# > Climate change in Switzerland

*Indicators of driving forces, impact and response*

*Summary of the publication «Klimaänderung in der Schweiz»*
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# > Extended abstract

The earth's climate is not static and undergoes multiple changes over long term periods, alternating between extremely hot periods and periods of glaciation. During these periods, the meteorological conditions present enormous natural variability, hence all of the vagaries of the weather should not necessarily be interpreted as indicative of climate change. The climate has varied since the end of the last ice age 10,000 years ago. However, a strong increase in temperature has been confirmed for the past three to four decades. This period is considered by climatologists as being sufficiently long to enable its differentiation from short-term events. The fluctuations and changes in the recorded meteorological data demonstrate that the current climate differs to that which prevailed in the early 20th century, and that the shift from one climate to the other happened extremely quickly. In contrast to previous episodes, the natural variability of the climate is not sufficient to explain this abrupt transition. The hot climate experienced for the past 3 to 4 decades is thus ascribed to anthropogenic effects, a theory that is no longer contested.

This report presents a brief outline of the multiple interactions between the climate and the natural and anthropogenic environments. With the help of indicators, it explains the pressure exerted by human activities on the climate (i.e. greenhouse gas emissions), documents the evolution of the sources of this pressure and traces the evolution of the climate based on data that go back in some cases over a century. It shows the numerous indicators that demonstrate the changes in the climate in Switzerland, whether in the cryosphere, the hydrosphere, vegetation, human health, the economy or the society. In order to provide the basis for decisions regarding the necessary actions and to monitor the results of the measures taken, other areas are also analysed and documented.

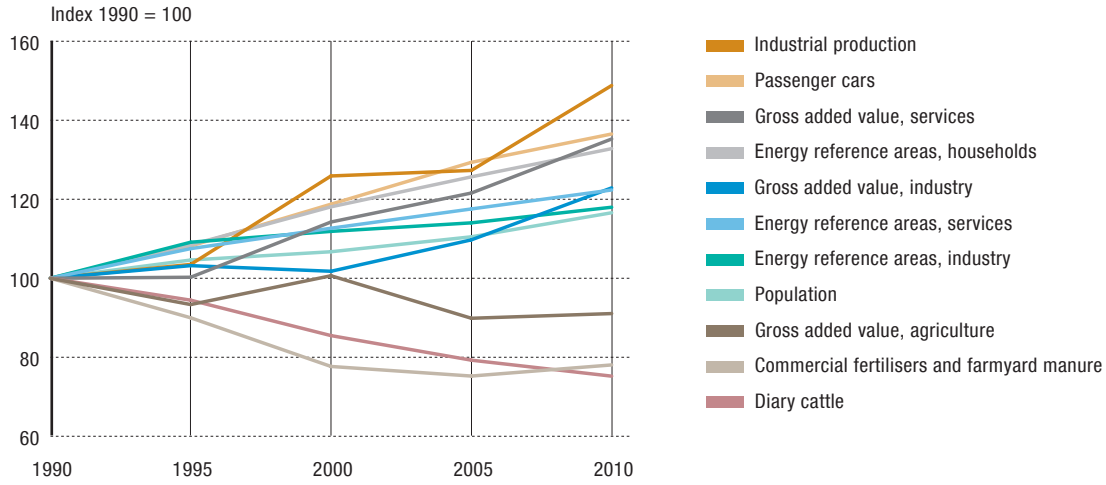
## Examples of causes

The effect of human activities on the climate in Switzerland is dictated to a very large extent by the quantities of carbon dioxide emitted to meet the country's energy requirements. The digestive systems of productive livestock and the use of fertilisers is the second greatest source of pressure and the main source of nitrous oxide and methane emissions. Apart from the influence of winter weather conditions, the long-term evolution of energy demand is mainly dependent on criteria associated with population growth and economic conditions.

