.70**	**70.27**	**28.20**
CF_4									IE	0.0075	0.0020
C_2F_6									IE	0.0012	0.0014
C_3F_8									IE	0.0011	0.0003
C_4F_{10}									IE	0.0001	0.0000
c-C_4F_8									IE	0.0001	0.0000
C_5F_{12}									IE	0.0001	0.0000
C_6F_{14}									IE	0.0001	0.0000
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**172.08**	**152.96**	**125.30**
SF_6									0.0072	0.0064	0.0052

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
c-C_4F_8	8700
C_5F_{12}	7500
C_6F_{14}	7400
SF_6	23900

[5] Enter information on the actual emissions. Where estimates are only available for the potential emissions, specify this in a comment to the corresponding cell. Only in this row the emissions are expressed as CO_2 equivalent emissions in order to facilitate data flow among spreadsheets.

TABLE 10 EMISSIONS TRENDS (SUMMARY) (Sheet 5 of 5)

Switzerland 1999 / Submission 2001

Greenhouse gas emissions	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
Net CO_2 emissions/removals	0	41'221	43'028	42'635	39'241	38'588	39'495	39'752	38'913	40'244	40'600
CO_2 emissions (without LUCF)[6]	0	44'409	46'285	45'990	43'566	42'928	43'805	44'212	43'549	44'809	44'826
CH_4	0	5'080	5'100	5'050	5'004	4'917	4'896	4'830	4'762	4'661	4'567
N_2O	0	3'516	3'548	3'568	3'581	3'592	3'584	3'582	3'555	3'624	3'615
HFCs	0	NE	NE	NE	NE	NE	NE	NE	355	468	366
PFCs	0	NE	NE	NE	NE	NE	NE	NE	61	70	28
SF_6	0	NE	NE	NE	NE	NE	NE	NE	172	153	125
Total (with net CO_2 emissions/removals)	0	49'817	51'676	51'252	47'826	47'097	47'975	48'164	47'818	49'221	49'301
Total (without CO_2 from LUCF)[6]	0	53'005	54'933	54'607	52'151	51'437	52'285	52'624	52'454	53'786	53'527

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
1. Energy	0	40'569	42'808	42'832	40'614	39'814	40'803	41'615	40'957	42'297	42'279
2. Industrial Processes	0	3'471	3'142	2'843	2'653	2'836	2'727	2'325	2'900	3'001	2'863
3. Solvent and Other Product Use	0	108	110	112	114	117	119	119	120	120	121
4. Agriculture (3 years average)	0	6'032	6'042	5'984	5'942	5'846	5'806	5'733	5'654	5'541	5'443
5. Land-Use Change and Forestry[7] (3 years average)	0	-3'188	-3'257	-3'355	-4'325	-4'340	-4'310	-4'460	-4'636	-4'570	-4'226
6. Waste	0	2'826	2'831	2'836	2'828	2'824	2'830	2'831	2'823	2'827	2'822
7. Other	0	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

[6] The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

[7] Net emissions.

Documentation Box:

HFCs, PFCs, SF6: no consistent time series. Preliminary data for 1997 and 1998.

Agriculture values are 3 year averages; for 1999 in table Summary 2" instead there are one year values! That is the reason for the small differences in total CO_2 equivalent emissions for 1999 in table „Summary 2" and „10s5".

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) (Sheet 1 of 3)

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**44'834.34**	**-4'226.00**	**215.62**	**11.61**	**891.22**	**365.54**	**24.75**	**28.20**	**0.02**	**0.00**	**98.68**	**399.59**	**165.18**	**25.51**
1. Energy	**41'181.34**		**18.06**	**2.32**							**93.05**	**384.90**	**51.80**	**19.83**
A. Fuel Combustion — Reference Approach [2]	41'255.57													
A. Fuel Combustion — Sectoral Approach [2]	41'104.34		5.68	2.32							92.99	384.89	44.91	19.83
1. Energy Industries	1'125.93		0.07	0.003							1.11	0.29	0.04	1.18
2. Manufacturing Industries and Construction	5'499.13		0.40	0.04							9.86	16.59	0.46	5.18
3. Transport	15'315.63		2.31	2.09							56.09	243.43	31.39	2.13
4. Other Sectors	18'436.62		2.60	0.17							19.02	83.75	7.29	11.15
5. Other	727.04		0.31	0.02							6.91	40.82	5.72	0.19
B. Fugitive Emissions from Fuels	77.00		12.38	NO							0.06	0.01	6.89	NO
1. Solid Fuels	NO		NO	NO							NO	NO	NO	NO
2. Oil and Natural Gas	77.00		12.38	NO							0.06	0.01	6.89	NO
2. Industrial Processes	**2'246.00**		**0.43**	**0.31**	**891.22**	**365.54**	**24.75**	**28.20**	**0.020**	**0.004**	**0.32**	**11.30**	**7.81**	**3.35**
A. Mineral Products	2'100.00		0.02	NO							0.01	2.11	3.48	2.28
B. Chemical Industry	13.00		0.39	0.31	NO	NO	NO	NO	NO	NO	0.01	1.18	0.29	0.50
C. Metal Production	132.00		NE	NE				11.87		0.001	0.19	2.66	0.32	0.38
D. Other Production [3]	NO										NO	NO	NO	NO
E. Production of Halocarbons and SF_6						NO		NO		NO				
F. Consumption of Halocarbons and SF_6					891.22	365.54	24.75	16.33	0.020	0.003				
G. Other	1.00		0.02	NE	NO	NO	NO	NO	NO	NO	0.11	5.36	3.73	0.19

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.
A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as CO2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach. Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

(3) Other Production includes Pulp and Paper and Food and Drink Production.

