> Swiss climate policy at a glance

Status and perspectives on the basis of Switzerland's 2014 report to the United Nations Climate Change Secretariat

Schweizerische Eidgenossenschaft
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– The FOEN's online-offers regarding Switzerland's climate policy: www.bafu.admin.ch/climate

> Foreword

Switzerland's share of global greenhouse gas emissions amounts to just 0.1 percent. With the economic growth in China, India, Brazil and other emerging economies, this percentage is steadily decreasing. Even if one holds Switzerland jointly responsible for emissions due to the goods that it imports from abroad, our reduction possibilities in terms of the global challenge are modest. Should Switzerland nevertheless pursue a committed climate policy?

From my point of view, two reasons speak in favour of a commitment. First, Switzerland not only contributes to climate change, but is also affected by it. We can dismiss the melting of glaciers as an aesthetic concern for nostalgic people and even assure our grandchildren that there are technical solutions for dealing with dry creek beds and heat waves. But, if in a few decades crop failures become common and natural disasters that cripple the production and transport structures of our foreign trading partners become more frequent, we cannot be indifferent. Switzerland – like all other countries – relies on finding solutions at national and international levels to keep the effects of climate change within acceptable limits.

The second reason for our commitment is that Switzerland as an economically advanced country has influenced the spread of an energy and resource-wasting lifestyle with high greenhouse gas emissions. It is thus up to us and other industrial countries to show that we can convert to a climate-friendly economic and social organisation, while maintaining a high quality of life.

Switzerland has met its obligations under the Kyoto Protocol of 1997, as this brochure and the underlying comprehensive report to the UN prove. It is also one of the countries that in 2012 committed to reducing their greenhouse gas emissions by 20 percent by 2020. We must redouble our efforts if we also want to meet this commitment.

Karine Siegwart
Vice Director of the Federal Office for the Environment (FOEN)

Milestones 2009–2013

	Climate policy	Climate research	Development of the climate
2008	The first commitment period of the Kyoto Protocol (2008–2012) begins The CO_2 levy on thermal fuels (12 fr. per tonne CO_2; 3 ct. per litre of heating oil) is introduced Emissions trading begins in Switzerland	The Centre for Climate Systems Modeling C2SM (ETH Zurich) is founded	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 385.3 ppm
2009		The FOEN and WSL launch the research programme “Forestry and Climate Change” Third World Climate Conference in Geneva: The “Global Framework for Climate Services” is established	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 386.7 ppm 2009: Globally the sixth warmest year since measurement began; in Switzerland, the seventh warmest year
2010	The Confederation and the cantons launch the buildings programme The CO_2 levy on thermal fuels rises to 36 fr. per tonne CO_2 (9.5 ct. per litre of heating oil) UN Climate Conference in Cancún (Mexico): Limiting global warming to 2 degrees is recognized as target	The National Research Programme “Sustainable Water Management” (NRP 61) is launched	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 388.2 ppm 2010: Globally the warmest year since measurement began
2011	Negotiations for linking Swiss-EU Emissions Trading Schemes are initiated	Swiss Climate Change Scenarios CH2011 are published The first risk analyses on the impact of climate at a regional level are started	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 391.0 ppm 2011: the warmest year in Switzerland since measurement began
2012	The Federal Council adopts the first part of the strategy “Adaptation to climate change” UN Climate Conference in Doha: A group of countries incl. Switzerland commit to continue the Kyoto Protocol until 2020 The first commitment period of the Kyoto Protocol ends	The project “Climate Change and Hydrology in Switzerland” is established	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 392.9 ppm
2013	The revised CO_2 Act and CO_2 Ordinance enter into force: new reduction target –20 % by 2020 The Confederation invites bids for pilot projects for adaptation to climate change	The National Centre of Competence in Research Climate (NCCR Climate) concludes its activities Part I of the IPCC’s Fifth Assessment Report is adopted: “Human influence on the climate system is clear.”	The CO_2 concentration in the atmosphere (Mauna Loa) reaches 395.3 ppm 2013: Globally the sixth warmest year since measurement began
2014	The CO_2 levy on thermal fuels is increased to 60 fr. per tonne CO_2 (16 ct. per litre of heating oil) The Federal Council adopts the second part of the strategy “Adaptation to climate change”		The CO_2 concentration in the atmosphere (Mauna Loa) reaches 397.5 ppm

> Climate Policy Interim Results: The Key Points in Brief

As a Member State to the Convention on Climate Change, Switzerland is required to account periodically on the implementation of its commitments. In early 2014, it reported to the UN and reviewed its climate policy at the national level.

In 1997 in the Kyoto Protocol, a supplementary treaty to the Convention on Climate Change, binding reduction targets were negotiated by all Member States. The agreed targets applied to average values for the period 2008 to 2012. Switzerland committed itself to reducing its greenhouse gas emissions by 8 % as compared with 1990 levels. Contributions to reductions achieved abroad and the performance of forests as CO_2 sinks could be taken into account.

Switzerland implemented its Kyoto target within the framework of the CO_2 Act: by reducing CO_2 emissions from thermal and motor fuels by 10 %, a simultaneous reduction of 8 % in the total volume of Switzerland's greenhouse gas emissions, which was just under 53 million t CO_2eq in 1990, was planned.

Data are now available to enable a review of the attainment of targets. Both, the target set by the Kyoto Protocol and the overall target of the CO_2 Act, have been met. The partial targets for thermal and motor fuels of the CO_2 Act – which are more ambitious than the overall target – were, however, just missed.

Thanks to its climate, energy and transport policy measures, Switzerland has managed to stabilize its greenhouse gas emissions at the 1990 level. Given the economic growth and population increase that occurred in the same period, this result can be considered a success. Without the efforts made so far, emissions today would be around 4.5 million t CO_2eq higher than in 1990.

The measures taken at the national level alone, however, would not have been sufficient to meet the reduction targets. The CO_2 Act and the Kyoto Protocol also envisioned that foreign emission reduction certificates and the effect of the forest as a CO_2 sink could be used to meet targets. Switzerland used these opportunities and thereby improved its emissions balance by around 4.7 million t CO_2.

To prevent dangerous interference with the climate system and restrict global warming to 2 degrees, all countries must fulfil their responsibilities and contribute to a significant turnaround in emissions. Switzerland also cannot be content with a stabilisation of its emissions. It meets this challenge with the fully revised CO_2 Act, which entered into force in early 2013. Additional instruments thus are available: on the one hand, to further reduce Switzerland's greenhouse gas emissions, on the other hand, to ensure that the Confederation has a coordinated approach in dealing with the effects of climate change.

The new CO_2 Act is attuned to the second phase of international climate policy: after no consensus over a successor agreement was reached at the UN climate conferences, Switzerland, with the EU and six other countries, decided in 2012 to continue the Kyoto Protocol. It thus undertook to reduce its emissions by 20 % as compared with 1990 levels by 2020.

The climate scenarios, impact studies and risk analyses recently developed in Switzerland also show that the consequences of climate change cannot be disregarded. Only the rough contours of the consequences of higher temperatures and changing precipitation for society, the economy and nature are apparent today. But the current state of knowledge makes it clear that in the coming decades – especially from the middle of the 21st century – noticeable effects can be expected. The Confederation, cantons and communes must take these into account at an early stage when formulating their long-term strategies and plans.

> Greenhouse Gas Emissions: Zero Growth as Success

Population numbers and economic production in Switzerland have shown strong growth since 1990. Today people are more mobile and consume significantly more than they did 25 years ago. Greenhouse gas emissions nevertheless have successfully been stabilised.

The average volume of **greenhouse gases** emitted in Switzerland for the years 2008–2012 was roughly 52 million t CO_2eq. Over this period the transport sector was by far the biggest polluter, with a share of over 31 %. The industry sector accounted for 21 % of emissions and the household sector accounted for almost the same amount at 20 %. The agriculture sector contributed about 12 % to total emissions. The services sector produced another 9 % of total emissions and waste management was responsible for the remaining 7 % (Fig. 1).

In comparing the various individual greenhouse gases, carbon dioxide (CO_2) was clearly at the top with approximately 84 % of total emissions in 2012. In second place came methane (CH_4) at 7 %, followed closely by nitrous oxide (N_2O) at just under 6 % of the total. The remaining approximately 3 % are divided among the synthetic gases (HFC, PFC, SF_6), of which the largest share of emissions were caused by hydrofluorocarbons, primarily used as refrigerants. To make the greenhouse gases comparable to each other, the emissions are converted into **CO_2 equivalent (CO_2eq)** (Fig. 2).