Over the past 20 years, the needs of the population sometimes grew faster than the number of inhabitants. The motor vehicle fleet, and particularly the passenger car fleet, increased significantly. Similarly, the increased requirements in relation to living space per person prompted a rise in the number of housing units. In economic terms, Switzerland is an extremely prosperous country. Industry and services display a clear growth trend in their gross value added, while industrial production volumes recorded an increase of almost 50 percent. As an energy-related consequence of this rapid growth, we observe an increase in areas that need to be heated or air-conditioned and in the fossil fuel used to generate process heat. The net decline in the cattle population and in the use of nitrogen fertilisers has not stemmed the growth in agricultural food production.

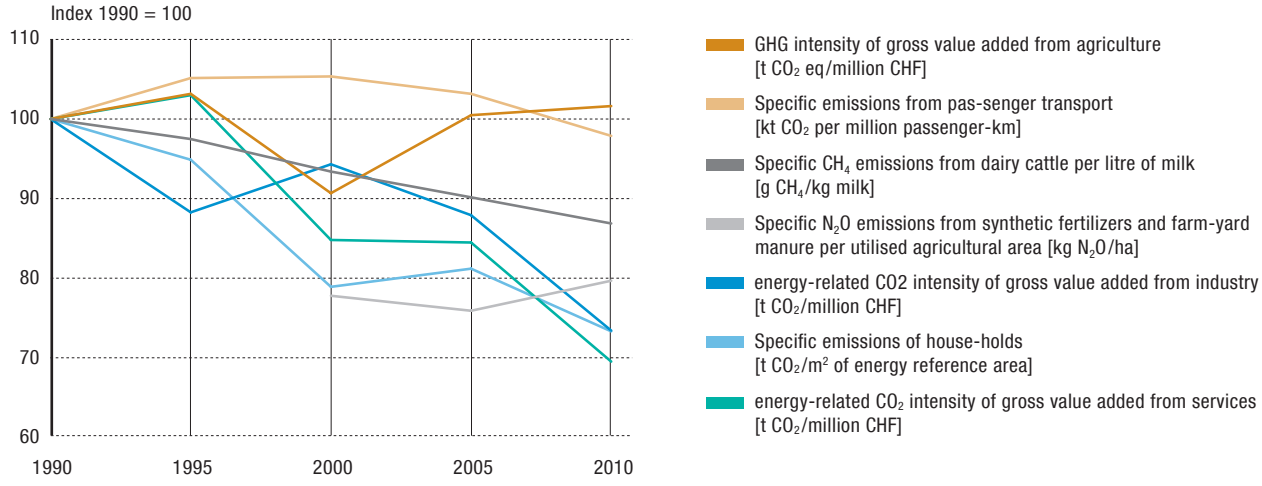
Although the factors that drive energy consumption do not show any sign of slowing down, the shift to renewable energy sources and the use of technologies that consume less energy may alleviate the rise in emissions. The improvement in the efficiency of the vehicle fleet (particularly passenger cars) and the trend involving the increased use of diesel cars have reduced the $CO_2$ emissions per passenger-kilometre. The increased use of natural gas and non-fossil fuel sources (heat pumps, wood etc.), the improvement in insulation standards and the energy refurbishment of buildings have also prompted a decrease in the specific emissions related to households energy reference areas. Industry and services have reduced their energy consumption and, accordingly, their emissions while also generating greater revenues. Hence, it has been possible to observe a partial decoupling of economic growth and emissions. The improvement in milk yields was accompanied by growth in the specific methane emissions per dairy cow but a decrease in specific emissions per litre of milk. The specific direct emissions of nitrous oxide originating from synthetic fertilizers and farmyard manure per utilised agricultural area have declined.