Note: The numbering of footnotes to all tables containing more than one sheet continue to the next sheet. Common footnotes are given only once at the first point of reference.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A) (Sheet 2 of 3)

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**NO**			**0.39**							**0.04**	**0.09**	**104.40**	**0.04**
4. Agriculture	**NO**	**NO**	**134.55**	**8.27**							NO	NO	NO	NO
A. Enteric Fermentation			115.86											
B. Manure Management			18.69	1.35									NO	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] NO	[4] NO	NO	6.92									NO	
E. Prescribed Burning of Savannas			NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues			NO	NO							NO	NO	NO	
G. Other			NO	NO							NO	NO	NO	
5. Land-Use Change and Forestry	[5] **0.00**	[5] **-4'226.00**	**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -4'226.00												
B. Forest and Grassland Conversion	NO		NO	NO							NO	NO		
C. Abandonment of Managed Lands	[5] IE	[5] IE												
D. CO_2 Emissions and Removals from Soil	[5] NE	[5] NE												
E. Other	[5] NO	[5] NO	NO	NO							NO	NO		
6. Waste	**1'407.00**		**62.60**	**0.32**							**5.27**	**3.30**	**1.17**	**2.30**
A. Solid Waste Disposal on Land	[6] 134.00		60.88								0.55	0.95	0.72	0.03
B. Wastewater Handling			1.60	0.07							0.54	0.42	0.01	1.31
C. Waste Incineration	[6] 1'273.00		0.12	0.25							4.18	1.93	0.39	0.96
D. Other	NO		NO	NO							NO	0.002	0.05	NO
7. Other (please specify)	**0.00**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

[4] According to the IPCC Guidelines (Volume 3. Reference Manual, pp. 4.2, 4.87), CO2 emissions from agricultural soils are to be included under Land-Use Change and Forestry (LUCF). At the same time, the Summary Report 7A (Volume 1. Reporting Instructions, Tables.27) allows for reporting CO2 emissions or removals from agricultural soils, either in the Agriculture sector, under D. Agricultural Soils or in the Land-Use Change and Forestry sector under D. Emissions and Removals from Soil. Parties may choose either way to report emissions or removals from this source in the common reporting format, but the way they have chosen to report should be clearly indicated, by inserting explanatory comments to the corresponding cells of Summary 1.A and Summary 1.B. Double-counting of these emissions or removals should be avoided. Parties should include these emissions or removals consistently in Table8(a) (Recalculation - Recalculated data) and Table10 (Emission trends).

[5] Please do not provide an estimate of both CO2 emissions and CO2 removals. „Net" emissions (emissions - removals) of CO2 should be estimated and a single number placed in either the CO2 emissions or CO2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

[6] Note that CO2 from Waste Disposal and Incineration source categories should only be included if it stems from non-biogenic or inorganic waste streams.

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Memo Items:[7]														
International Bunkers	**4'520.00**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation	4'520.00		NE	NE							NE	NE	NE	NE
Marine	NO		NO	NO							NO	NO	NO	NO
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1'894.42**													

[7] Memo Items are not included in the national totals.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) (Sheet 1 of 1) Switzerland 1999 / Submission 2001

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**44'834.34**	**-4'226.00**	**215.62**	**11.61**	**891.22**	**365.54**	**24.75**	**28.20**	**0.020**	**0.004**	**98.68**	**399.59**	**165.18**	**25.51**
1. Energy	**41'181.34**		**18.06**	**2.32**							**93.05**	**384.90**	**51.80**	**19.83**
A. Fuel Combustion — Reference Approach[2]	41'255.57													
A. Fuel Combustion — Sectoral Approach[2]	41'104.34		5.68	2.32							92.99	384.89	44.91	19.83
B. Fugitive Emissions from Fuels	77.00		12.38	NO							0.06	0.01	6.89	NO
2. Industrial Processes	**2'246.00**		**0.43**	**0.31**	**891.22**	**365.54**	**24.75**	**28.20**	**0.020**	**0.004**	**0.32**	**11.30**	**7.81**	**3.35**
3. Solvent and Other Product Use	**NO**			**0.39**							**0.04**	**0.09**	**104.40**	**0.04**
4. Agriculture[3]	**NO**	**NO**	**134.55**	**8.27**							**NO**	**NO**	**NO**	**NO**
5. Land-Use Change and Forestry	**0.00**	[4] **-4'226.00**	**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
6. Waste	**1'407.00**		**62.60**	**0.32**							**5.27**	**3.30**	**1.17**	**2.30**
7. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:														
International Bunkers	**4'520.00**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
Aviation	4'520.00		NE	NE							NE	NE	NE	NE
Marine	NO		NO	NO							NO	NO	NO	NO
Multilateral Operations	**NO**		**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**1'894.42**													

P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.
A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as CO2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in document box of Table1.A(c). Where possible, the calculations using the Sectoral approach should be used for estimating national totals. Do not include the results of both the Reference approach and the Sectoral approach in national totals.