Is the glass half-empty or half-full?

At first glance, the progression of emissions observed in Switzerland since 1990 is sobering: In order to curb the advancement of climate change, significant reductions are necessary, but no clear signs of a reversal in the emissions trend are apparent.

If the progression of emissions over the last 25 years is compared with the economic and population growth, however, the judgement is less harsh. These two parameters influence energy consumption for production and consumption,

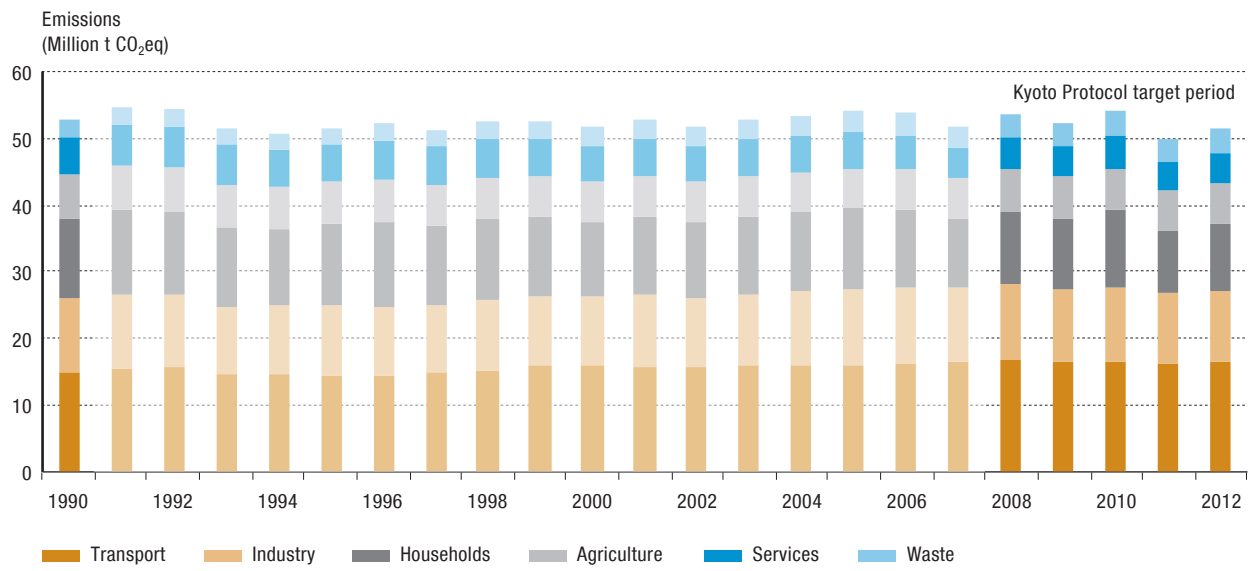

Fig. 1 *Development of total emissions by source 1990–2012. Emission-increasing and -reducing factors since 1990 maintain an equilibrium.*

traffic volumes and the number of heated buildings, which strongly impacts emissions in almost all sectors.

Compared to 1990, in 2012, Switzerland's real gross domestic product (GDP) as a measure of economic output rose by 36 %, the building space that had to be heated increased by 31 %, over 36 % more passenger cars were in circulation on Swiss roads and 19 % more people lived in Switzerland. Greenhouse gas emissions in this period nevertheless remained stable: new buildings are better insulated than in the past, cars have become more fuel efficient, more natural gas and electricity (e.g., for heat pumps) is in use and less heating oil. The trend away from petrol- to diesel-powered passenger cars also tended to a reduction in CO_2 emissions.

Varying development of the sectors

But the emissions trend has not been the same in all sectors. While emissions from the household sector in the years 2008–2012 decreased by almost 12 % on average as compared with 1990 levels and that of the services sector by a good 16 %, the transport sector recorded an increase of over 11 %. Emissions from agriculture fell by 8 %, while those of the industry sector declined by 2 %. Emissions from the waste management sector have increased by nearly 30 %.

The industry sector had a lesser decline than the services and household sectors because this sector includes synthetic greenhouse gases. Without these gases, a decrease of 16 % would have been observed even in the industry sector. The volume of synthetic gases has significantly increased, mainly because the ozone-depleting CFC gases have been replaced by chlorine-free HFC gases.

Smaller numbers of livestock and the reduced use of fertilizers are primarily responsible for the decrease in emissions from agriculture. Here climate protection benefited from the efforts of the policy favouring more natural animal husbandry and soil management. The increase in emissions from the waste-management sector is primarily due to an increase in the quantity of waste being incinerated (with the ban on landfill). Since waste heat from waste incineration plants is used, fossil thermal fuels in other sectors can be saved.

Several factors have contributed to the stabilisation of greenhouse gas emissions. Without growing political and public awareness of the urgency of climate protection, its progression today would still be shaped by economic and population growth. The Convention on Climate Change adopted in 1992 and the Kyoto Protocol of 1997 were important milestones in this learning process.

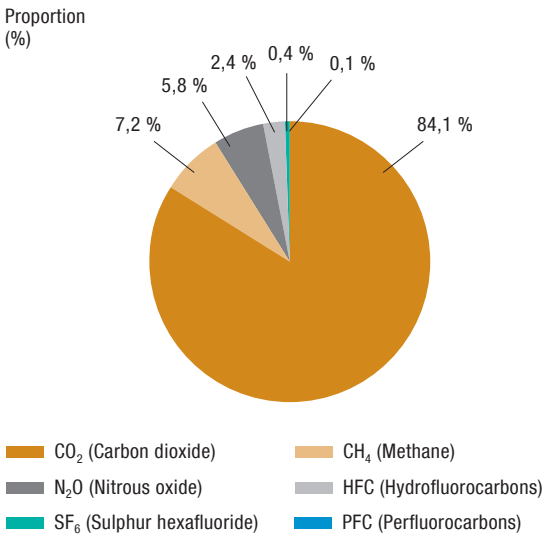

Fig. 2 *Proportions of the various greenhouse gases of total emissions 2012. As compared to CO_2, the other gases are of minor significance.*

Climate Glossary I

Greenhouse gases are gases in the atmosphere that reduce the reflection of heat from the earth's surface into space. Since the beginning of industrialisation (around 1750), their concentration has increased due to human activities – primarily the combustion of oil, coal and natural gas as well as the clearing of forests.

CO_2 equivalent (CO_2eq): The various greenhouse gases contribute to global climate change in varying degrees. CO_2 (equivalent value 1) serves as a reference. To compare and aggregate the effects of gases, they are converted into the equivalent quantity of CO_2 (CO_2eq). Example: 1 kg methane (CH_4) corresponds to 21 kg CO_2eq because the warming effect of this gas is 21 times that of CO_2 (equivalent value valid through 2012; from 2013, values revised, e.g., for methane = 25).

> A Broad Mix of Measures: Reduction Targets Achieved

Thanks to domestic measures, emission reduction certificates from projects abroad, and the carbon-sink effect of forests, Switzerland has met its reduction targets under the CO_2 Act and the Kyoto Protocol for the period 2008–2012.

With the ratification of the Kyoto Protocol in July 2003, Switzerland undertook to reduce its average greenhouse gas emissions in the years 2008–2012 by 8 % as compared with 1990 levels. The goal was to meet the reduction target primarily through domestic measures. In addition, there was the opportunity of buying **emission reduction certificates** for climate protection projects abroad. As a third option, the Kyoto Protocol envisaged that the performance of forests as **CO_2 sinks** could be taken into account to meet reduction targets.

At the national level, the first CO_2 Act of 1999 served as the basis for climate policy until the end of 2012. At the same time, it created the legal framework for the fulfilment of Switzerland's obligations under the Kyoto Protocol. The main objective of the Act was the reduction of CO_2 emissions from the consumption of fossil thermal and motor fuels. These account for around 90 % of all CO_2 emissions or over three-quarters of all greenhouse gas emissions originating in Switzerland.

Contributions – Domestic and Abroad

In addition to the global target of minus 10 %, the CO_2 Act of 1999 included partial targets for thermal fuels and motor fuels. Emissions from fossil thermal fuels, such as heating oil, natural gas and coal, were to have been reduced by an average of 15 % as compared with 1990 levels in the years 2008–2012. For fossil motor fuels (primarily petrol, diesel as well as kerosene for domestic flights), the reduction target was minus 8 %. Like the Kyoto Protocol, the CO_2 Act allowed

Fig. 3 *The thermal insulation of older buildings reduces energy consumption and CO_2 emissions.*

emission reduction certificates from climate-protection projects abroad to be used to meet the target.