**Fig. 1 > Evolution of the main factors driving anthropogenic greenhouse gas emissions for the transport sector, households, industry, services and agriculture.**




Sources: FSO (2012a,c,d), SFOE (2011, 2012), Swiss Confederation (2012)

**Fig. 2 > Specific emissions of the transport sector, households and agriculture and the energy-related carbon dioxide intensity of the industrial and services sector**




Sources: FSO (2012b,d), SFOE (2012), Swiss Confederation (2012)

## Examples of pressure

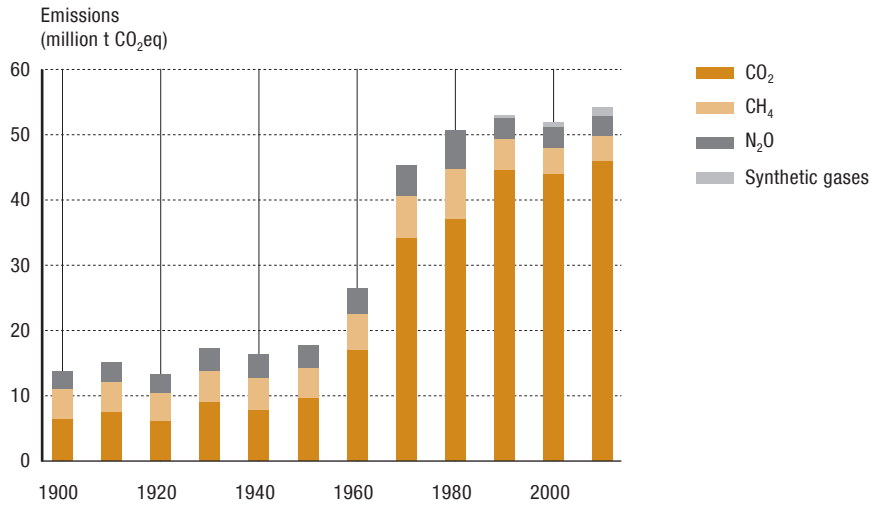
Greenhouse gas emissions that may be ascribed to human activities have been exerting strong pressure on the environment since the 1950s. In Switzerland alone, the total emissions of greenhouse gases (GHG) more than doubled between 1900 and 1960, and quadrupled between 1900 and 2010. However, total GHG emissions appear to have stabilised since 1980. The most spectacular increase involves carbon dioxide, whose share rose from 55 % to 85 % between 1950 and 2010. The synthetic gases HFC, PFC and $SF_6$, which did not exist in 1950, are used to replace CFCs and HCFCs – synthetic gases that deplete the ozone layer..

The strong increase in GHG emissions between 1950 and 1980 arose through the dual effect of the explosion in road traffic and strong economic growth. While transport now accounts for almost one third of Switzerland's GHG emissions, in 1900 it was merely responsible for 9 percent. Conversely, in just over one century, agriculture's contribution to emissions fell from 47 percent to 11 percent. In absolute terms, having peaked in the late 1970s, current agricultural emissions have declined to below the 1900 level. At around 20 percent, the level of emissions generated by the households has remained relatively unchanged since 1900. The cumulative contribution of the industry and services sectors increased by a few percentage points to 30 percent. As compared with 1990, the emissions trend for all sectors, excluding transport and waste, is downward.