(3) See footnote 4 to Summary 1.A.

(4) Please do not provide an estimate of both CO2 emissions and CO2 removals. "Net" emissions (emissions - removals) of CO2 should be estimated and a single number placed in either the CO2 emissions or CO2 removals column, as appropriate. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

SUMMARY 2
SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)
Switzerland 1999 / Submission 2001

Greenhouse gas source and sink categories	CO_2 [(1)]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**40'608.34**	**4'528.11**	**3'600.10**	**365.54**	**28.20**	**125.31**	**49'255.60**
1. Energy	**41'181.34**	**379.16**	**719.61**				**42'280.12**
A. Fuel Combustion (Sectoral Approach)	41'104.34	119.29	719.61				41'943.24
1. Energy Industries	1'125.93	1.42	1.03				1'128.38
2. Manufacturing Industries and Construction	5'499.13	8.33	12.61				5'520.07
3. Transport	15'315.63	48.57	647.51				16'011.71
4. Other Sectors	18'436.62	54.55	51.64				18'542.81
5. Other	727.04	6.41	6.82				740.27
B. Fugitive Emissions from Fuels	77.00	259.88	NO				336.88
1. Solid Fuels	NO	NO	NO				NO
2. Oil and Natural Gas	77.00	259.88	NE				336.88
2. Industrial Processes	**2'246.00**	**8.97**	**96.72**	**365.54**	**28.20**	**125.31**	**2'870.73**
A. Mineral Products	2'100.00	0.38	NO				2'100.38
B. Chemical Industry	13.00	8.23	96.72	NO	NO	NO	117.95
C. Metal Production	132.00	NE	NE		11.87	23.90	167.77
D. Other Production	NO						NO
E. Production of Halocarbons and SF_6				NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6				365.54	16.33	101.41	483.27
G. Other	1.00	0.36	0.00	NO	NO	NO	1.36
3. Solvent and Other Product Use	**NO**		**120.90**				**120.90**
4. Agriculture (no 3 years average !)	**NO**	**2'825.49**	**2'562.74**				**5'388.22**
A. Enteric Fermentation		2'433.01					2'433.01
B. Manure Management		392.48	416.95				809.43
C. Rice Cultivation		NO					NO
D. Agricultural Soils [(2)]	NO	NO	2'145.79				2'145.79
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NO	NO				NO
5. Land-Use Change and Forestry [(1)]	**-4'226.00**	**NO**	**NO**				**-4'226.00**
6. Waste	**1'407.00**	**1'314.50**	**100.13**				**2'821.63**
A. Solid Waste Disposal on Land	134.00	1'278.48					1'412.48
B. Wastewater Handling		33.50	22.63				56.13
C. Waste Incineration	1'273.00	2.52	77.50				1'353.02
D. Other	NO	NO	NO				NO
7. Other (please specify)	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
							0.00
Memo Items:							
International Bunkers	4'520.00	NE	NE				4'520.00
Aviation	4'520.00	NE	NE				4'520.00
Marine	NO	NO	NO				NO
Multilateral Operations	NO	NO	NO				NO
CO_2 Emissions from Biomass	1'894.42						1'894.42

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
Land-Use Change and Forestry	CO_2 equivalent (Gg)					
A. Changes in Forest and Other Woody Biomass Stocks	0.00	-4'226.00	-4'226.00			-4'226.00
B. Forest and Grassland Conversion	NO		NO	NO	NO	NO
C. Abandonment of Managed Lands	IE	IE	IE			IE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE			NE
E. Other	NO	NO	NO	NO	NO	NO
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	0.00	-4'226.00	-4'226.00	NO	NO	-4'226.00

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [(a)]	53'481.60
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [(a)]	49'255.60

(1) For CO2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

2) See footnote 4 to Summary 1.A of this common reporting format.

(a) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Annex 2: Policies and measures – fact sheets

The following fact sheets give a brief overview of some of the most relevant contributions to climate policy at the federal level.

1 Law on the reduction of CO_2 emissions

Sector: **Energy (all)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Agency for the Environment, Forests and Landscape, CH-3003 Berne
phone: +41-31-322 93 11; contact person: Mrs. A. Burkhardt
email: climate@buwal.admin.ch; www.klima-schweiz.ch
Level of implementation: national

Brief description of measure or policy:
Law stipulates legally binding CO_2 reduction targets by 2010 compared to 1990: all fossil fuels 10 % reduction, combustibles 15 % reduction, transport fuels 8 % reduction. If (and only if) these targets seem unlikely to be met by negotiated voluntary agreements and other approved measures, a subsidiary CO_2 tax will be levied on fossil fuels from 2004 onwards. The maximum rate is fixed at 210 CHF per tonne of CO_2. By means of a CO_2 reduction commitment, energy intensive industries, big emitters and groups of emitters may be exempted from the tax.

