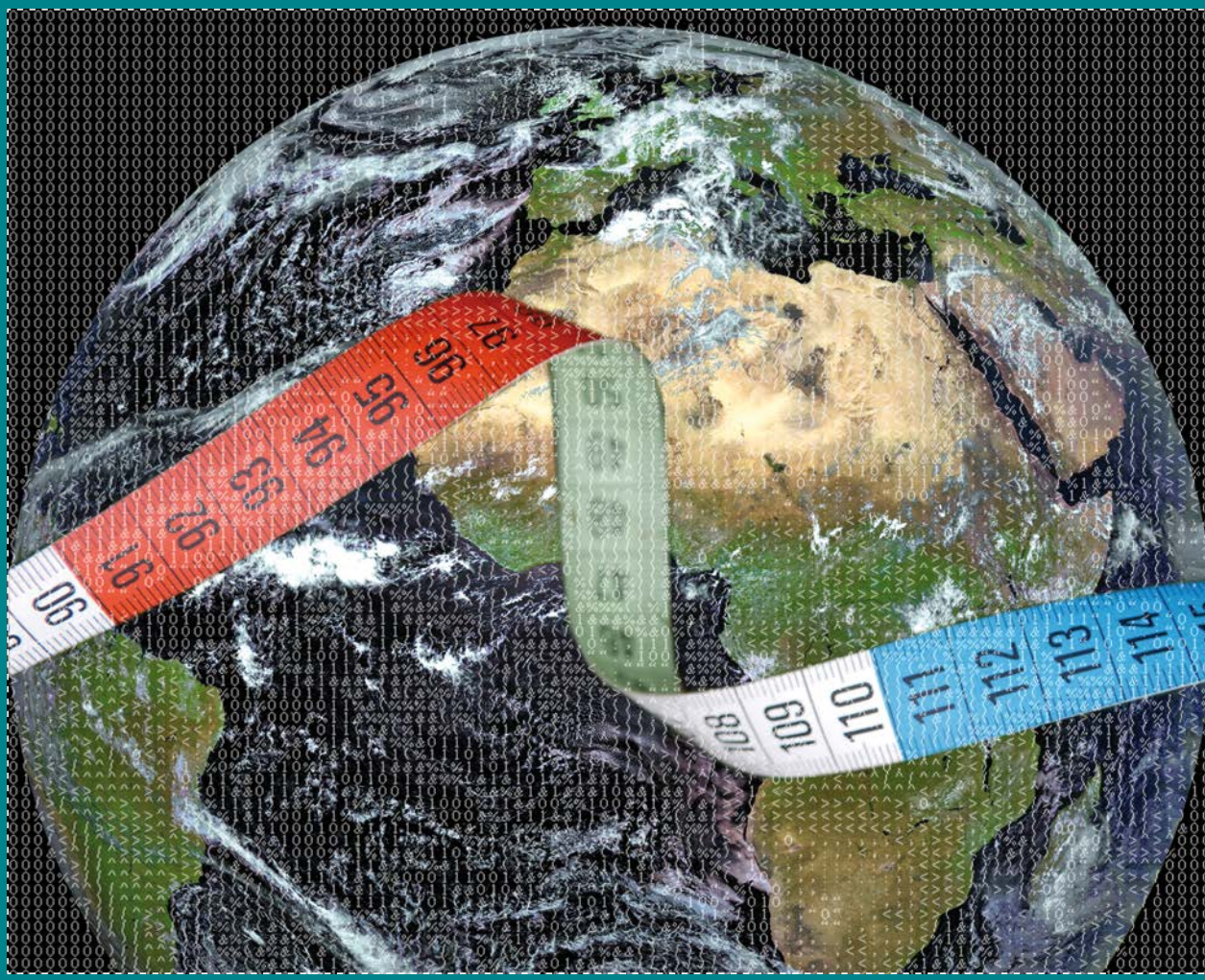
> Development of Switzerland's worldwide environmental impact

Environmental impact of consumption and production from 1996 to 2011



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> Extended summary

Initial position and aims

Global pressure on the natural environment is increasing

While in Switzerland some environmental problems have been solved and attempts are increasingly being made to solve others, pressure on the natural environment is still growing at a rapid pace around the world. In many locations natural resources are being consumed and damage done to them to an extent exceeding what is naturally sustainable in the long term. For instance, rain forests are being chopped down, soil is losing its fertility and biodiversity is decreasing, seas are being contaminated with nitrogen and greenhouse gases are influencing the climate. Our consumer behaviour is having an effect not only on our immediate environment but also on the whole value chain, both upstream and downstream. Thus cocoa beans are cultivated in tropical countries for the manufacture of Swiss chocolate and coltan is mined in Africa for smartphones. The disposal of these smartphones may become a source of long-term soil pollution. Our consumer behaviour thus has a global impact. The environmental impact on other countries of production and consumption is particularly relevant for an economy that is as strongly service-oriented and globally connected as that of Switzerland.

Green Economy

The Federal Government's work on the Green Economy is oriented towards the whole of the value chain. It aims to improve the resource efficiency of consumption and production so as to protect natural resources. It plans to reduce the environmental impact of consumption and production in Switzerland, including the emissions and resource consumption abroad for which Switzerland shares responsibility.