## Examples of observed changes

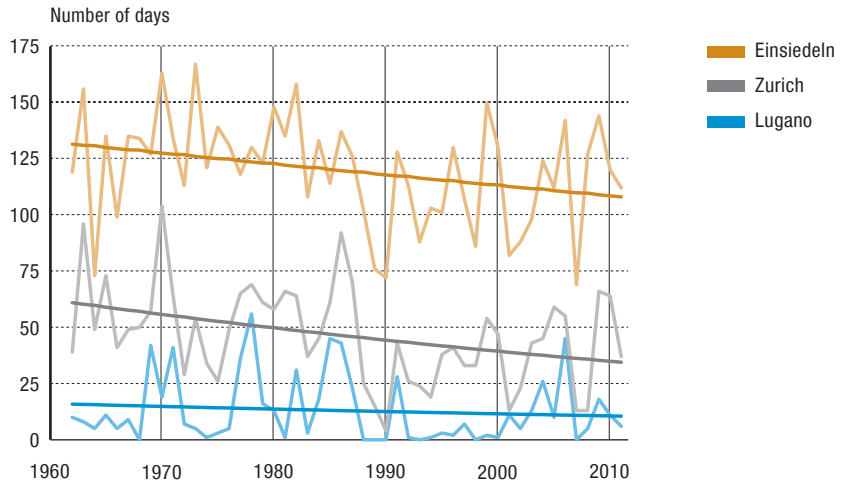
The significant rise in temperature in Switzerland is probably the most impressive indicator of climate change in recent decades. Over the entire measurement period from 1864 to 2011, this corresponds to a temperature increase of 1.7 °C. The temperature of the earth's surface in the northern hemisphere rose by 1.1 °C over the same period. It comes as no surprise to learn that 2011 will go down in Swiss history as the warmest year since records began in 1864. This signal of climate change is also reflected in various climate indicators related to the temperature, for example, the number of hotter years, very hot days, tropical nights and also the snow cover in the Central Plateau. As opposed to this, it is not possible to identify a clear trend in relation to precipitation.

**Fig. 3 > Evolution of greenhouse gas emissions from 1900 to 2010**



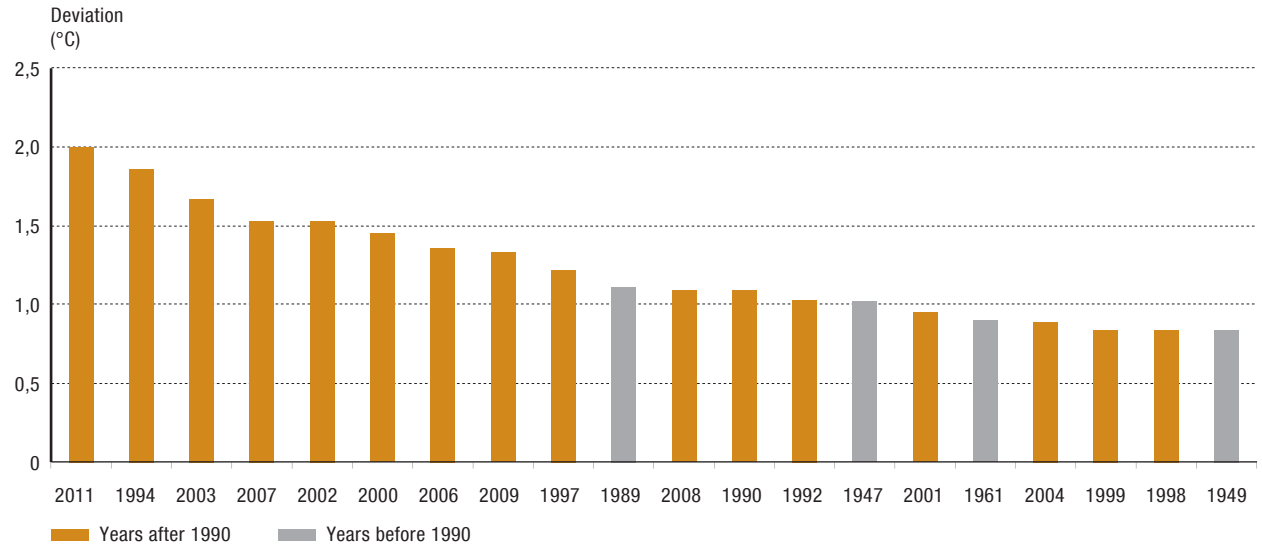

Source: FOEN (2012a)

**Fig. 4 > Days with snow**




Source: MeteoSwiss (2012b)

**Fig. 5 > Ranking of the 20 warmest years since 1864. The bars show the deviation of the mean annual temperature from the reference value for 1961–1990 in °C.**