Objective(s):
Swiss response and contribution to the challenge of climate change. Quantified reduction of CO_2 emissions from combustion of fossil fuels. Compatible with the Kyoto reduction commitment of Switzerland.

Schedule and status of implementation:
Law in force since 1 May 2000. Negotiations with representatives from economic, buildings and transport sector underway. First voluntary agreements expected to be signed at the end of 2001. Guidelines on voluntary measures by industry to reduce energy consumption and CO_2 emissions released in July 2001. Necessity for the CO_2 tax assessed on the basis of energy projections in 2002 taking into account declared voluntary action. Decision on the introduction of the tax by the federal council in 2003, approval of tax rate by parliament in 2004.

Indicator(s) of success or estimate of impact:
Periodically updated energy perspectives serve as a basis to determine the necessity to introduce the CO_2 tax at the appropriate rate. Number and importance of negotiated agreements will indicate success of voluntary phase.

Documentation available from the SAEFL, Economics and Climate Section, 3003 Berne:
- Federal law on the reduction of CO_2 emissions (CO_2 law), see: www.umwelt-schweiz.ch/buwal/eng/fachgebiete/co2
- Mesures librement consenties visant à réduire la consommation d'énergie et les émissions de CO_2 (industrie, artisanat, services), juillet 2001 (implementation guideline; other sectors forthcoming)
- Message relatif à la loi fédérale sur la réduction des émissions de CO_2, 1997

2 Energy law

Sector: **Energy (all)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. M. Beck
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national

Brief description of measure or policy:
The law allows the following measures to be implemented: establish procedures and energy consumption targets for appliances and vehicles, individual metering mandatory for heating and hot water, regulations on the connection to the electricity grid and for the buy-back tariff for electricity producers, encourage information and training courses related to energy savings, fund research and development, and demonstration projects, extensive co-operation with the private sector giving priority to voluntary measures as compared with regulations, fund cantons that have established programmes favouring energy efficiency and renewable forms of energy, assess whether supply can be met by renewable forms of energy, and whether there is a possibility of recovering heat when building a fossil fuel power plant.

Objective(s):
The aims of the energy law are to ensure a safe energy supply that is environmentally compatible and economically feasible, to secure the production and delivery of a sufficient amount of energy under optimal economic and environmental conditions, to contribute to rational and efficient use of energy and to encourage domestic and renewable energy sources.

Schedule and status of implementation:
Implemented since 1998

Indicator(s) of success or estimate of impact:
Energy demand is measured by ex post analysis of energy perspectives and by specific monitoring activities within the 'SwissEnergy' action plan.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- Energy policies of Switzerland 1999 review, OECD/IEA 1999
- periodic ex post analyses of energy consumption (German only)

3 ‚SwissEnergy' action plan

(formerly ‚Energy 2000' action plan)

Sector: **Energy (all)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. G. Schriber
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national, regional

Brief description of measure or policy:
The action plan implements extensive co-operation with the cantons and the private sector. Voluntary agreements with private energy agencies and organisations, funding measures favouring energy savings and renewables, promoting renewable energy, research, training courses and dissemination of information are the main tasks of the action plan. There are the four main topics buildings, economy, transport, and renewable forms of energy and energy efficiency (see fact sheets 3.1 - 3.4).

Objective(s):
10 % reduction in the consumption of fossil fuels between 2000 and 2010. Reduction in CO_2 emissions of 10 % by 2010 compared with 1990. Increase of less than 5 % in electricity consumption; increase of 3 TWh (= 3 % of total heat production) in renewable heat production and 0.5 TWh (= 0.8 % of overall electricity production) in renewable electricity production (2000 to 2010).

Schedule and status of implementation:
‚SwissEnergy' started in 2001 and followed on from the ‚Energy 2000' action plan.

Indicator(s) of success or estimate of impact:
The previous ‚Energy 2000' action plan saved 4.6 % of total energy consumption, and induced the production of 2 TWh (= 2 % of total heat production) of heat from renewable sources, and 0.4 TWh (= 0.6 % of overall electricity production) of electricity from renewable sources.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- SwissEnergy - The programme following on from Energy 2000, Swiss Federal Office of Energy, 2001, (also in German and French; also see: www.swiss-energy.ch)
- Final Report on the ‚Energy 2000' action programme and 10th Annual Report, April 2001 (also in German and French)

3.1 'SwissEnergy' Action Plan — Buildings

Sector: **Energy (small scale combustion)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. M. Stettler
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: regional

Brief description of measure or policy:
The cantons are the main actors for efficient energy use in buildings. Their action is ensured by the energy laws of the cantons. The energy laws regulate the permitted heating of buildings, which is developed by the standards of the Association of Swiss Engineers and Architects. The measurements are co-ordinated in co-operation between the cantons and the federal authorities. The 'Minergie' standard is used to promote energy efficient buildings in the public and private sectors.

Objective(s):
Implementation of new technologies for efficient energy use in buildings as early as possible.

Schedule and status of implementation:
Implemented in general. Constant adaptation of measures to new technologies and new standards.