Priority for the industry's own responsibility

Until 2012 voluntary measures by industry and the private sector were given high priority in Switzerland's climate policy. A reduction in CO_2 emissions was to be achieved firstly through agreements between the Confederation and automobile importers and the cement industry and secondly through federal and cantonal programmes promoting energy saving measures or the use of renewable energy.

If the impact of voluntary measures proved insufficient, the Act provided for an incentive fee: the CO_2 levy. This was introduced on thermal fuels in 2008 and increased in 2010 after it became clear that emissions in this area would not decrease to the desired extent without additional measures.

For motor fuels, the Federal Council dispensed with the introduction of an incentive fee. Instead it entered into agreements with the "Climate Cent Foundation" for the purchase of emission reduction certificates and for additional domestic emission-reduction projects. These were funded through a surcharge of 1.5 cents per litre of petrol and diesel sold in Switzerland.

Bulk consumers of fossil thermal fuels could have themselves exempted from the CO_2 levy if they committed to the Confederation to limit their CO_2 emissions to a specific amount. They thus undertook to adhere to a predetermined maximum number of emission allowances. If their reduced emissions exceeded the agreed volume, then they could sell the surplus emission allowances or carry them over for the post-2012 period. If, however, they were unable to comply with their agreed obligation, then they could buy emission allowances from other companies or purchase emission reduction certificates from abroad.

Starting in 2010, the Confederation and the cantons used one-third of the revenue from the CO_2 levy (a maximum of 200 million francs) for the buildings programme. In addition to improving the thermal insulation of buildings, this also supports investments in renewable energy, the use of waste heat, and the optimisation of building technology.

CO_2 from thermal fuels: a trend reversal achieved

CO_2 emissions from thermal fuels have declined notably since 2006. From 2008 to 2012, they were 14 % below 1990 levels. The partial target of minus 15 % thus was just missed.

Although the area of heated floor space has steadily increased since 1990, emissions even from the household sector, responsible for around half the emissions from thermal fuels, show a downward trend (Fig. 4).

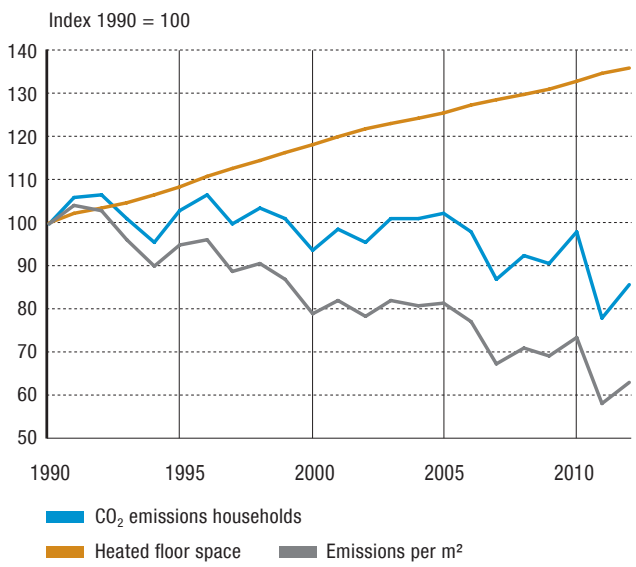

Fig. 4 *CO_2 emissions of the household sector. The fluctuating heating demand shapes the course. Despite increased floor space, the trend points downward.*

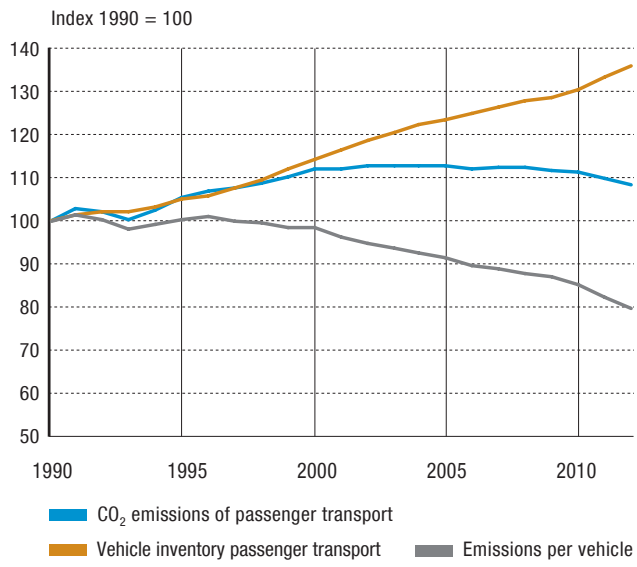

Fig. 5 *CO_2 emissions from passenger transport. Increasingly efficient motors compensate for the growth in mobility on the road.*

CO_2 from motor fuels: potential not yet realized

CO_2 emissions from motor fuels increased significantly until 2000. From 2008 to 2012, they were on average 13 % above 1990 levels. If emission reduction certificates purchased from "climate cent" funds are taken into account, then there was a decline of 6.5 %. This value is slightly above the partial target of minus 8 %.

For passenger travel on the roads, which is responsible for about 70 % of the emissions from motor fuels, a trend reversal is only visible in recent years. A growing number of motor vehicles face an accelerated decrease in CO_2 emissions per vehicle (Fig. 5).

Support from other sectors

Since deforestation in some countries leads to large volumes of CO_2 emissions, the Kyoto Protocol took account of the CO_2 balance of the forest. The Swiss forest is regularly used in plateau regions, but in the Lower Alps and the mountain regions this is much less the case, with the result that timber stocks increase as a whole. Taking the country as a whole, the forest can be viewed as having the effect of a CO_2 sink during the period 2008–2012. In this sense, forests also contributed to meeting the Kyoto target.

Measures in other policy areas also have contributed since 1990 to the reduction, or at least to slowing down the growth, of greenhouse gas emissions. Examples include encouraging the use of public transport and transfer of road traffic to rail, less emission-intensive agricultural practices or the regulation of the use of the potent climate-affecting synthetic greenhouse gases.

Emission reductions abroad

The Kyoto Protocol assumes that each country takes responsibility for its own greenhouse gas emissions and undertakes to reduce global emissions primarily through domestic measures. The existing potential for more efficient use of fossil fuels should be exploited and lower-emission energies and technologies introduced.

Measures with comparable impacts, however, can often be implemented in emerging economies and developing countries at a lower cost. Both the Kyoto Protocol and the CO_2 Act thus envisaged that a part of the agreed-to reduction could be achieved through investments in projects abroad.

Switzerland has made use of this possibility, particularly with respect to greenhouse gas emissions from transport. Most of the expected reduction from the transport sector comes from projects that have been financed from the "climate cent" on motor fuels. A total of over 700 million francs was made available for this purpose.

A portion of these funds was used to purchase foreign emission reduction certificates representing over 15 million t CO_2eq. Spread among the five years from 2008 to 2012, this amounts to roughly 3 million t CO_2eq per year. The certificates came, for example, from wind, biomass and hydropower projects, as well as from projects for the use of gases that escape from landfill sites.

Fig. 6 *Cattle livestock and fertilizer use dominate emissions from agriculture*

Climate Glossary II

Emission reduction certificates are certificates issued for reductions achieved from projects abroad that have been reviewed by independent experts. Certificates thus may be recognized, traded, and counted towards the individual targets of States as long as they satisfy the quality requirements specified in the Kyoto Protocol. Each certificate represents the reduction of 1 tonne CO_2.

CO_2 sinks: If more wood grows in a forest than is used, the volume of carbon stored in the wood increases. The forest then is a CO_2 sink. Under the Kyoto Protocol, incremental forest growth can be counted as sequestered carbon ("negative emissions"). CO_2 released as the result of forest clearing or storm damage, however, must be recorded as emissions.

The Interim Result is on Target

The "zero growth" in emissions in Switzerland since 1990 differs significantly from the emissions trends of earlier decades. Without the climate, energy and transport policy measures that have been implemented since the early 2000s, the level of emissions in the period 2008–2012 would have been around 57 million t CO_2eq, about 8 % higher than 1990 levels. At 52.3 million t CO_2eq, average emissions during the period 2008–2012 were effectively lower. Domestic measures therefore reduced the volume of emissions by about 4.5 million t CO_2eq (Fig. 7).

Emission reduction certificates from climate protection projects abroad also made a significant contribution to achieving the Kyoto target. Due to the counting of certificates acquired with "climate cent" funds, the emissions balance improved by a good three million t CO_2eq. A small portion was also acquired by companies to meet their reduction obligations to the Confederation.