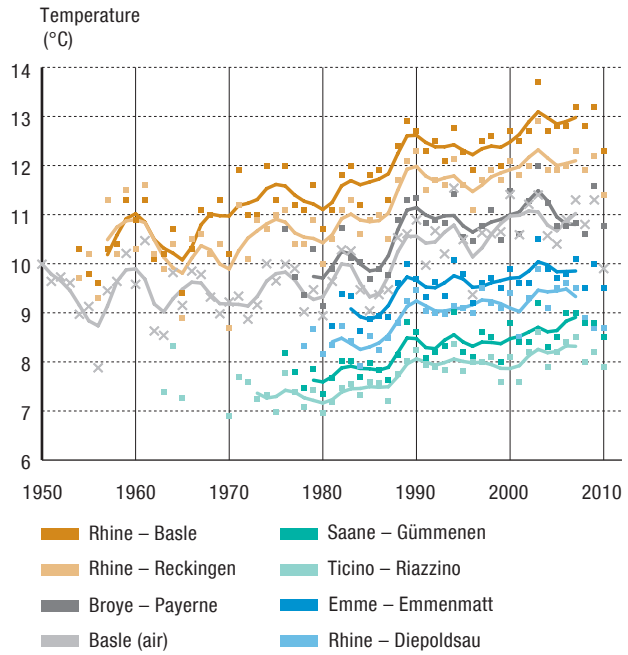

Source: MeteoSwiss (2012)

## Examples of impacts

In recent decades, natural assets have modified in response to the changes in the climate and, in particular, the increase in air temperatures. The retreat of the glaciers and the melting of the permafrost frequently illustrate the direct impacts associated with this phenomenon, however the warming effects are being felt in many other environments. Lakes and rivers are heating up, their dynamics are changing and seasonal variations in plant and animal communities are observed.

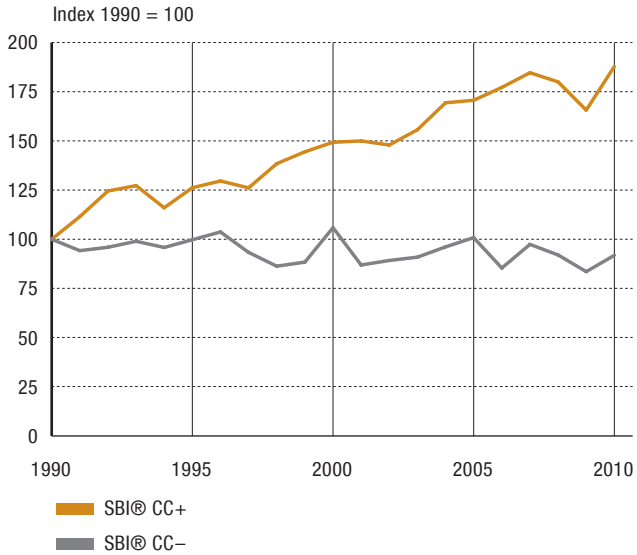
The phenological spring stages have advanced for Switzerland's plant species. The Swiss spring index, an aggregate of data from various plant species and sites, shows that most plants developed very early over the past 25 years. The presence of Alpine plant species has also been increasing on all Alpine summits for a century due to the colonisation of low altitude species. According to the forecasts, a milder climate should promote the extension of the distribution areas of some breeding bird species (e.g. the cirl bunting). As a matter of fact, an increase in their populations has actually been observed since 1990 (SBI CC+).