Production and consumption perspectives

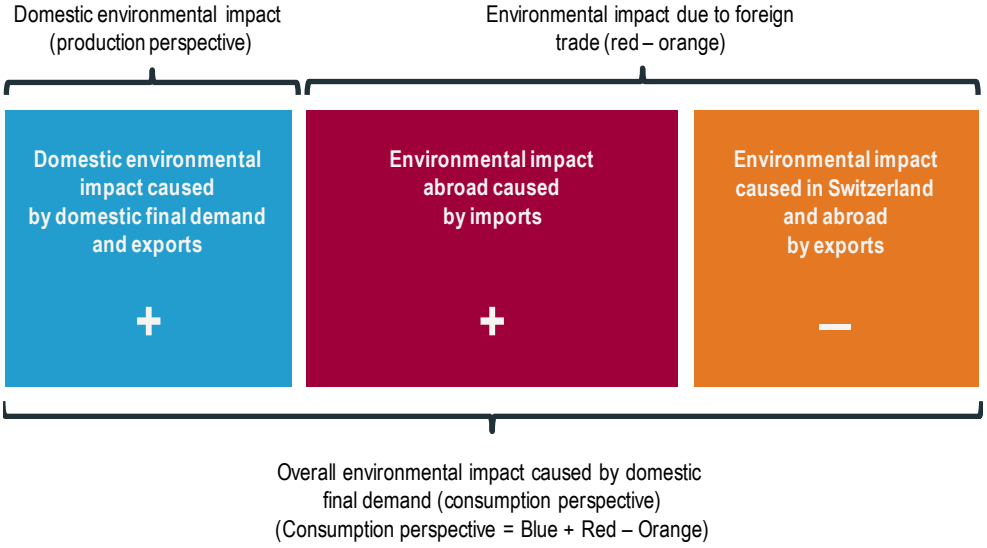
The environmental impact caused by Switzerland can be viewed from two different perspectives:

- From the production perspective, i.e. the environmental impact caused by businesses and households located in Switzerland
- From the consumption perspective, based on the products consumed within Switzerland. This attributes to Switzerland the environmental impact caused around the world by Swiss domestic consumption. The entire life-cycle of the goods consumed is taken into account here.

Both perspectives are illustrated in Fig. A.

Fig. A > Production perspective, foreign trade and consumption perspective

The chart shows the connection between the production and consumption perspectives.



Source: own diagram following Jungbluth et al. 2011

Aims

The environmental impact that Swiss consumption causes abroad is considerably greater than that caused at home. This has already been shown in a pilot study (Jungbluth et al. 2011) commissioned by the FOEN for the year 2005.

The present study calculates the development of the environmental impact caused by the Swiss end-consumer from 1996 to 2011. This environmental impact is analysed and discussed both from an overall viewpoint and also with regard to individual environmental aspects. The results of the study will answer the following questions:

- How have the domestic environmental impact (production perspective) and the environmental impact of Swiss final consumption both at home and abroad (consumption perspective) developed?
- How has the environmental impact developed overall and which individual environmental domains or environmental problems are particularly relevant as regards size and momentum?
- How has the relationship between domestic and transboundary environmental impact developed? Has the share of the environmental impact caused abroad increased or decreased over time?
- How has the environmental impact developed by comparison with economic performance? Has there been any appreciable decoupling, and if so, in which environmental domains?