The third element that has significantly contributed to meeting the target was the effect of forests as CO_2 sinks. Switzerland was able to receive a credit of 1.6 million t CO_2 for its forest-management measures.

Companies that had fulfilled their reduction obligations to the Confederation at an early stage were allowed to carry over excess reductions achieved to the next commitment period (starting 2013) in the form of emission allowances. For this reason, approximately 0.5 million t CO_2eq were not taken into account in the accounting for the Kyoto Protocol as of the end of 2012 and were deducted from the total of emission reductions achieved.

In the overall balance of all eligible measures, domestic and abroad, Switzerland met its individual Kyoto Protocol target of minus 8 %.

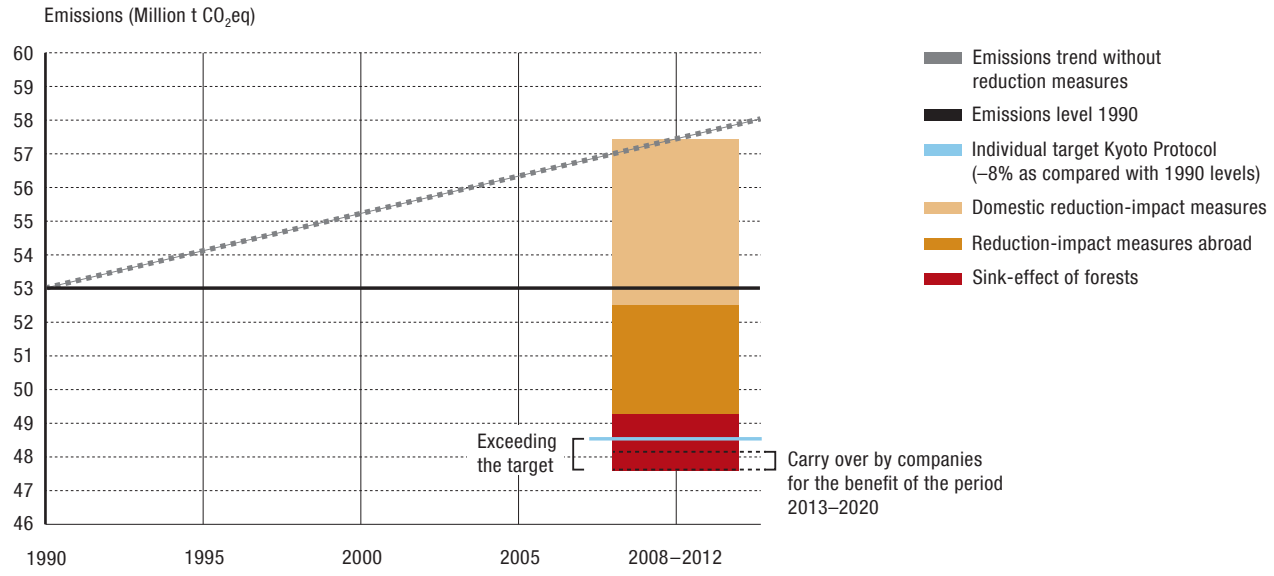

Fig. 7 *Contributions to meeting the Kyoto Protocol target. Thanks to domestic measures and measures abroad and the incremental growth of forests, Switzerland has met its individual target.*

> Objectives and Measures by 2020: Prepared for the Second Stage

At the beginning of 2013, the CO_2 Act and the CO_2 Ordinance entered into force in revised form. They form the framework for Swiss climate policy for the period 2013 to 2020. The desired reduction of emissions by 2020 of 20 % below 1990 levels requires decisive action.

The individual targets of the Kyoto Protocol adopted in 1997 covered the period to the end of 2012. Because no binding successor agreement at the international level could be negotiated by that time, Switzerland, along with the EU and six other countries, committed to further emission reductions within the framework of a second period through 2020.

Estimates have shown that a 20 % reduction in Switzerland's greenhouse gas emissions is economically feasible and can be achieved by 2020 through the consistent use of existing domestic potential. The new CO_2 Act, in contrast to the previous legislation, thus provides for the purchase of emission reduction certificates from abroad only on a very limited basis. This option should, in particular, remain available to companies with high emissions that need additional flexibility in order to be able to meet their contributions to the reduction targets. The scope of the new CO_2 Act extends to all gases covered by the Kyoto Protocol.

A Wider Range of Instruments

The following measures form the core for meeting the reduction target by 2020:

CO_2 levy

The CO_2 levy on fossil thermal fuels will continue. The Confederation will adjust the amount of the levy if emissions do not move in line with the pre-set target. With the increase in the levy from 36 to 60 francs per tonne CO_2, the first adjustment was already made on 1 January 2014. If pre-set targets

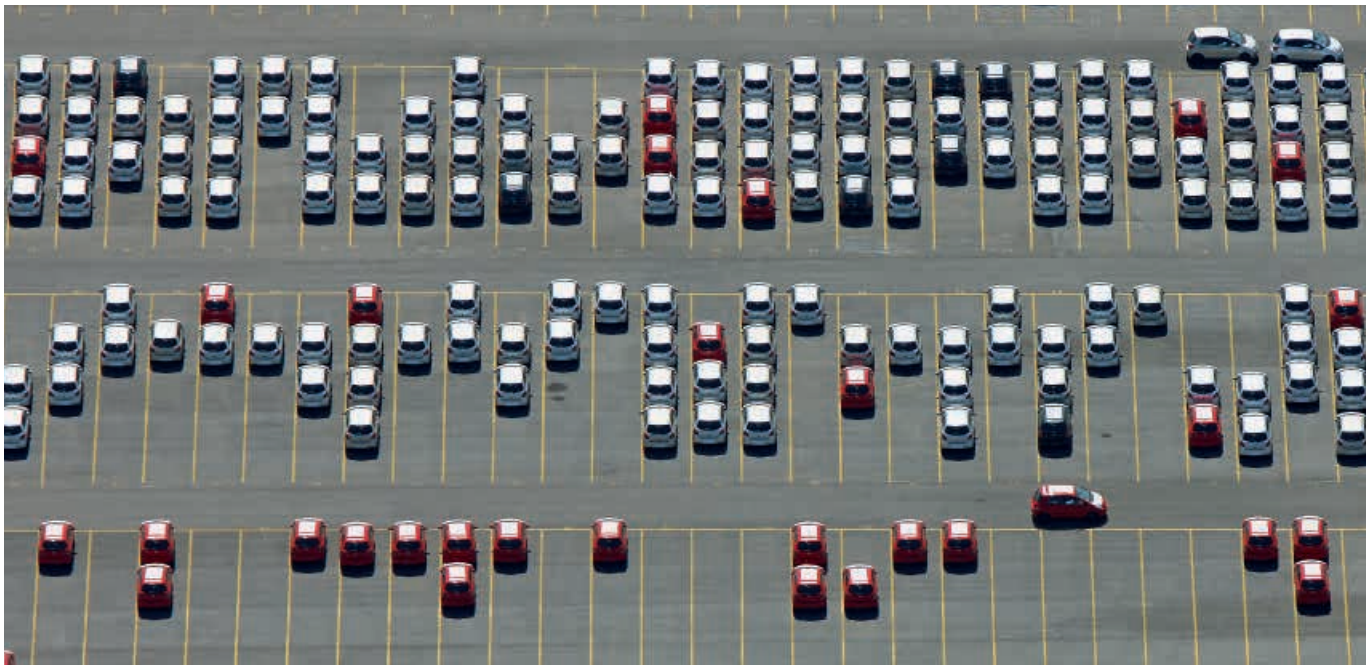

Fig. 8 *Smaller, low-emission vehicles are part of a climate-friendly mobility.*

are not reached, further increases are planned for the beginning of 2016 and 2018. In the period 2013–2020, companies that emit large amounts of CO_2 may be exempted from the levy if they commit to a quantified emission limitation or participate in emissions trading.

Emissions Trading Scheme

Through the trading of domestic emission allowances and emission reduction certificates from abroad, also in the future it should be possible to reduce emissions where costs are lowest. Some 50 companies that together emit over 5 million t CO_2 are included in Switzerland's Emission Trading Scheme (ETS). Negotiations for linking Switzerland's ETS with the European Union Emissions Trading Scheme are already well advanced. Once the link is completed, Swiss companies will also have access to a much larger market for emission reduction certificates.