**Fig. 6 > Temperature of water courses**



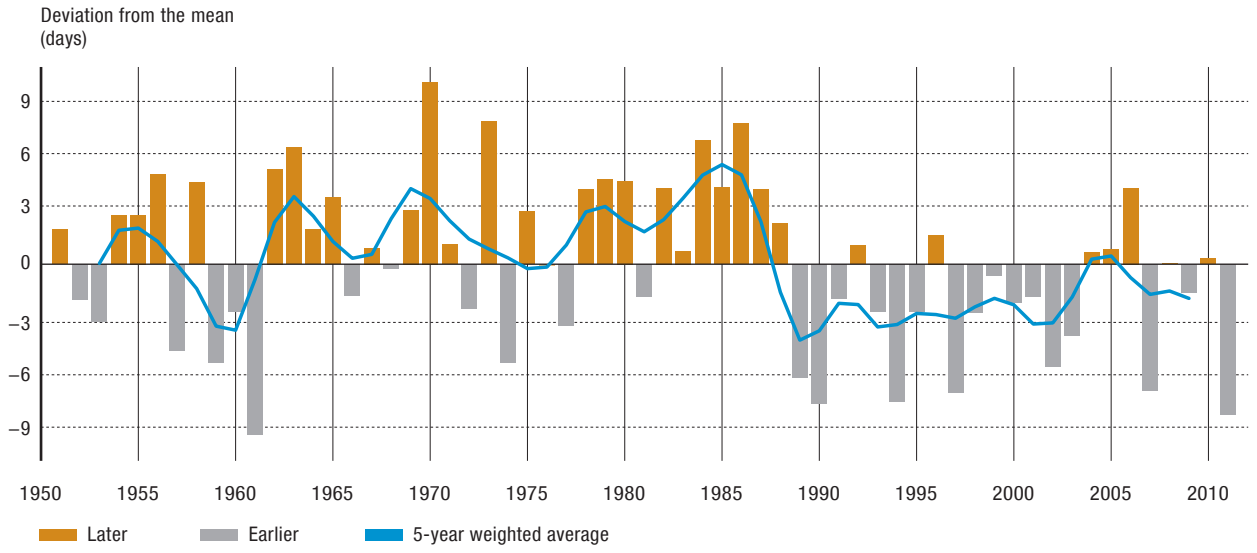

Source: FOEN (2012b)

**Fig. 7 > Populations of two groups of bird species**



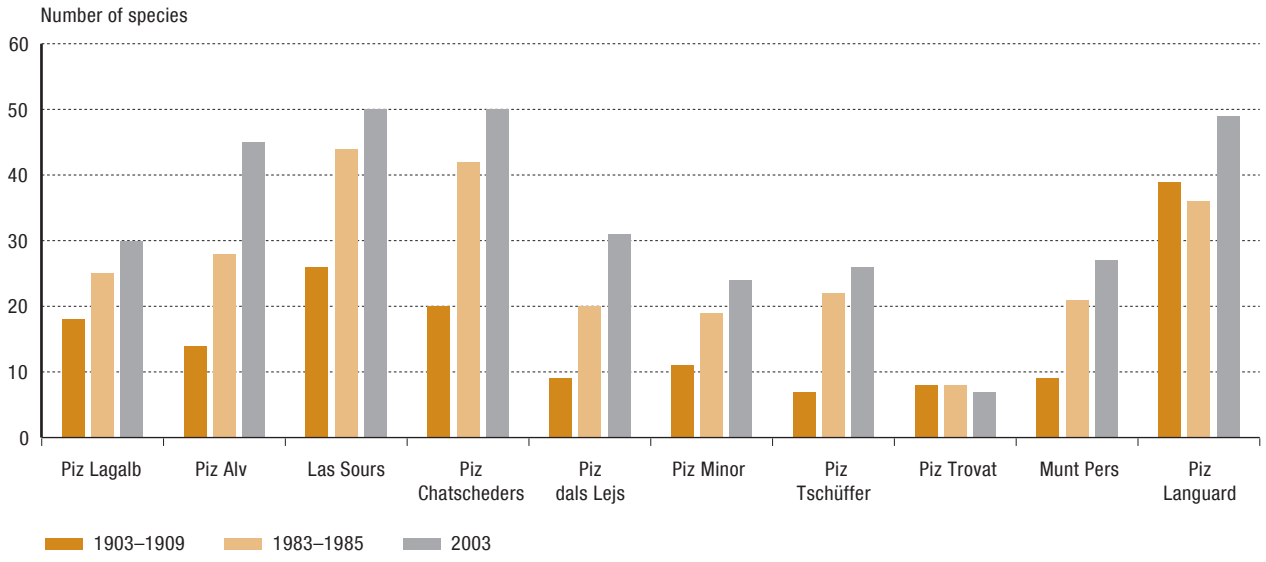

Source: Swiss Ornithological Institute (2012)