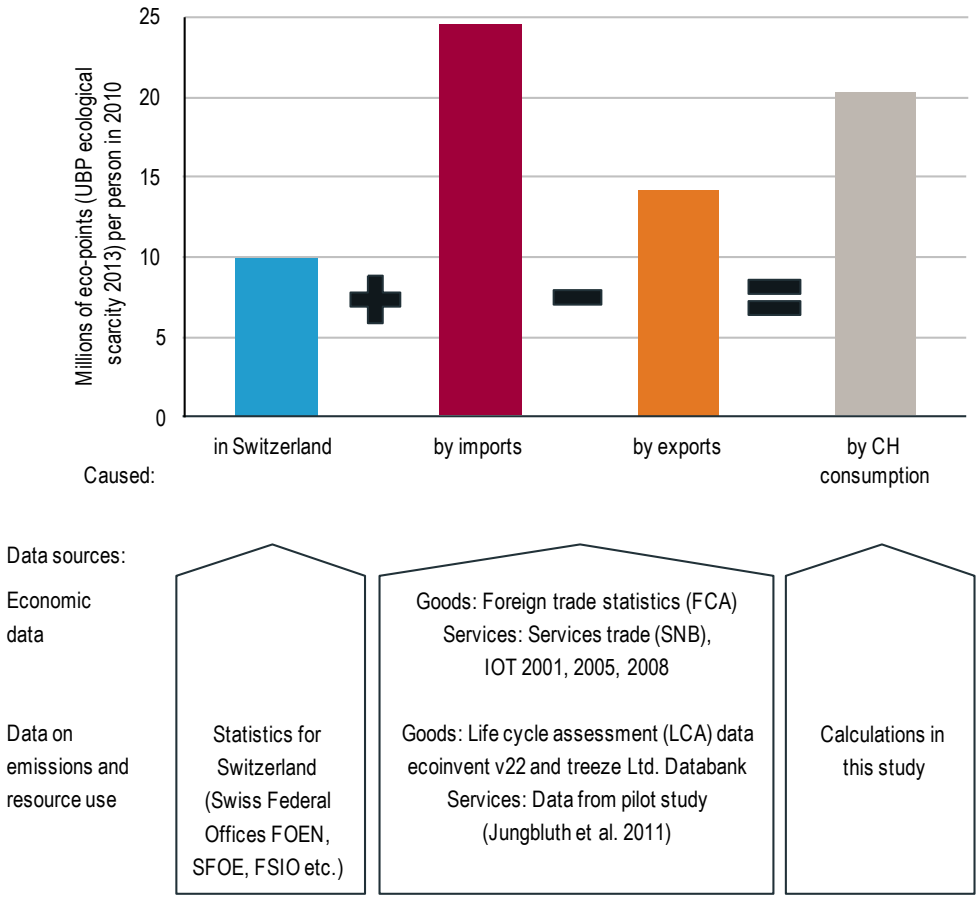
Methodology and procedures

The methodology used here is named "LCA&trade" in the pilot study (Jungbluth et al. 2011). In contrast to the method known as "Environmentally-Extended Input-Output Analysis" that is mainly used in the pilot study, the calculation of the domestic environmental impact is not based on an environmentally-extended input-output-analysis. Instead, the emissions and resource consumption for the time period are directly taken into account as a whole. A further important distinction is the simplified method of calculating environmental intensities of exports, i.e. their environmental impact per unit of weight or of value in francs.

Calculation of consumption-based environmental impact

Switzerland's environmental impact from the consumption perspective is calculated in this study as follows: the impact linked to imports is added to the domestic impact and the environmental impact linked to exports is deducted from this. The environmental impact caused directly at home, coloured blue in Fig. B, represents the production perspective.

Fig. B > Diagram for the calculation of consumption-based environmental pollution



Source: own diagram following Jungbluth et al. 2011

Data set

Data from official statistics are used to record domestic emissions and consumption of resources (mainly from the Federal Offices of the Environment FOEN, Energy FOE and Statistics FSO). The data on imports and exports of goods are based on foreign trade statistics from the customs administration. They are combined with specific life cycle assessment (LCA) data so that the environmental impact can be calculated for the various categories of goods. To ascertain imports and exports of services, the balance of payments of the Swiss National Bank and the Swiss input-output tables are evaluated. The calculation of the related environmental impact is based on the environmental intensities from Jungbluth et al. (2011). This methodology allows all consumption-based environmental impacts to be recorded. It is not, however, possible to attribute environmental impacts to individual economic sectors or consumption domains.

Indicators used

Indicators used in assessment of impacts

In assessing the total environmental impact, the method chiefly used in the present study will be the ecological scarcity method, or UBP Method[1], which is frequently used in environmental impact assessments. This method summarises a very broad spectrum of environmental impacts (e.g. climate change, use of different land types, emissions of pollutants in air, water and soil) into a single digit. The method was updated in 2013. It is based on Swiss targets or international targets agreed to by Switzerland. The total results are reported using other methodologies in order to check the extent to which the results depend on the choice of methodology.

The indicators for selected important environmental domains ("thematic footprints") are greenhouse gas emissions (carbon footprint), water use, air pollution, land use (influence on biodiversity), nitrogen (eutrophication) and primary energy consumption.

Development of the consumption-based environmental impact

Three quarters of environmental impact caused abroad

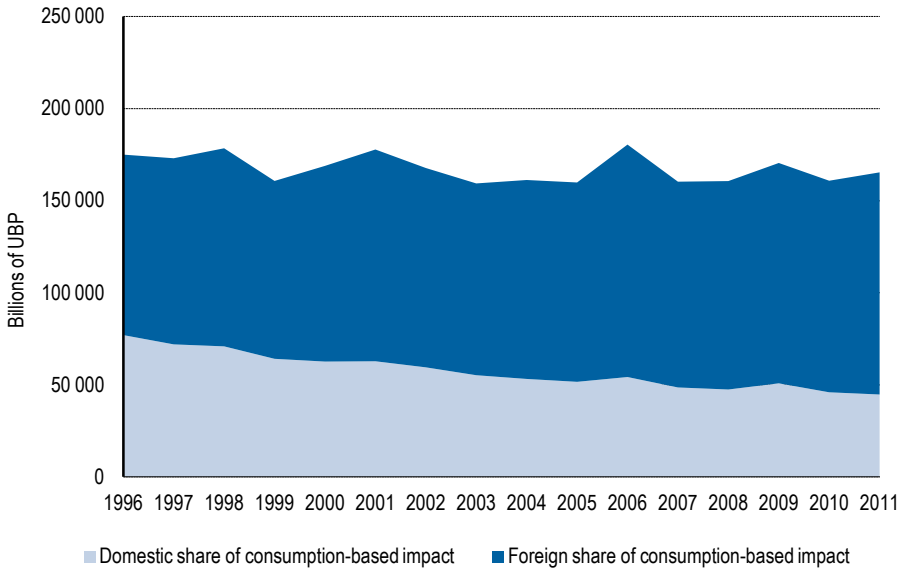
There was a substantial and continuous decline in the domestic environmental impact over the period observed. This progress, however, was offset to a large extent by the increase in the environmental impact caused abroad. In 2011, almost three-quarters of the environmental impact caused by consumption in Switzerland occurred abroad.