Buildings programme

The federal and cantonal buildings programme plays an important role in achieving the targets of the new CO_2 Act. This programme, aiming to improve the thermal insulation of buildings, for example, provided 174 million francs in support of around 15,000 projects in 2012. The cantons spent another 79 million francs to promote renewable energy sources, waste-heat recovery and building technology. Taking account of the entire lifespan of the measures, this one-year investment will bring emission reductions of approximately 4 million t CO_2. From 2014 additional funds are available, through which the impact of the programme can be further enhanced.

Partial Compensation for Emissions from Motor Fuels

Motor fuel importers must compensate for part of the CO_2 emissions attributable to the use of fossil motor fuels by financing domestic emission-reduction projects. The proportion of emissions to be compensated will gradually be increased from 2 to 10 % between 2014 and 2020. The compensation obligation for motor fuels replaces the temporary – until 2012 – "climate cent". The required funding in turn comes from a surcharge on the price of motor fuels imported into Switzerland.

Reduction of CO_2 emissions from new passenger cars

Since 2012, car importers are required to reduce emissions from passenger cars that are registered in Switzerland for the first time. The CO_2 emissions from new passenger cars must be reduced to an average of 130 gram CO_2 per kilometre by the end of 2015. If average CO_2 emissions from an importer's fleet of new passenger cars exceed the individual target, the importer must pay a penalty. Increasing emissions target values and extending them to other categories of vehicles – in line with EU provisions – is planned for the period after 2015.

Further measures for reducing emissions

Energy policy: The development of greenhouse gas emissions is strongly dependent on how Switzerland is supplied with energy. To ensure that climate targets are reached, climate and energy policies must support each other.

The Federal Council has for a long time aimed to increase energy efficiency and the proportionate use of renewable energies. The accident at the Japanese Fukushima nuclear power plant in the spring of 2011 has given further impetus to this policy: With the Energy Strategy 2050, the Federal Council is increasingly focusing on the economical use of energy and the development of hydropower, wind, solar energy, biomass and geothermal energy as energy sources.

Whether there is a need for fossil fuel power plants for Switzerland's future electricity supply, however, is still unclear. In order to reach the 2020 reduction target if power plants with high CO_2 emissions (e.g., gas-fired, combined-cycle power plants) are built in Switzerland, the operators must fully compensate for emissions from such power plants. Under the CO_2 Act, at least half the compensation must be achieved through domestic projects.

Forest policy: The Confederation's Forest Policy 2020 aims to achieve the sustainable management of forests. This also benefits climate protection. Due to continuous rejuvenation, forests should remain resilient to drought, storms and infestation by insect pests. The use of wood should in the future also contribute to the improvement of Switzerland's greenhouse gas balance. CO_2 that is sequestered in wood construction (e.g., in timber houses) can be counted towards meeting the reduction target starting in 2013.

Agriculture policy: The goal of the Federal Office for Agriculture's 2011 climate strategy is to reduce the agricultural sector's greenhouse gas emissions by at least a third compared with 1990 levels by 2050. If emissions from the processing and consumption of food were to decrease at the same time, even a reduction of two thirds would be achievable. Direct payments for environment-friendly production systems as well as ecological compensation areas should contribute to less emission-intensive agriculture.

Synthetic gases: The Ordinance on Chemical Risk Reduction of the Environmental Protection Act, revised in 2012, contains provisions on the use of synthetic greenhouse gases. The implementation of this ordinance is expected to result in a noticeable attenuation in the growth in emissions observed in recent years.

Enormous Reduction Potential

Within the framework of Energy Strategy 2050, the Federal Council demonstrates how Switzerland's energy supply might develop. In September 2013, it presented Parliament with its proposals for a first package of measures. The aim of these measures is to exploit potentials in the fields of energy efficiency and renewable energy that can be developed with currently existing or foreseeable technologies.

Based on the scenarios of Energy Strategy 2050, and on supplementary estimates for development in the agriculture and forestry sectors as well as for synthetic greenhouse gases, three emission scenarios were created. These demonstrate how greenhouse gas emissions will evolve under different assumptions for the implementation of climate policy in the coming years (Fig. 10):

Scenario 1: Implementation of measures adopted through 2010

This scenario assumes that only the measures adopted by 2010 will be implemented. Also taken into account is the contribution of technical progress in the efficient use of energy and thus towards the reduction of CO_2 emissions, regardless of policy measures. Scenario 1 is therefore used to estimate changes in emissions without the new CO_2 Act, without any measures within the framework of Energy Strategy 2050, without setting climate policy targets for agriculture, and without Forest Policy 2020.

Under these conditions, it is likely that Switzerland's greenhouse gas emissions would only slowly fall below the present level of roughly 50 million t CO_2eq.

Scenario 2: Implementation of measures adopted since 2010

Scenario 2 takes into account the implementation of measures specified in the CO_2 Act and is based on a maximum CO_2 levy of 96 francs per tonne, as well as the continuation of existing promotion measures. Reduction contributions come primarily from the buildings programme and stricter cantonal energy provisions for new buildings, the CO_2 levy on thermal fuels, provisions reducing the CO_2 emissions of new passenger cars and the partial compensation of emissions from transport.

The impact of the revised legislation on the use of synthetic greenhouse gases is also being felt. Emissions from the agriculture sector decrease as the new agricultural policy is implemented.

Total emissions under Scenario 2 would reach 15 % below 1990 levels by 2020 and 28 % below 1990 levels by 2030. The reduction target of the CO_2 Act for 2020 will not be reached.

Scenario 3: Stricter implementation of the measures adopted since 2010

Scenario 3 reflects the fact that a massive, worldwide reduction in CO_2 emissions down to 1–1.5 tonnes per person per year by 2050 is required for the early stabilisation of the climate. Such a reduction provides the best guarantee that the effects

Fig. 9 *The climate and industry benefit from the use of renewable energy.*

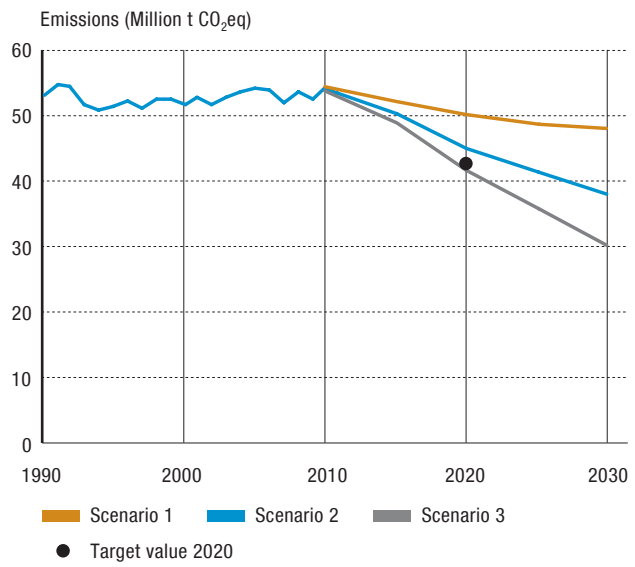

Fig. 10 *Emission scenarios until 2030. The reduction target for 2020 will only be met if the latitude in implementing current legislation is fully exploited.*

of climate change can be tackled with reasonable effort. For a reduction of greenhouse gas emissions on this scale, a significantly more efficient use of energy as well as an internationally coordinated climate policy is needed.

The CO_2 Act provides various flexible options in defining requirements for the compensation of emissions, and with respect to amounts of incentive fees and requirements for the implementation of individual measures. If these options are fully exploited, achieving a 20 % reduction in emissions by 2020 is possible. This statement, however, applies only if future power plants do not impose additional burdens on the Swiss CO_2 balance.

The scenarios for the period to 2030 show that Switzerland can significantly reduce its greenhouse gas emissions on the basis of its climate policy up to 2012 and the new CO_2 Act. Under Scenario 3, in 2030 an average home of comparable floor space would cause only 18 % of the emissions that were normal in 2000. Passenger cars also would emit at least 60 % less per kilometre of travel than the average vehicle emitted on the road in the year 2000.

This is still far from the "1-tonne-CO_2 society" that is needed to limit the global rise in temperature to **2 degrees** and thereby keep the effects of climate change within acceptable limits. But a big step in the right direction would be taken. After all, with the consistent implementation of existing climate policy instruments, the per capita emissions of the Swiss population would be halved within 20 years. This would correspond to a level of 3.5 t CO_2eq per inhabitant (Fig. 11).