**Fig. 8 > Mean deviation of various phenological spring phases compared to the long-term mean**




Source: MeteoSwiss (2012)

**Fig. 9 > Number of floral species on 10 summits in the Bernina region**




Source: Walther et al. (2005)

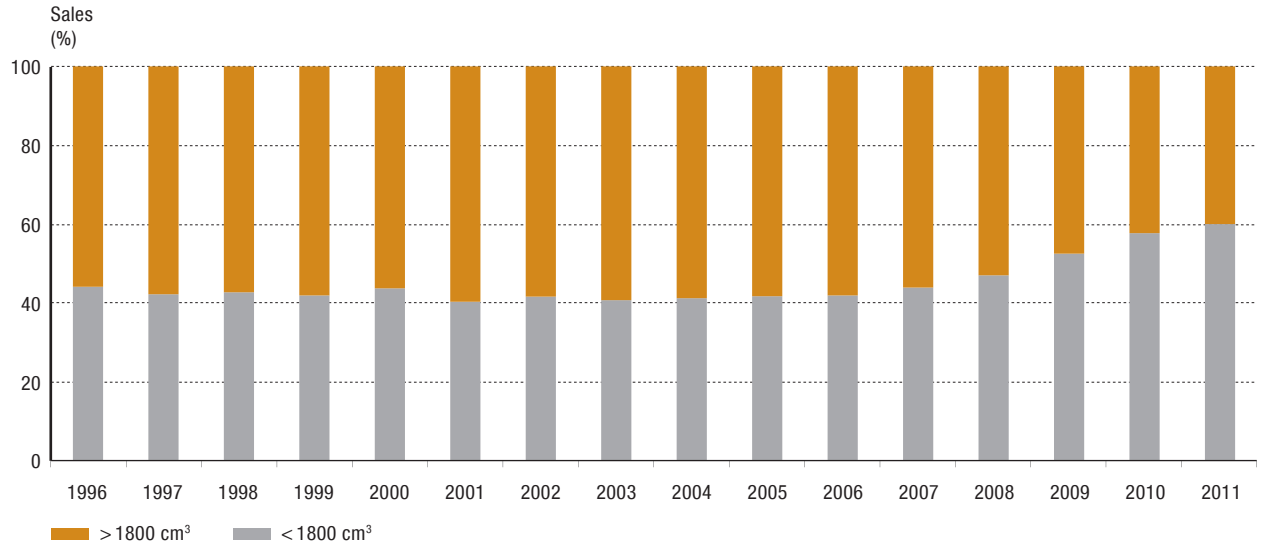
## Examples of responses

In order to respond to the current concerns relating to the climate, Switzerland ratified the Kyoto Protocol in summer 2003 and thereby committed to a global process for the reduction of greenhouse gas emissions. Switzerland's goal is to achieve a reduction of 8 percent of the total sum of emissions of six greenhouse gases ($CO_2$, $CH_4$, $N_2O$, HFC, PFC, $SF_6$) over the period 2008-2012 as compared with 1990 levels (while also taking carbon sinks and the purchase of emission certificates from abroad into account). In order to achieve this goal, the country passed a "$CO_2$ Act". In accordance with this act, it was planned to reduce carbon dioxide emissions generated by the energy use of transport fuel and heating/process fuel, in other words around 80 percent of greenhouse gas emissions defined in the Kyoto Protocol, by 10 percent. To comply with the legal requirements, a series of instruments were created within the various sectoral policies and priority was initially given to non-binding voluntary measures. Because the latter proved insufficient to attain the defined objective, in 2005 the Federal Council decided to introduce a levy on $CO_2$ emissions generated by combustion of fossil heating and process fuels and the introduction of the "climate cent" on fossil transport fuels. Through the "Climate Cent Foundation", the oil industry has been levying a tax of 1.5 centimes per litre of petrol and diesel since October 2005 and has made a commitment to the Confederation to reduce $CO_2$ emissions by a total of 3.4 million tonnes annually over the period 2008–2012, through projects in Switzerland and abroad. The major part of the reduction is realized abroad (2,8–3,0 million tonnes).