Over the last fifteen years, there is no evidence of any overall increase in the environmental impact caused by domestic consumption. On the basis of the main method used, a slight decline in the consumption-based environmental impact can even be detected (cf. Fig. C). The substantial reduction of the environmental impact which is necessary in the medium term is not, however, apparent.

[1] The UBP method is based on the methodological concept of ecological scarcity and expresses the environmental impact using eco-points, abbreviated to UBP after the German word "Umweltbelastungpunkte". This method aggregates the individual impacts into a single parameter. It is based on legally defined targets for pollutant emissions and resource consumption, and measures the differences between current emission values and these target values. The further the current status is from the target, the greater the number of points assigned to an emission. For more information, see Frischknecht et al. (2013).

Fig. C > Development of the consumption-based overall environmental impact of Switzerland

Development of the total environmental impact caused by domestic final consumption in billions of UBP (UBP method 2013), subdivided into impacts caused abroad and at home.



Source: Calculations treeze and Rütter Soceco AG

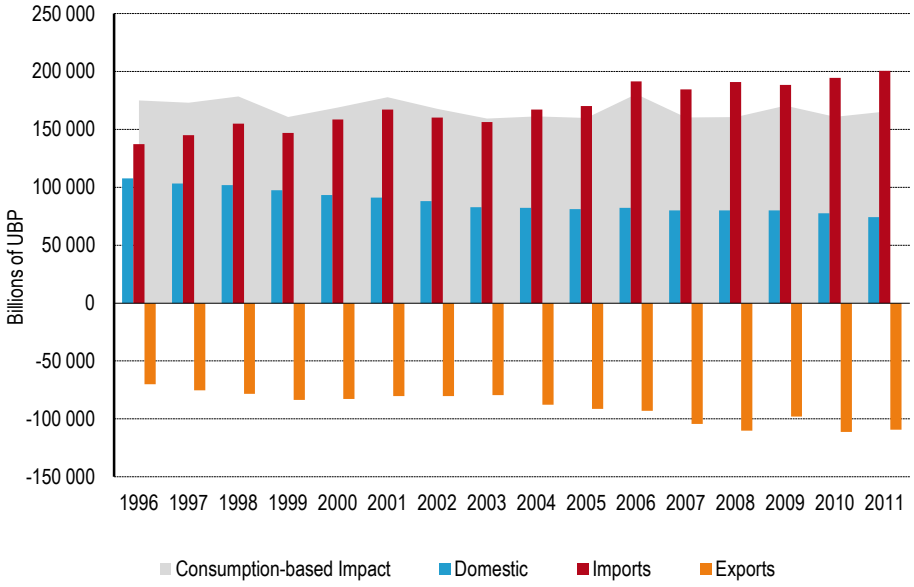
Annual fluctuations

In order to be able to evaluate the success or deficiencies of environmental policies, trends should be observed over ten-year periods. Annual fluctuations are dominated by short-term effects, for example, the cyclical increase and decrease in stocks connected with the trade in metals (especially platinum and palladium) and fossil fuels.

Developments per capita: development per person is comparable with that of the absolute consumption-based total environmental impact in Switzerland. Overall, the consumption-based environmental impact per person (in UBP) diminished in the period under examination from 24.6 million UBP per person in 1996 to 20.7 million for 2011. The increase in the population, however, means that the decline in the absolute environmental impact is less than the decline per person.

Fig. D > Development of the consumption-based overall environmental impact in Switzerland

Development of the overall environmental impact in billions of UBP (UBP method 2013).



Source: Calculations treeze and Rütter Soceco AG

Fig. D shows the consumption-based environmental impact, composed of the domestic, import-based and export-based environmental impacts, which must be deducted to arrive at the total for the consumption-based impact.

Comparison with the naturally sustainable level

Exceeding naturally sustainable level

On the basis of the information currently available, there is no clear answer to the question how much the environmental impact exceeds the naturally sustainable level. Nevertheless, the order of magnitude can be narrowed down in various ways:

- If the consumption-based overall environmental impact of 2011 is compared with the critical flow[2], which, like the UBP method, can be deduced from the targets of Swiss environmental policies, then there is a difference of 70% (cf. Fig. D). In this analysis, it is assumed that the same national targets apply for consumption-based environmental impact as for the domestic impact. However, this method does not take account of the different conditions in other countries (e.g. the greater shortage of water than in Switzerland in some regions of the world). This can lead to an over- or underestimation of the need for reduction.
- If the current environmental impact within Switzerland (current flow[3] according to the UBP method) is compared with the critical flow, the latter is 42% lower (cf. Fig. D). This current flow corresponds approximately to the production perspective. It