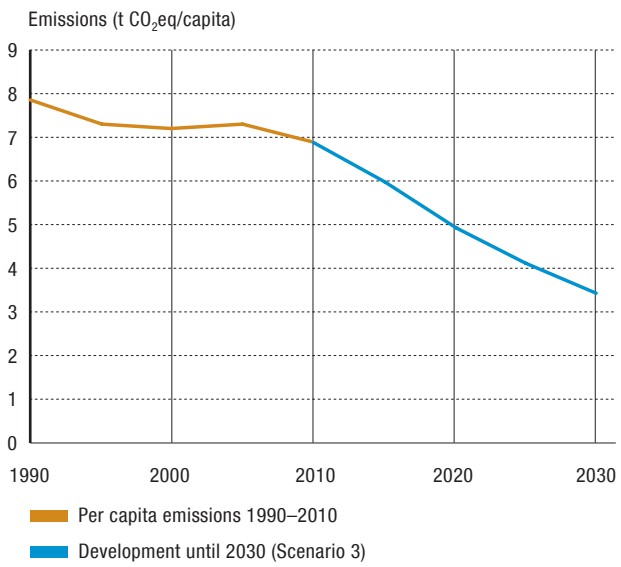

Fig. 11 *Greenhouse gas emissions per person. A committed climate policy enables the halving of per capita emissions within 20 years.*

Climate Glossary III

2-degree target: Current climate research on the relationship between greenhouse gas emissions and global warming effects and its impacts on nature, society and the economy suggests that an increase in average global temperature by more than 2 degrees over pre-industrial levels would have negative consequences, coping with which would be very costly. In 2010 at the UN Climate Conference in Cancún (Mexico), limiting global warming to 2 degrees Celsius thus was recognized as a target.

> Effects of Climate Change: Tanker on a Collision Course

Regular measurements over longer periods make it possible to identify new climate trends and their impact on nature. Climate change has already left many marks in Switzerland. The economy and society also are affected.

Switzerland has a well-developed monitoring network for the observation of weather and climate. This provides a wealth of data, in part going back to the 19th century, that provides information about changing trends in indicators such as temperature, precipitation, hours of sunshine and snow cover. In addition, regular measurements or observations are made that tell us something about climate change, such as changes in the length of glaciers, the seasonal development of vegetation, the temperature of the waters or the frequency of forest fires.

Switzerland thus makes important contributions to the worldwide climate monitoring system GCOS. It is dedicated to ensuring that the data collected is made available to potential users, including via the "Global Framework for Climate Services" initiated in 2009 by the World Meteorological Organization (WMO). This aims to make scientific knowledge of climate monitoring usable for public authorities, businesses and the population.

Clear Signals in the Sea of Data

The wealth of data collected enables the determination of whether and how long the climate has been changing and where these changes have been felt. Since the beginning of temperature measurements in Switzerland in 1864, the average annual temperature has risen by 1.75 °C. The trend towards higher temperatures has accelerated significantly since 1960, as indicated by even more frequent hot days and less frequent frost days. The zero degree level is now around 350 m higher than it was 50 years ago.

Fig. 12 *The Trift glacier in the Bernese Oberland is an impressive example of the shrinking of glaciers.*

These are examples of the numerous indicators that demonstrate a shift in the climate system. This responds – like a tanker at full speed – very slowly to course corrections: even with a rapid reduction in greenhouse gas emissions, climate change would still progress for decades before reaching a new equilibrium.

One of the most reliable indicators of climate change is the melting of glaciers. Glaciers respond slowly but sensitively to changes in temperature. Only when the temperature deviates upward or downward for several years does a sustained change in their volume become visible.

In the Alps, the glaciers have been retreating at an accelerating pace since 1980. Since 1999 alone, glaciers have lost over 12 % of their volume. If the warming continues, only a fraction of the current glacier cover will be left by the end of the 21st century. This also applies to large glaciers like the Aletsch, which is expected to shrink to about a third of its current size.

This will not only result in the loss of an attractive element of the mountain landscape. Parallel to the retreat of glaciers, the permanently frozen subsoil in the high mountains also would thaw. More frequent mountain and rock falls as well as debris slides that can endanger transport links and infrastructure in the high mountains would result (Fig. 16).

Nature is sensitive to changes in weather

Changes in plants also indicate that climate change has started making its impact felt: Individual species have spread to higher altitudes and new, thermophilic species have appeared and become more common. The development stage of many plant species has shifted to earlier in the spring. Well-known examples are the leaf development of horse-chestnut trees in Geneva and the beginning of the flowering of cherry trees in Liestal. Since the mid-20th century, the overall growth period of plants has lengthened by two to three weeks.

Due to their high mobility, birds are good indicators of the impact of climate change on wildlife. Using assumptions about the development of climate and land-management, the Swiss Ornithological Institute has created forecasts for the future distribution of indigenous bird species. The population of thermophilic species such as the European Bee-eater or the Blue Rock Thrush, which is predicted to spread widely, has already soared since 1990.

People are sensitive too

In summer 2003, many people became aware that heat waves are associated with health risks. Only recently has it also been recognized that even the slow but steady increase in daily temperatures has a demonstrable impact on the well-being of people. A study that examined how weather conditions relate to pharmaceutical purchases, doctors' visits and hospital admissions proves this fact. It shows that the services of pharmacies, doctors or hospitals are sought more often at above-average temperatures than under "normal" conditions. Daily maximum temperatures in Switzerland have risen steadily since 1960 (Fig. 13).

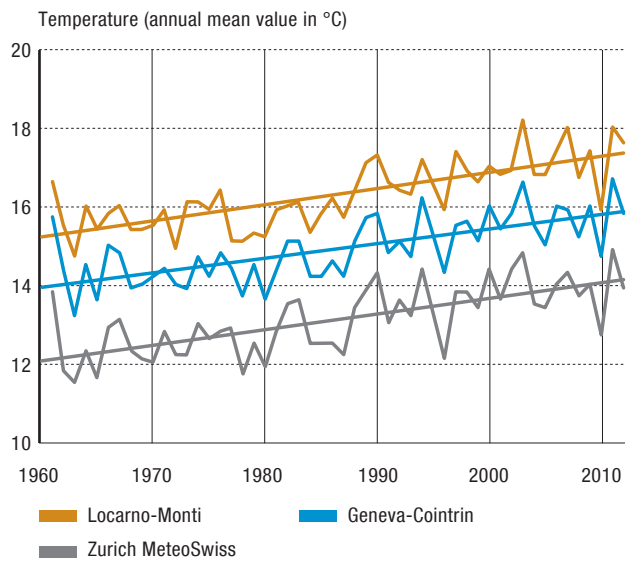

Fig. 13 *Progression of daily maximum temperatures since 1961. Not only heat waves but also steadily rising temperatures affect health. (Source: MeteoSwiss)*

A View into an Uncertain Future

The question of how the climate will change, globally and at the national level, in the coming decades, is the subject of numerous research initiatives. In Switzerland various specialized institutes and programmes are searching for answers.

The National Centre of Competence in Research Climate (NCCR Climate) focussed on the study of climate progression and its impact from 2001 to 2013. This comprehensive programme has provided significant stimulus to climate research in Switzerland. And in 2007 the Oeschger Centre for Climate Change Research at the University of Bern was established, followed by the Centre for Climate Systems Modeling (C2SM) based at the ETH Zurich in 2008.

Increasingly warm and increasingly dry in the summer

In 2011 C2SM published new climate scenarios for Switzerland. These form a good basis for a more accurate estimate of the effects of climate change on Switzerland. According to the new scenarios, by the end of the 21st century, temperatures will have increased by another 2.7 to 4.8 °C above the average in the years 1980–2009 if we are unsuccessful in significantly reducing worldwide greenhouse gas emissions. Even with a halving of global greenhouse gas emissions by 2050 as compared with 2000 levels, a further rise in temperature of 1.2 to 1.8 °C is expected in Switzerland by the turn of the century. The zero degree level and the snow line are likely to increase by several hundred meters as a result.

Precipitation is not expected to show a marked decrease in summer until after the middle of the 21st century – depending on the success of global climate policy, in a better-case scenario by around 10 %, in a less favourable one, by 20 to 25 %. In southern Switzerland, winter precipitation is expected to increase (Fig. 14).

Since 2013, information has been available about how climate is likely to evolve until the middle of this century in the various regions of Switzerland (Jura, Plateau, Lower Alps, Alps, south of the Alps) and in the urban centres. In addition to the general trends with respect to temperature and precipitation, there are indications of how, for example, the number of summer and frost days, the length of the growing season, and the number of days with fresh snow will change at the regional level. Such information is an important basis for being able to estimate future adaptation needs in the cantons and communes.