Indicator(s) of success or estimate of impact:
The activities within the previous 'Energy 2000' action plan saved about 2 to 3 % of annual energy consumption in the building sector. The 'Minergie' label, which is awarded to buildings with very good insulation, has been very successful.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- SwissEnergy – The programme following on from Energy 2000, Swiss Federal Office of Energy, 2001, (also in German and French; see also: www.swiss-energy.ch)
- Final Report on the Energy 2000 Action Programme and 10th Annual Report, April 2001 (also in German and French)

3.2 'SwissEnergy' Action Plan — Economy

Sector: **Energy (industry/ commercial services)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. A. Mörikofer
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national

Brief description of measure or policy:
The private 'Energy Agency of the Trade and industry' is the main partner of federal offices to decrease energy use and CO_2 emissions in industry and commercial services, by means of voluntary agreements. Groups of companies, and companies with high energy consumption agree their future energy savings and reporting procedures with the federal authorities. They are themselves responsible in defining the ways how they reach the reduction goals. If the targets are not met, the companies will have to pay the future CO_2 tax. The exchange of know-how and individual measures by companies to achieve the objectives support this measure.

Objective(s):
Decrease energy consumption and CO_2 emissions in the business sector according to voluntary agreements.

Schedule and status of implementation:
The implementation of the corresponding energy and CO_2 laws is ongoing. In spring 2001 the negotiations on the agreements were underway. See also fact sheet no.1 (Law on the reduction of CO_2 emissions).

Indicator(s) of success or estimate of impact:
Industry is showing interest in signing agreements.
The previous 'Energy 2000' action plan saved about 5 to 6 % of annual energy consumption in the industrial and commercial services sector.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- SwissEnergy – The programme following on from Energy 2000 , Swiss Federal Office of Energy, 2001, (also in German and French; see also: www.swiss-energy.ch)
- Final Report on the Energy 2000 Action Programme and 10th Annual Report, April 2001 (also in German and French)

3.3 'SwissEnergy' Action Plan — Mobility

Sector: **Transport**
GHGs mainly affected: **CO_2, precursors**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. H. Scherrer
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national

Brief description of measure or policy:
Several measures support the efforts to decrease energy consumption by transport. These include promoting environmentally efficient ways of driving, which means fuel savings of up to 15 % (EcoDrive®), supporting the Mobility car sharing programme and promoting human powered vehicles. In addition, regulations relating to the energy efficiency of new cars may be introduced if voluntary approaches do not succeed.

Objective(s):
Decrease fuel consumption despite the expected increase in traffic.

Schedule and status of implementation:
In general implemented, institutional strengthening underway.

Indicator(s) of success or estimate of impact:
The previous 'Energy 2000' action plan saved about 2 % of annual fuel consumption in the transport sector. The Mobility car sharing programme involves over 40,000 users and is currently based on 1,450 cars and 900 locations in 350 municipalities.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- SwissEnergy –The programme following on from Energy 2000 , Swiss Federal Office of Energy, 2001, (also in German and French; see also: www.swiss-energy.ch)
- Final Report on the Energy 2000 Action Programme and 10th Annual Report, April 2001 (also in German and French) see also: www.mobility.ch

3.4 'SwissEnergy' Action Plan — Renewable Energy

Sector: **Energy (all)**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. H. U. Schärer
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national

Brief description of measure or policy:
Promotion of biomass, ambient heat, solar energy, wind, geothermal energy and small hydropower plants in collaboration with the private 'Agency for Renewable Energy and Energy Efficiency', and networks in these fields. The Federal Office of Energy supports the players in many ways such as developing and implementing quality management, overall marketing, financial contribution to training courses, research and development funds.

Objective(s):
By 2010, increase renewable heat production by 3 TWh (= 3 % of total heat production) and renewable electricity production by 0.5 TWh (= 0.8 % of overall electricity production, compared to 2000).

Schedule and status of implementation:
Implementation ongoing.

Indicator(s) of success or estimate of impact:
The previous 'Energy 2000' action plan induced the production of 2 TWh (= 2 % of total heat production) of renewable heat and 0.4 TWh (= 0.6 % of overall electricity production) of renewable electricity. For renewable electricity production, the goals were exceeded, and for heat they were 70 % attained.

Documentation available from Swiss Federal Office of Energy, 3003 Berne:
- SwissEnergy – The programme following on from Energy 2000 , Swiss Federal Office of Energy, 2001, (also in German and French; see also: www.swiss-energy.ch)
- Final Report on the Energy 2000 Action Programme and 10th Annual Report, April 2001 (also in German and French)

4 Distance-related heavy vehicle fee (HVF)

Sector: **Transport**
GHGs mainly affected: **CO_2, precursors**

Relevant federal authority:
Federal Office of Spatial Development, CH-3003 Berne
phone: +41-31-322 55 57; contact person: Mr. Ch. Albrecht
e-mail: christian.albrecht@are.admin.ch; www.are.admin.ch
Level of implementation: national (Swiss Customs Authority)

Brief description of measure or policy:
The distance-related heavy vehicles fee is calculated on the basis of
- the kilometres driven
- the maximum weight of the vehicle permitted
- the emission class of the vehicle.