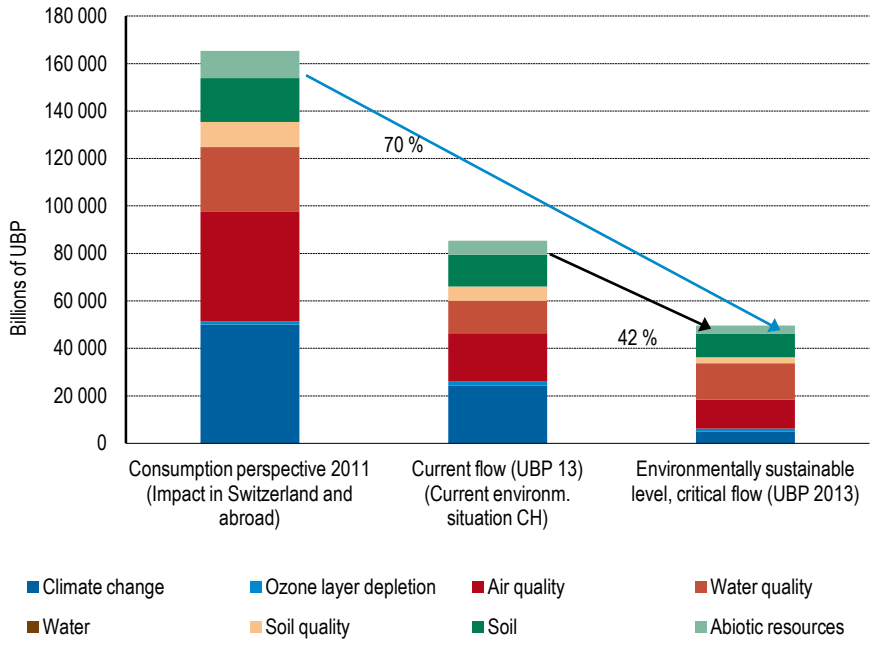
[2] The critical flow quantifies the target situation aimed at by environmental policy. Example: The Swiss Federal Council wants to reduce nitric oxide emissions by around 50% compared to the total for 2005 in order to meet the pollution threshold for ozone and the limits for acid deposition. This is equivalent to an annual nitric oxide load of 45000 tonnes.

[3] The current flow quantifies the present environmental situation. The current annual nitric oxide load, for example, is around 78700 tonnes.

therefore takes no account of the environmental impact caused in other countries, with only a few exceptions.

Fig. E > Comparison of current impact with the "naturally sustainable" level[4]

Results of the environmental impact (UBP method 2013) in billions of UBP for the consumption perspective and for current flow according to the UBP method 2013.



Source: Calculations treeze and Rütter Soceco AG

> Consumption-based greenhouse gas emissions in 2011 corresponded to 13.6 t CO_2-equivalents (CO_2-eq) per person (Kyoto substances). This can be compared to various targets in the discussions on climate change. Compared for example with the target of 1 tonne of CO_2-eq per person and year, it results in a need to reduce consumption-based emissions by 93%. The 1-tonne target is based on the 2° C target set by the world community, and should be met by 2050.

Overall environmental impact must be reduced by at least 50%

On the basis of these figures, it can be assumed that a naturally sustainable level for the overall environmental impact lies at least 50% below today's level of the consumption-based overall environmental impact.

[4] "Naturally sustainable" level according to critical flow with the UBP method 2013.

Other methods of evaluating the total environmental impact

Comparison with other aggregating methodologies

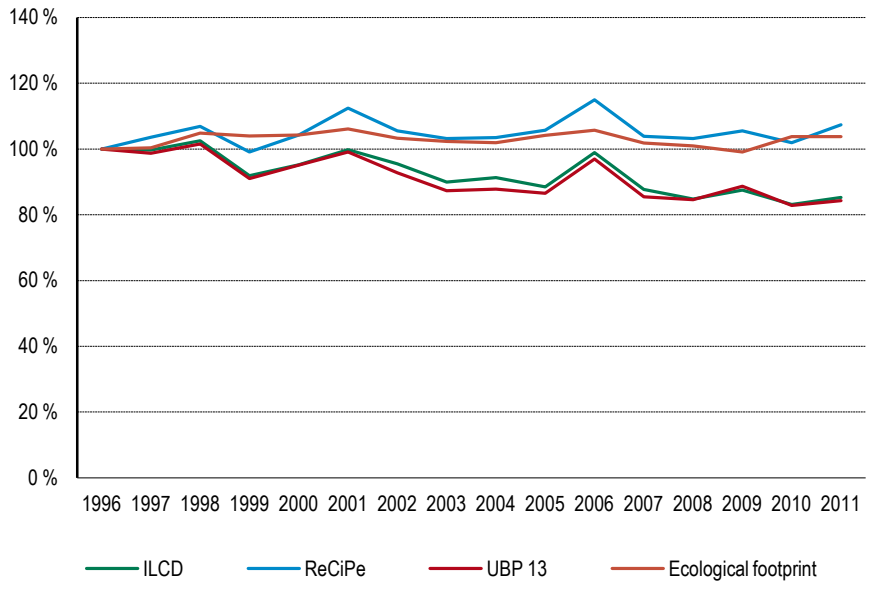
In addition to the UBP method mainly used here, there are various other methods which aggregate the overall environmental pollution into one single indicator. Three of these methods are used to validate the results achieved with the UBP method. They are:

- the ILCD method, which is proposed by the Joint Research Centre (JRC) of the EU,
- the ReCiPe method developed at the University of Leiden
- and the ecological footprint, calculated with the data set from this study.