Many losers – few winners

Changes in temperature and precipitation influence both the natural environment and many socially and economically important areas. But many uncertainties about the specifics of the impacts of these changes persist, not least due to differing local conditions. Based on the new climate scenarios for Switzerland, various statements about how Switzerland will be affected by climate change nonetheless can be made:

> **Water** will, in principle, remain plentiful in Switzerland in the future. In the second half of the 21st century, avail-

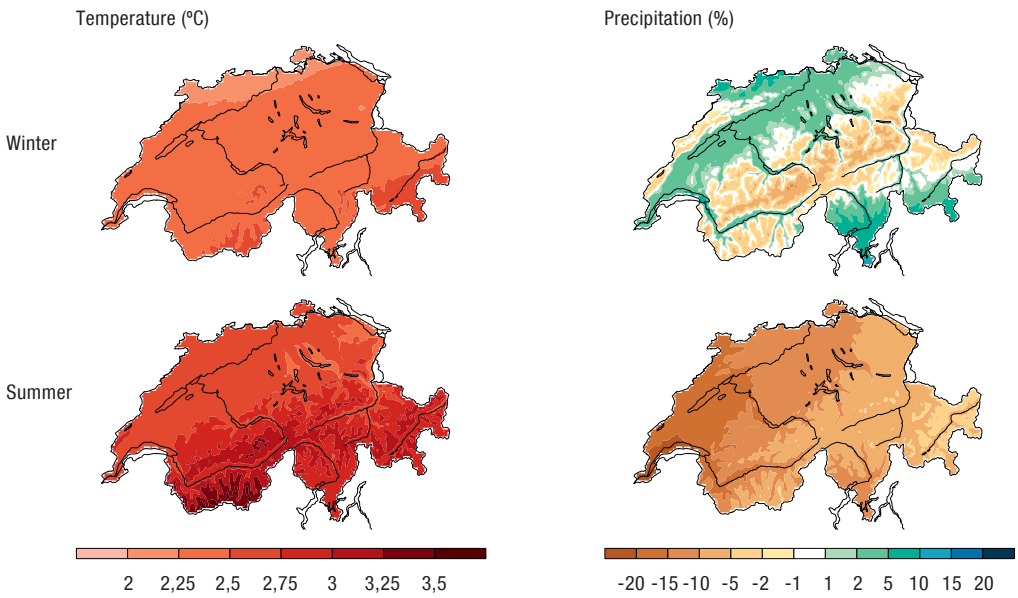

Fig. 14 *Temperatures and precipitation in Switzerland. An unbridled increase in global emissions until 2060 leads to striking changes. (Source: MeteoSwiss)*

ability and usage possibilities, however, will noticeably change at the local, and in some cases at the regional, level due to less rain in the summer, the lack of melt water from the mountains and higher evaporation, increasing the need for water – e.g., for irrigation (Fig. 15).

> **Plant and animal species** respond to changes in temperature and precipitation according to their needs. Species of breeding birds and plants that today are widespread in the plateau regions are likely to move to higher altitudes and in turn be replaced by new, immigrant species. Due to Switzerland's population density and intensive land use, however, the mobility of many species is limited. The risk that they will lose their habitat thus increases.

> The longer growing season will initially bring an increase in **agricultural** production and the expansion of areas of production. In the longer term, however, the disadvantages of rising temperatures and longer periods of drought will become more significant. Growing levels of heat stress due to advancing climate change in the late 21st century thus may require targeted adaptation measures in animal husbandry.

> A risk to the **health** of the population is expected in the second half of the 21st century as a result of regular heat waves. The densely populated urban centres will be especially affected. Higher temperatures also favour the transmission of infectious diseases and the development of pathogens in water and food.

> **Tourism** will benefit from the fact that Switzerland, as compared to neighbouring countries, has some particularly high altitudes and thus comparatively snow-sure ski resorts. But even in the high Alps, the number of days with fresh snow will steadily decrease in the coming decades. Numerous low-lying winter sport resorts in the Alps and the lower Alpine regions will, in the medium term, have to develop alternative offerings.

> Climate change influences **energy consumption.** Thanks to higher temperatures, heating needs will tend to decrease. On the other hand, electricity consumption for cooling purposes will increase. The extra cost of electricity however will be less than the financial savings in heating oil and natural gas, so that the savings effect will prevail.

> How **natural hazards** such as floods and storms are affected by climate change is difficult to assess. The potential for rock falls and debris slides in the mountains will rise because the rise of the zero degree level and the retreat of glaciers will cause large quantities of loose material to become dislodged. In the long term, the risk of economic losses may also increase due to low water levels and extreme drought in the plateau, Valais and Ticino regions.

As a consequence of advancing climate change, far more areas in Switzerland are likely to experience negative effects than positive ones. For this reason, whenever long-term strategies and investments are considered, the need for adaptation measures should be examined in a timely manner.

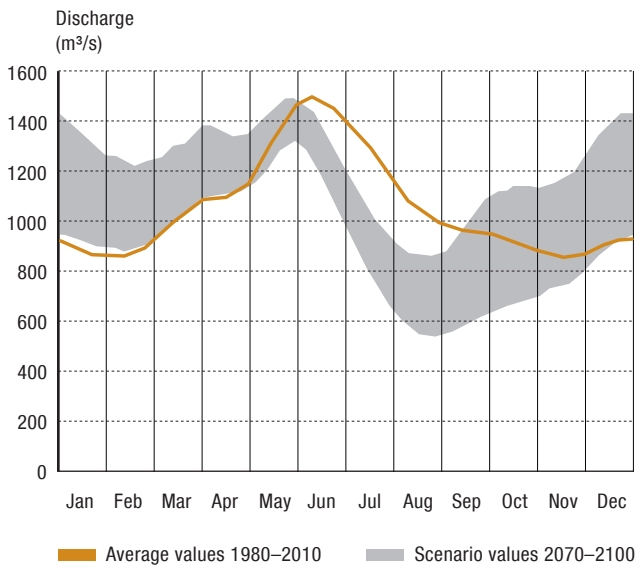

Fig. 15 *Discharge of the Rhine at Basel. Pronounced low-water phases in late summer and high-water levels in winter will be more frequent in the future.*

> Adaptation to Climate Change: Prevention is better than Cure

Despite initial progress in the reduction of greenhouse gas emissions, climate change is progressing. Switzerland must learn to cope with the emerging risks and opportunities. The Confederation thus supports cantons and communes in recognizing these in due time.

Even with the international community's dedicated and coordinated action, it may take decades for the rise in temperature observed today to come to a complete stop. Switzerland thus would be well advised to do more than advocate the reduction of greenhouse gas emissions. It must also consider how it wants to deal with the foreseeable consequences of climate change.

Identifying risks and seizing opportunities

In 2011, the Confederation began clarifying the dangers, but also the opportunities, arising from climate change. Because how fast global greenhouse gas emissions can be reduced remains unclear, two scenarios are considered: The "weak climate change" scenario assumes that the future emissions course will lead to a rapid reduction in global greenhouse gases and make it possible to limit the global rise in temperature to 2 degrees. It thus presupposes that CO_2 emissions will be reduced to 1–1.5 tonnes per person per year by 2050, a reduction course that requires stricter implementation in Switzerland of the measures decided in 2010 (emission scenario 3, see page 14). In contrast, the "strong climate change" scenario perpetuates the current worldwide rapidly increasing emissions into the future.

Risk analyses for all parts of the country are intended to show how expected changes in temperature and precipitation are likely to affect important areas in nature, society, and the economy until 2060 and what the associated costs (or benefits) could be for the general public. In so doing, not only how the climate will change, but also how the economic and social environment will change in the coming decades, are taken into account.

Fig. 16 *Since 2010 a dam protects the Grimsel Pass road at Guttannen (BE) against debris slides.*

In 2013, the first case study for the canton of Aargau was completed. The studies have shown that in the plateau, even with a successful climate policy, negative effects on biodiversity and health are to be expected. Slightly positive effects can be expected in the areas of energy consumption and agriculture. In five of the eight areas studied, however, there will be negative consequences if climate change is not successfully curbed by a significant reduction in emissions and no adaptation measures are taken (Fig. 17).

Another case study that further analyses prospects for the Alpine region was carried out in the canton of Uri. The cantons of Geneva and Basel are to be studied by mid-2015 as examples of densely populated urban centres. Further analyses are planned for Ticino, the lower Alps and the Jura, with the ultimate objective of making statements about the opportunities and risks of climate change for the entire country.

Efficiency through a coordinated approach

Improving the basis for planning and implementation of measures is one of the central challenges of adapting to climate change. The risk analyses described above are an example of this.