Since 1 January 2001, the distance-related fee has replaced the previous flat rate fee, which did not comply with the polluter pays principle.

Objective(s):
True cost (including external costs) of heavy vehicles (more than 3.5 tonnes) leading to the use of less greenhouse gas emitting heavy vehicles.
Schedule and status of implementation: The HVF was introduced in January 2001. With the opening of the first of the two new railway tunnels under the Alps in 2006-7, the fee will rise; at the same time, the weight limit allowed will be adapted to EU standards. Increases in the fee are also planned for 2010 and finally in 2015 after the opening of the second new railway tunnel.

Indicator(s) of success or estimate of impact:
The HVF is expected to lead to a reduction in the CO_2 emissions from heavy vehicles of about 18 to 22 % from 2005, and about 21 to 25 % in 2015 (the railway measures imply the modernisation of infrastructure, reform of the railways and associated measures). A specific monitoring project has been installed. The development of HGV traffic in the first half year of implementation of the fee is according to forecasts. The full impact of the HVF is best appreciated in combination with the modal split measures (see fact sheet no.5 on “Modal split measures”).

Documentation available from the Federal Office of Spatial Development, 3003 Berne:
- HVF – in concrete terms, Swiss Customs Authority, Berne, 2000
- Fair and efficient, the distance-related heavy vehicle fee (HVF) in Switzerland, Bureau for Transport Studies, DETEC, Berne, 2000
- Through the Alps, transalpine freight traffic by road and rail, Federal Office for Spatial Development, Berne, 2001
- Message relatif à une loi fédérale concernant la redevance sur le trafic des poids lourds liée aux prestations, Berne, 1996
- Message relatif à l’approbation des accords sectoriels entre la Suisse et l’UE, Berne, 1999
- Federal Office of Transport: Swiss Traffic no. 12, Berne, June 1999
- Die verkehrlichen Auswirkungen des bilateralen Landverkehrsabkommens zwischen der Schweiz und der Europäischen Union auf den Strassen- und Schienengüterverkehr (summary in French), GVF-Bericht 2/99, Bureau for Transport Studies, Federal Department of Environment, Transport, Energy and Communications (DETEC), Berne, June 1999

5 Modal split measures

Sector: **Transport**
GHGs mainly affected: **CO_2, precursors**

Relevant federal authority:
Federal Office of Transport, CH-3003 Berne; phone: +41-31-322 57 11; contact person: E. Maillefer; www.bav.admin.ch/index_e.cfm; Level of implementation: national

Brief description of measure or policy:
A change in modal split favouring rail transport is encouraged by the following main instruments of transport policy:
- the distance-related heavy vehicle fee (HVF), see previous fact sheet no.4
- the modernisation of the railway infrastructure (New Rail Link through the Alps) and
- specific economic instruments such as financial contributions to combined transport solutions (rolling motorway and non accompanied combined transport).

Objective(s):
Transfer of as much transalpine heavy goods traffic from road to rail as possible, leading to reductions in greenhouse gas emissions from HGVs. The law fixes the aim of allowing a maximum of 650,000 heavy goods vehicles per year crossing the Alps by road, at the latest two years after the opening of the first of the two new rail tunnels.

Schedule and status of implementation:
1994: acceptance of the Alpine protection initiative, constitutional mandate 1999: railways reform came into force 2001: Federal law on the transfer of transalpine goods traffic to rail and supporting measures come into force 2001: HVF comes into force 2006/7: opening of the first New Rail Link through the Alps 2012 opening of the second New Rail Link through the Alps

Indicator(s) of success or estimate of impact:
The frequencies of the HGV crossing the Alps have been periodically monitored. In addition, a specific monitoring report is requested by the law every two years. The first assessments do not show major changes yet as HGV traffic is still increasing. At the same time combined transport shows high frequencies and loading factors. In 2000, 1.4 million HGVs have crossed the Alps by road.

Documentation available from the Federal Office of Transport, 3003 Berne:
- Transportation: yesterday, today, tomorrow, Bureau for Transport Studies, Federal Department of the Environment, Transport, Energy and Communications, Berne, 1998
- Message sur la construction de la ligne ferroviaire suisse à travers les Alpes du 23 mai 1990, Berne, 1990
- Message sur la réforme des chemins de fer du 13 novembre 1996, Berne, 1996
- Message sur la construction et le financement des infrastructures des transports publics du 26 juin 1996, Berne, 1996
- Message relatif à l’apporbation des accords sectoriels entre la Suisse et la CE du 23 juin 1999 (Loi fédérale du 8 octobre 1999 visant à transférer sur le rail le trafic de marchandises à travers les Alpes ou Loi sur le transfert du trafic), Berne, 1999
- Fair and efficient, the distance-related heavy vehicle fee (HVF) in Switzerland, Bureau for Transport Studies, Federal Department of the Environment, Transport, Energy and Communications (DETEC), Berne, 2000
- Grenzquerender Strassengüterverkehr 1998 (including French summary), GVF
- Auftragsbericht Nr.317, Bureau for Transport Studies, DETEC, Berne, 2000

6 Increase and protection of forest area; sustainability in forest management

Sector: **Forestry**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Forest Agency, SAEFL, CH-3003 Berne
phone: + 41-31-324 77 86; contact person: Mr. R. Volz
e-mail: richard.volz@buwal.admin.ch; www.buwal.ch/forst/facts/facts_f.htm
Level of implementation: national

Brief description of measure or policy:
Any surface covered by trees or woody shrubs, regardless of their use or origin, is defined as woodland. New, naturally established tree or shrub cover on abandoned land is legally treated as woodland after twenty years of growth. The forested area must not be reduced. Deforestation is prohibited. In the case of exceptions, an equal compensation area located in the same region is compulsory. Forests must be managed in a sustainable manner. Their ability to perform their protective, economic and social functions must be ensured. For reasons of adaptation and biodiversity, natural regeneration has first priority in forest management, afforestation and reforestation.