The assessments using ILCD and the UBP method suggest a lower environmental impact in 2011 than in 1996. On the other hand, the assessments based on ReCiPe and the ecological footprint[5] calculated here result in a slightly higher environmental impact (cf. Fig. F). This difference can primarily be attributed to the fact that, when measured with ReCiPe, the domestic impact is considerably less significant compared with the overall impact than when assessed with the UBP method and with ILCD. Accordingly the lower domestic impact, although an improvement, cannot compensate to the same extent for the increase in the impact caused abroad. This results in an overall increase in the consumption-based environmental impact.

Fig. F > Comparison of different assessment methods for the calculation of the consumption-based overall environmental impact

Development of the consumption-based overall environmental impact per person, indexed.



Source: Calculations treeze and Rütter Soceco AG

When looked at in detail (changes from year to year), the ecological footprint has a relatively low level of agreement with the other aggregating indicators. This is because

[5] Because different data sources and methodology have been used, in this study the results of assessment using the ecological footprint are different from those calculated for Switzerland using the global footprint network.

the ecological footprint only takes account of the CO_2 emissions and land use. Other environmental problems such as air pollution or excessive water use are not taken into account. Over the entire 15-year period, ReCiPe and the ecological footprint have developed in a similar direction, since for both indicators CO_2 emissions and land use are influential parameters.

Consideration of individual environmental domains

13.6 tonnes CO_2-eq per person and year

Fig. G shows the development of selected important environmental indicators. The slight fall in domestic greenhouse gas emissions cannot compensate for the additional emissions due to foreign trade. Absolute consumption-based greenhouse gas emissions ("the carbon footprint") increased over the period observed and were 17% higher in 2011 than in 1996 (considering Kyoto Substances). Due to the population increase of 12% in the same period, the consumption-based greenhouse gas emissions per capita increased by just under 5%, from 13.0 tonnes (1996) to 13.6 tonnes (2011).

Specific Environmental Aspects

The consumption-based environmental impact caused by air pollution varied considerably during the period under review and on the whole diminished slightly. The other specific environmental impacts analysed tended to increase during the period of observation (primary energy consumption, eutrophication, land use (influence on biodiversity) and water use). Air pollution is subject to strong fluctuations that are primarily due to the trade in platinum.

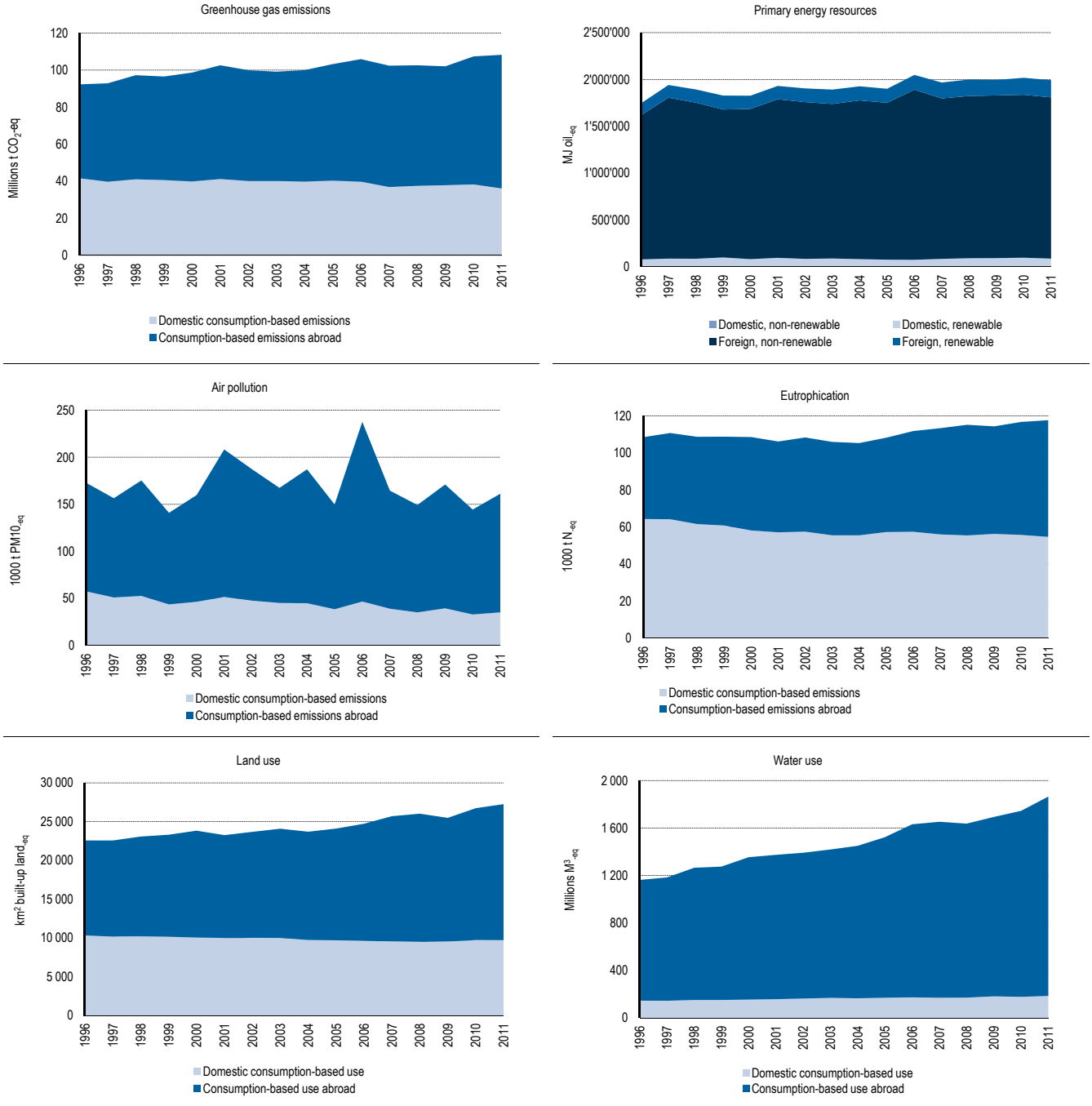
The increased impact in several environmental domains appears to contradict the general trend towards a slight reduction seen with the UBP method. This is because the broadly-based UBP method covers a wide range of environmental impacts. A decrease can be observed in domains such as air pollution or ozone layer depletion, which make up a relatively large proportion of the overall environmental impact. This contributes to the decrease in the overall environmental impact. However, emissions of ozone-depleting substances are not among the individually analysed environmental domains. The environmental domains that have been selected, on the other hand, represent environmental impacts that have generally increased in recent years.