In 2009, the Federal Council instructed the administration to develop an adaptation strategy for Switzerland. In 2012, it adopted the first part of this strategy, which describes the targets, challenges and action areas for adaptation. The strategy is designed to contribute to

> minimising the risks of climate change,
> taking advantage of emerging opportunities,
> ensuring the protection of people, property and natural resources and
> improving the adaptation skills of society, the economy and the environment.

In 2014, the second part of the adaptation strategy, the action plan, was defined in concrete terms.

The CO_2 Act provides the legal framework for the Confederation's activities with respect to adapting to climate change. It formulates the mandate for coordinating measures that can be applied to avoid or overcome the harms of climate change. On the one hand, principles for management and practice are needed that science must provide at an early stage. On the other hand, the activities of the Confederation, cantons and communes should be well coordinated to avoid duplication and to make use of synergies. That best ensures the efficient use of necessary resources for adaptation measures.

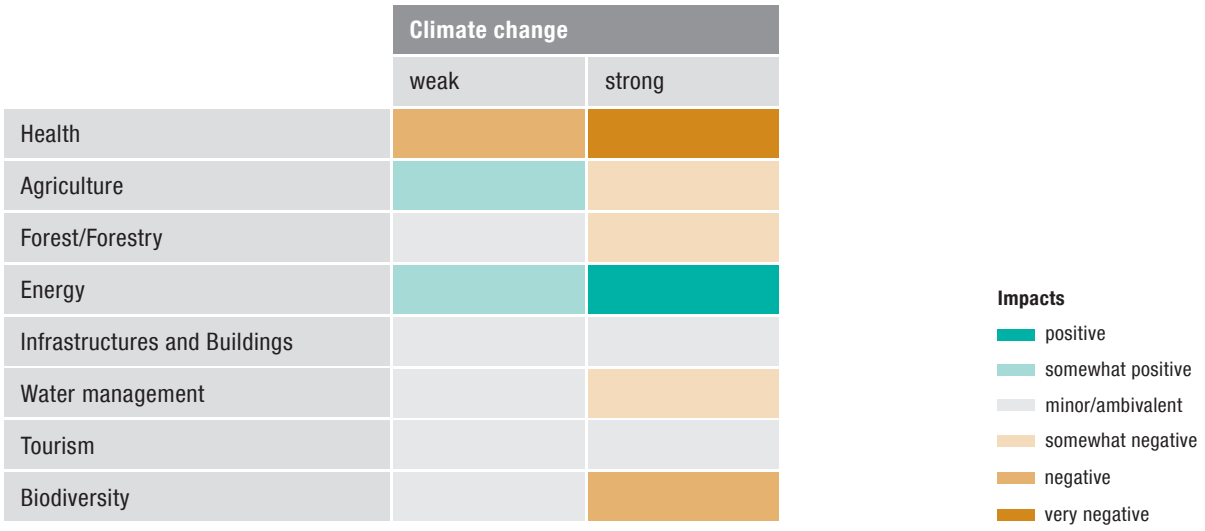

Fig. 17 *Opportunities and risks of climate change by 2060 for the canton of Aargau. Under a pessimistic emissions scenario, the risks of climate change clearly prevail. (Source: EBP/WSL/SLF)*

> Support for Developing Countries: A Benefit for Switzerland too

Climate change knows no geographical boundaries. Emerging economies contribute increasingly to greenhouse gas emissions, but at the same time the poorest countries are particularly hard hit by their effects. Switzerland supports them through development cooperation and technology transfer.

Within the framework of the Convention on Climate Change, the industrial countries have committed to providing emerging economies and developing countries with financial and technical support in coping with the challenges of climate change. The emerging economies, in particular, have rapidly growing energy needs and thus are the source of ever-increasing greenhouse gas emissions. Introducing them to modern technologies helps to lower emissions and slow climate change. For the export sector of industrial countries, this offers the opportunity to develop new markets through participation in climate protection projects. Both will ultimately benefit Switzerland.

The Swiss Agency for Development and Cooperation (SDC), the State Secretariat for Economic Affairs (SECO) and the Federal Office for the Environment (FOEN) support numerous projects that aim to help reduce emissions and cope with the effects of climate change. They do this either directly on site or by making financial contributions to international environmental, climate and development funds to facilitate such projects.

An example of the dissemination of Swiss know-how is the SDC programme for increasing energy efficiency in South Africa's building sector. The programme supports the introduction of requirements for the energy consumption of buildings and thus contributes to optimal energy use in residential buildings for the poorest strata of the population.

At the same time, the programme is promoting the more climate-friendly manufacture of building materials. In South Africa, clay brick production emits large quantities of greenhouse gas emissions due to the use of outdated, energy-ineffi-

Fig. 18 *The modernisation of brick factories in South Africa protects the climate and secures jobs.*

cient, coal-fired kilns. With the introduction of modern kilns, the consumption of coal is significantly reduced and the CO_2 emitted is halved.

India is another country in which Switzerland is working towards the more efficient use of energy. Here, among other things, the Minergie standard commonly used in Switzerland for energy-efficient buildings was developed for use under Indian conditions. With the measures supported, total energy savings of up to 40 % per building are achievable.

Switzerland also has extensive experience in coping with natural hazards. Through joint projects, it can share this experience with other countries and thus help them adapt to the impact of climate change – e.g., through the establishment of a modern weather observation system in Peru.

Another focus is on projects to support sustainable forest management. Deforestation in developing countries accounts for a significant share of global greenhouse gas emissions. In the context of development cooperation, measures have been implemented in Tanzania, for example, to preserve existing forest areas, enlarge them and use them sustainably.

In 2011, Parliament decided to increase Switzerland's development assistance funds. This also made it possible to comply with the commitment made at the 2009 Copenhagen climate conference and provide additional resources especially for the countries affected by climate change. Switzerland has made total contributions of around 513 million francs in the period 2009 to 2012 for the financial support of climate-related projects and the transfer of emission-reduction technologies. Around half of these contributions were invested in global funds, programmes and projects, and the rest used in the context of regional and bilateral development cooperation (Fig. 19).

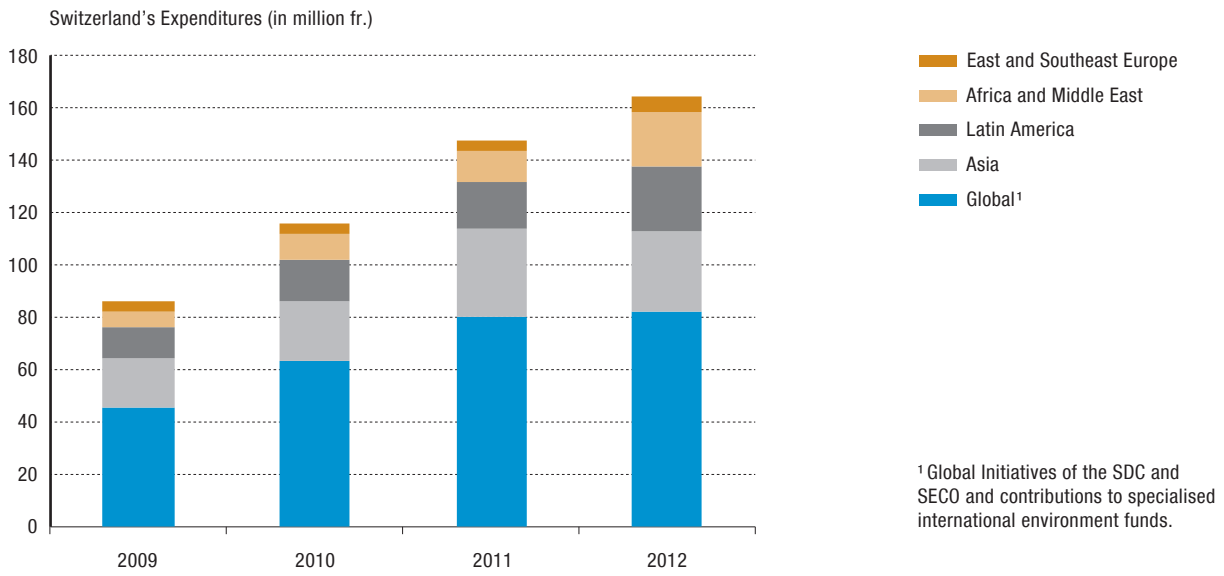

Fig. 19 *Development cooperation and technology transfer for the benefit of climate protection. In the period 2009–2012, the funds invested increased significantly.*