Objective(s):
Increase or at least maintain the forested area, thereby increasing or maintaining carbon stocks.

Schedule and status of implementation:
1878: 1st forest law for mountainous regions protecting the forest area, sustainability principle in timber use. Beginning of large afforestations.
1902: 2nd forest law for the whole country protecting the forest area, principle of sustainability in the use of timber. Pursuit of afforestation.
1993: Entry into force of new federal law on forests; sustainability was extended to all forest functions. Funds were made available for subsidies according to the new principles.

Indicator(s) of success or estimate of impact:
Increase in forest area between 1890 and 1990: 369,000 hectares. (1890: 825,000 hectares; 1990: 1,194,000 hectares.) Increase in growing stock (volume of live trees): about 235 million m^3. (1890: about 130 million m^3; 1990: about 365 million m^3). Between the two national forest inventories of 1985 and 1995, the area increased by 47,600 hectares (4.0 per cent). Over the same period, the standing volume increased from 387 million to 404 million m^3.

Documentation available from the SAEFL, 3003 Berne:
- Sustainable development of Switzerland's forests. Swiss Agency for the Environment, Forests and Landscape. Berne 1995
- Criteria and Indicators for Sustainable Forest Management in Switzerland. Swiss Agency for the Environment, Forests and Landscape. Berne 1997
- Forest and Hunting Legislation in Switzerland as of 1 August 1996
- Mahrer, F. et al.: Inventaire forestier national suisse. Résultat du premier inventaire 1982-1986. Institut fédéral de recherches forestières, Birmensdorf 1990
- Brassel, P. and U.-B. Brändli (ed.): Inventaire forestier national suisse. Résultat du deuxième inventaire 1993-1995. Berne 1999

7 Greenhouse gases in agriculture

Sector: **Agriculture**
GHGs mainly affected: **CH_4, N_2O**

Relevant federal authority:
Swiss Federal Office for Agriculture, CH-3003 Berne
phone: +41-31-322 25 69; contact person: Mr. H. Haenni
e-mail: heinz.haenni@blw.admin.ch; www.blw.admin.ch/e/index.htm
Level of implementation: national

Brief description of measure or policy:
The agriculture policy reform is based on measures on three different levels: - Research, Education, Consulting - Incentives - Regulatory means Over the last ten years, the focus has been on the creation of economic incentives (direct payments) that serve ecological ends. These are supported by conventional regulatory means.

Objective(s):
Promote ecological practices on farms to reach set aims in agricultural ecology. For example: Reduction of nutrient losses by limiting animal numbers to the land available for manuring (balanced fertiliser accounts) with effects on emissions of methane and nitrous oxide, also water protection and soil management.

Schedule and status of implementation:
Implementation started in 1993. Since 1999, every farm that wishes to receive direct payments of any kind has to prove that it satisfies the ecological criteria required by the law.

Indicator(s) of success or estimate of impact:
Reduced nitrogen and methane fluxes in agriculture; Reduced phosphorus load/reserves in agricultural soils in the catchment basins of Swiss lakes (prevention). In 2001, over 90 per cent of all farms meet the requirements to receive direct payments.

Documentation available from the Swiss Federal Office for Agriculture, Staff Position Ecology, 3003 Berne:
- Report on "Methane Emissions in Swiss Agriculture" (Methanemissionen der schweizerischen Landwirtschaft, including English summary)
- Report on "N_2O Emissions in Swiss Agriculture" (Lachgasemissionen der Schweizer Landwirtschaft, including English summary)

8 Law on the electricity market

Sector: **Energy conversion**
GHGs mainly affected: **CO_2**

Relevant federal authority:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. M. Renggli
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Level of implementation: national

Brief description of measure or policy:
The federal law on the electricity market contains some regulations on renewable forms of energy. The law gives the possibility of indicating the means of electricity production to the customer, of providing federal loans for the modernisation and maintenance of existing hydropower plants and of the use of the electricity grid free of charge for renewable plants with less than 1 MW (0.5 MW for hydropower) capacity.

Objective(s):
By means of these regulations, the competitiveness of electricity from renewable sources is to be improved. The large contribution of hydropower to electricity production (61 % in 1999) is to be maintained and electricity production through new renewable techniques is to be increased.

Schedule and status of implementation:
Adopted by parliament in December 2000. Due to a national referendum, with signatures collected mainly from electricity trade unions, there will be a plebiscite in 2002. If the law is adopted by the population it will be implemented thereafter.
Indicator(s) of success or estimate of impact: To be determined.