Continuous increase in foreign share of consumption-based environmental impact

The domestic share of the consumption-based environmental impact is declining in all the environmental aspects examined over the period of observation. The general tendency towards an increase can therefore be attributed to an increasing impact abroad. For air pollution and water use, the consumption-based share of the domestic impact was relatively low even in 1996. The domestic consumption-based impact of land use was only slightly lower in 1996, and in the case of eutrophication, it was even higher than the impact caused abroad.

Fig. G > Consumption perspective for individual environmental aspects

Development of the environmental impact divided into consumption-based environmental impact occurring within Switzerland and the impact caused abroad. Greenhouse gas emissions were re-calculated in accordance with the domestic production principle and assessed with the global warming potentials of the IPCC (2007, Table TS.2, 100a); as a result, they do not correspond exactly to the emissions listed in the official Swiss greenhouse gas inventory (FOEN 2012b) as regards system limits and the substances considered.



Source: Calculations treeze and Rütter Soceco AG

Environmental impact and economic growth – resource efficiency of consumption

Resource efficiency

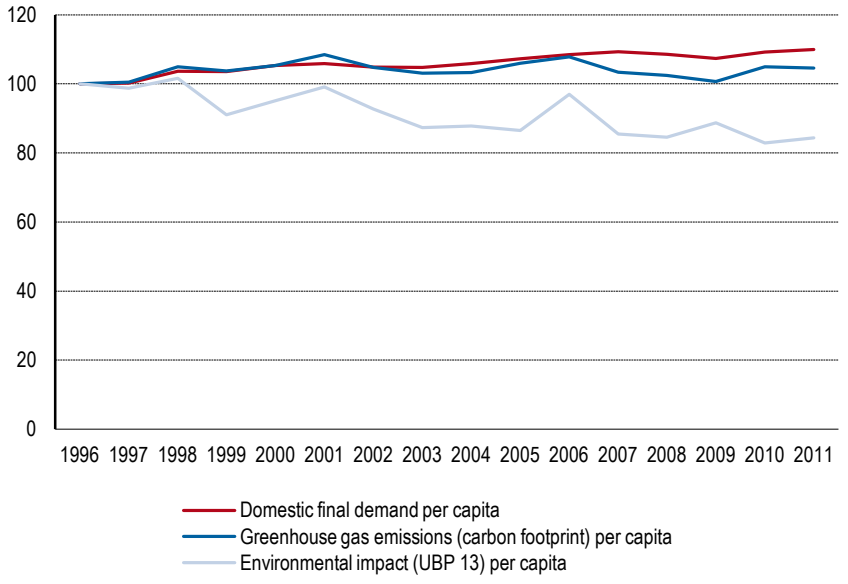
Alongside the development of the absolute environmental impact and per-capita environmental impact, it is also interesting to look at the comparison with economic growth. This makes it possible, for instance, to judge whether environmental resource efficiency, i.e. the environmental impact compared to the economic performance of the Swiss economy, has improved.