Other measures were taken, as in the area of transport, the main emitter of carbon dioxide. An agreement was signed between the Federal Department of the Environment, Transport, Energy and Communications (DETEC) and the association of Swiss automobile importers which aimed to reduce the average fuel consumption of new cars by 3 percent per year. It did not have the desired effect and the objective of 6.4 litres per 100 km could not be attained in 2008. However, as a result of the pressure exerted through the introduction of more stringent requirements regarding $CO_2$ emissions, new passenger vehicles finally reached a consumption level of 6.39 litres per 100 km in 2011. This is the result of the declining trend in engine size ("downsizing", see diagram below), among other things.

The measures undertaken at national and international levels to reduce greenhouse gas emissions can limit climate warming at best. Hence, the environment, economy and society will have to cope with an even more severe increase in tem-

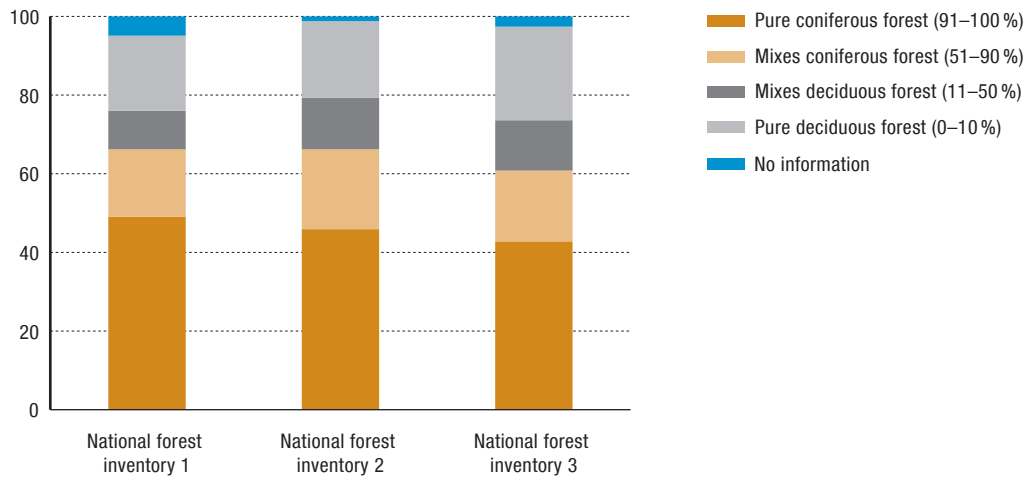
**Fig. 10 > Development in the proportion of sales of new cars with an engine size of less than 1800 cm³ in relation to the total sales of new cars.**




Source: auto-schweiz (2012)

perature, more frequent heat waves and changes in the precipitation regime. Adaptation to the consequences of climate change is, therefore, particularly important. Accordingly, the Confederation decided to develop a strategy for adaptation to climate change. Adaptation processes have already been implemented by some sectors, for example the forestry sector. It has been possible to observe a reduction in pure coniferous forests. Mixed forests that are close to a natural state and have a high proportion of indigenous deciduous trees can better withstand high temperatures and drought conditions.

**Fig. 11 > The degree of mixing coniferous and decideuous trees of forest areas (in % of coniferous trees) during three national forest inventories (NFI) 1, 2 and 3 (1983/1985, 1993/1995 and 2004/2006)**




Sources: Brändli (2010), Brassel et Brändli (1999), EAFV and BFL (1988)

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