Documentation available from the Swiss Federal Office of Energy, 3003 Berne:
- Loi sur le marché d'éléctricité de 15. décembre 2000, Swiss Federal Office of Energy (in German, French and Italian)
- Message concernant le loi sur le marché d'éléctricité, Swiss Federal Office of Energy, 1999 (in German, French and Italian) see also www.swiss-energy.ch: Fact sheets on the law on the electricity market (in German, French and Italian)

9 Ecological tax reform

Sector: **Energy (all)**
GHGs mainly affected: **CO_2**

Relevant federal authorities:
Swiss Federal Office of Energy, CH-3003 Berne
phone: +41-31-322 56 11; contact person: Mr. P. Previdoli
e-mail: office@bfe.admin.ch; www.swiss-energy.ch
Swiss Federal Finance Administration, CH-3003 Bern
phone: +41-31-322 60 11
Level of implementation: national

Brief description of measure or policy:
In the long term, the Swiss government plans an ecological tax reform, decreasing labour taxes and increasing environmental taxes at the same time without increasing national budget.

Objective(s):
The ecological tax reform plans an energy levy on non-renewable fuels. The revenues will be used to reduce wage costs. This should decrease energy consumption and increase employment.

Schedule and status of implementation:
Due to the negative result of a referendum on an energy levy and an energy promoting tax in September 2000, there is no specific action on this issue at present. Nevertheless is planned that a report for the government will be prepared by the end of 2003.

Indicator(s) of success or estimate of impact:
For the referendum in autumn 2000, studies were done on the impacts of an energy levy. The proposed taxes would have had only a small negative effect on the economy (0.6 % reduction in GDP for 2010) and a positive effect on energy consumption (9 % reduction in total energy consumption relative to a trend development).

Documentation available from the SAEFL, 3003 Berne:
- Sustainable development in Switzerland, Strategy, 1997
- Le développement durable en Suisse, Document intermédiaire du Conseil fédéral, 2000

Abbreviations

AUT	Austria
billion	US billion i.e. thousand million
BSRN	Baseline Surface Radiation Network
CFCs	chlorofluorocarbons
CHARM	Swiss Atmospheric Radiation Network
CH_4	methane
CHE	Switzerland
CHF	Swiss francs
CIS	Commonwealth of Independent States
CO	carbon monoxide
CO_2	carbon dioxide
COP	Conference of the Parties
CORINAIR	Coordination d'information environnementale projet partiel air
COST	European Cooperation in the Area of Scientific and Technical Research
EMPA	Swiss Federal Laboratories for Materials Testing and Research
ETH/ETHZ	Swiss Federal Institute of Technology Zurich
EURATOM	European Atomic Energy Community
EUREKA	European Research Coordination Agency
FOE	Swiss Federal Office of Energy
FOMC	Swiss Federal Office of Meteorology and Climatology
FOS	Swiss Federal Office of Statistics
FOWG	Swiss Federal Office for Water and Geology
FRA	France
GATT	General Agreement on Tariffs and Trade
GAW	Global Atmosphere Watch
GAW-WCC	GAW-World Calibration Centre
GAW-WORCC	GAW-World Optical depth Research and Calibration Centre
GCOS	Global Climate Observing System
GDP	gross domestic product
GEF	Global Environment Facility
GER	Germany
Gg	gigagram (1,000 tonnes)
GHG	greenhouse gas
GNP	Gross National Product
GOOS	Global Ocean Observing System
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network - Glaciers
GTN-P	Global Terrestrial Network - Permafrost
GTOS	Global Terrestrial Observing System
GUAN	GCOS Upper Air Network
GWP	Global Warming Potential
HFCs	hydrofluorocarbons
HGV	heavy goods vehicle
HVF	Heavy Vehicle Fee
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
MeteoSwiss	Federal Office of Meteorology and Climatology
NCCR	National Competence Centre of Research
NDSC	Network for the Detection of Stratospheric Change
NGO	non-governmental organisation
NMVOC	non-methane volatile organic compound
NO_x	oxides of nitrogen
N_2O	nitrous oxide
OECD	Organisation for Economic Cooperation and Development
O_3	ozone
PACE	Permafrost and Climate in Europe
p.a.	per annum
PFCs	perfluorocarbons
PJ	Petajoule
PMOD/WRC	World Radiation Centre
ProClim-	Swiss Forum for Climate and Global Change
PSI	Paul Scherrer Institute
SAEFL	Swiss Agency for the Environment, Forests and Landscape
SDC	Swiss Agency for Development and Cooperation
SF_6	sulphur hexafluoride
SINGADS	Synthesis of Integrated Global Aerosol Data Sets
SLF	Swiss Federal Institute for Snow and Avalanche Research
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
WDCA	World Data Centre for Aerosol (GAW, Italy)
WDCGG	World Data Centre for Greenhouse Gases (GAW, Japan)
WGMS	World Glacier Montoring Service (GTN-G)
WMO	World Meteorological Organisation
WSL	Swiss Federal Institute for Forests, Snow and Landscape Research
www	World Wide Web