Increase in domestic final demand and simultaneous decrease in consumption-based greenhouse gas emissions and environmental impact

The economic factor directly comparable to environmental pollution in the consumption perspective is domestic final demand. It is the sum of the consumption expenditure of private households, of state final demand and macroeconomic investments. While domestic final demand and consumption-based greenhouse gas emissions increased per capita between 1996 and 2011, the overall environmental impact per capita declined by around 16% (Fig. H).

Fig. H > Development of economic performance, population and environmental impact

Domestic final demand (CHF), consumption-based overall environmental impact (UBP 13) and consumption-based greenhouse gas emissions (kg CO_2-eq, Kyoto Substances) per capita between 1996 and 2011.



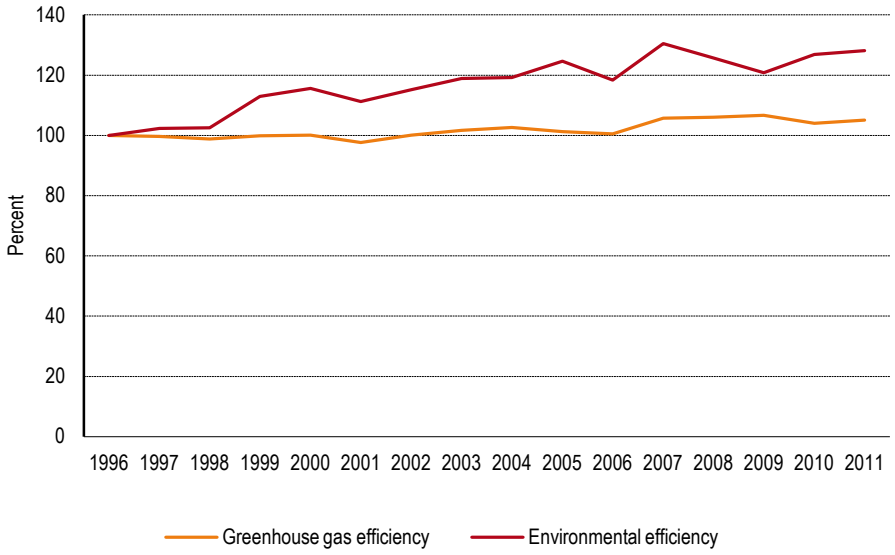
Source: Calculations treeze and Rütter Soceco AG

Development of Resource efficiency

The development of consumption-based environmental efficiency or greenhouse gas efficiency calculated for the period between 1996 and 2011 is depicted in Fig. I below. These efficiency indicators show domestic final demand as an economic factor per unit of consumption-based environmental impact or greenhouse gas emission. During the period under observation, both environmental efficiency and greenhouse gas efficiency improved, the former more significantly than the latter.

Fig. I > Greenhouse gas efficiency and environmental efficiency

Development of consumption-based greenhouse gas efficiency and environmental efficiency (UBP method 2013) between 1996 and 2011.



Source: Calculations treeze and Rütter Soceco AG

Conclusions

Decrease in domestic and increase in imported environmental impact

This study demonstrates that efforts at environmental protection within Switzerland are effective and that the trend is for the domestic environmental impact to fall. These successes, however, are to a large extent offset by a rise in the environmental impact abroad. It can be assumed that a naturally sustainable level in the total environmental impact would be at least 50% below today's level of the total environmental impact based on consumption.

When assessed using the UBP and the ILCD methods, the overall consumption-based environmental impact decreased slightly over the period under examination. In the same period, both the population and the economy grew. This led to a fall in the environmental impact (measured in UBP) per person and an increase in environmental efficiency. A large and constantly increasing share of the overall environmental impact is produced abroad.

On the other hand, when assessed with ReCiPe and the ecological footprint method, the overall consumption-based environmental impact increased.

When concentrating on individual environmental aspects, it can be seen that consumption-based greenhouse gas emissions, eutrophicating emissions, land use, water use and the primary energy consumption have also increased. Air pollution, on the other hand, has fallen.

Annual fluctuations

In contrast to the domestic environmental impact (from the production perspective), the consumption-based overall environmental impact is subject to significant fluctuations. These fluctuations do not completely accord with the quantity of goods consumed. They can be attributed to growth and decline in stocks, in particular of precious metals (platinum and palladium) and of petroleum products. These fluctuations affect, among other things, the air pollution caused in other countries.

Ten-year periods and individual environmental domains

Annual differences are not therefore reliable indicators of improvements or deteriorations in the environmental impact. Across the whole 15-year period of observation, however, the trends that were observed are statistically significant. For this reason, when Switzerland's development towards a Green Economy is being assessed, attention should be paid to discernible differences over ten-year periods instead of short-term annual fluctuations. Moreover, it is important for a thorough assessment to observe individual environmental domains such as climate change separately and in the relevant physical dimensions (e.g. greenhouse gas emissions in tonnes and CO_2 equivalents).

Need for further research

Additional research is necessary to determine the extent of the environmental impact that is permissible if natural resources are to be conserved in the long term. Estimates and a comparison with existing target values indicate that a substantial reduction is required. There is a need for further research involving environmental impact data differentiated by time and region, showing foreign development of the environmental impact in the production of goods and the change in the environmental intensity of services over the years.

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